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(54) Title: CLAUDIN 6 ANTIBODIES AND USES THEREOF

FIG. 1

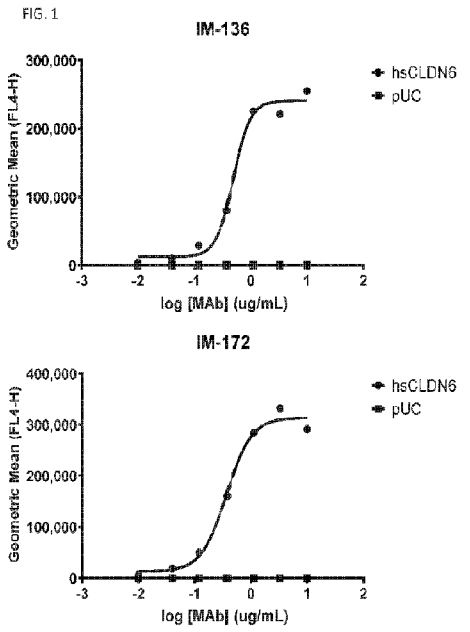
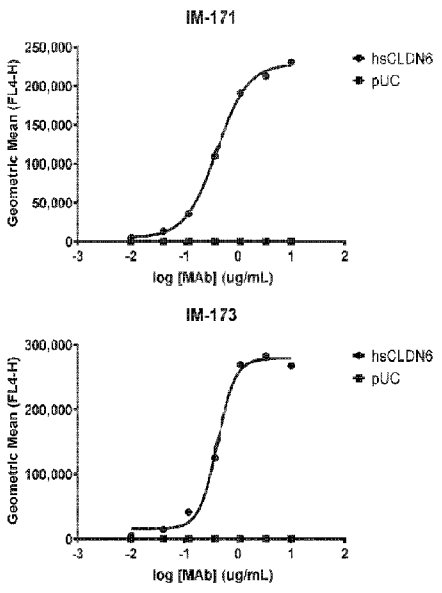


FIG. 1 CONT.



(57) Abstract: Antibodies and compositions against Claudin 6 and uses thereof are provided.

[Continued on next page]

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CLAUDIN 6 ANTIBODIES AND USES THEREOF

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to U.S. Provisional Application No. 62/806,048, filed February 15, 2019, which is hereby incorporated by reference in its entirety.

Background:

[0002] Claudin 6 is a receptor that is overexpressed on cancer cells. Targeting Claudin 6 with antibodies that are specific to Claudin 6 can help activate a cytotoxic response against Claudin 6 expressing cancers. Thus, there is a need for antibodies that can bind to Claudin 6 and antibodies that can modulate the activity of Claudin 6. The present disclosure provides for these needs as well as others.

Summary

[0003] In some embodiments, isolated antibodies are provided that bind to a protein or a nucleic acid molecule encoding the same.

[0004] In some embodiments, methods of using the antibodies are provided for herein.

[0005] In some embodiments, antibodies that binds to claudin 6 with an affinity of less than 10 nM and with at least 100 fold greater EC_{50} than claudin 9, claudin 3, and/or claudin 4 are provided.

[0006] In some embodiments, peptides comprising, consisting of, or consisting essentially of a sequence as provided herein, or a variant thereof, are provided.

[0007] In some embodiments, peptides comprising, consisting of, or consisting essentially of a sequence that is 90-99% identical to a sequence as provided herein, or a variant thereof, are provided.

[0008] In some embodiments, antibodies, such as a monoclonal antibody or ScFv, that bind to an epitope on Claudin 6 (SEQ ID NO: 1) whose binding residues include T33, N38, D68, P74, D76, D146, V152, A153, E154, Q156, R158, or any combination thereof, are provided. In some embodiments, the antibody binds to an epitope on Claudin 6 that includes residues E48, D68, P74, D76, and R158 of Claudin 6 (SEQ ID NO: 1). In some embodiments, the antibody binds to an epitope on Claudin 6 that includes residues T33, N38, E48, D76, A153, E154, Q156, and R158 of Claudin 6 (SEQ ID NO: 1). In some embodiments, the antibody binds to an epitope of Claudin 6 that includes residues N38, E48, Y67, P74, D76, D146, V152, E154, Q156, and R158

on Claudin 6. In some embodiments, the antibody binds to an epitope of Claudin 6 that includes residues E48, Y67, Q156, and R158 of Claudin 6.

[0009] In some embodiments, bi-specific antibodies comprising a first V_H peptide that binds to Claudin 6 and second V_H peptide that binds to a different moiety are provided herein.

[0010] In some embodiments, nucleic acid molecules encoding an antibody or an amino acid sequence described herein are provided. In some embodiments, vectors comprising the nucleic acid molecules are provided. In some embodiments, cells comprising the vectors or the nucleic acid molecules are provided herein.

[0011] In some embodiments, antibodies, or an isolated form thereof, that binds to claudin 6 with an affinity of less than 10 nM and with at least 100 fold greater EC_{50} than claudin 9, claudin 3, and/or claudin 4 are provided.

[0012] In some embodiments, antibodies, or an isolated form thereof, wherein the antibody comprises a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 25, 31, 37, 43, 53, 55, 56, 62, 71, 76, 80, 90, 95, 139, 141, 143, or 145, or a variant of any of the foregoing; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 26, 32, 38, 44, 46, 48, 49, 54, 125, 72, 77, 81, 86, 91, 96, 101, 102, 140, 142, 144, or 146, or a variant of any of the foregoing; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 27, 33, 39, 45, 57, 61, 63, 65, 66, 67, 126, 69, 73, 82, 57, 92, or 97, or a variant of any of the foregoing.

[0013] In some embodiments, the antibody of any one of claims 1-3, wherein the antibody comprises a light chain variable region comprising a sequence of any one of sequences as set forth in SEQ ID NOs: 127-135 are provdied.

[0014] In some embodiments, antibodies comprising a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 22, 28, 34, 40, 47, 50, 58, 64, 74, 83, 87, 93, or 98; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 23, 29, 41, 51, 59, 68, 84, 88, or 99, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 24, 30, 36, 42, 52, 60, 70, 75, 79, 85, 89, 94, or variants of any of the foregoing, are provided.

[0015] In some embodiments, antibodies, or antigen binding fragments thereof, wherein the antibodies, or antigen binding fragments thereof, comprise: (i) a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 25, 31, 37, 43, 53, 55, 56, 62, 71, 76, 80, 90, or 95; the heavy chain CDR2 has the amino acid sequence of 26, 32, 38, 44, 46, 48, 49, 54, 125, 72, 77, 81, 86, 91, 96, 101, or 102 and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 27, 33, 39, 45, 57, 61, 63, 65, 66, 67, 126, 69, 73, 82, 57, 92, or 97 or variants of any of the foregoing; and (ii) a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence 22, 28, 34, 40, 47, 50, 58, 64, 74, 83, 87, 93, or 98; the light chain CDR2 sequence has the amino acid sequence of 23, 29, 41, 51, 59, 68, 84, 88, or 99, and the light chain CDR3 sequence has the amino acid sequence of 24, 30, 36, 42, 52, 60, 70, 75, 79, 85, 89, 94, or variants of any of the foregoing, are provided.

[0016] In some embodiments, a peptide comprising, consisting of, or consisting essentially of a sequence as provided herein, or a variant thereof, is provided.

[0017] In some embodiments, antibodies, such as a monoclonal antibody or scFv, that bind to an epitope on Claudin 6 whose residues include T33, N38, D68, P74, D76, D146, V152, A153, E154, Q156, R158, or any combination thereof, are provided.

[0018] In some embodiments, antibodies, such as a monoclonal antibody or a scFv, that bind preferentially to Claudin 6 as compared to Claudin 9, wherein the antibody binds to an epitope on Claudin 6 that comprises Q156 are provided.

[0019] In some embodiments, bi-specific antibodies comprising a first V_H peptide that binds to Claudin 6 and second V_H peptide that binds to a different moiety are provided.

[0020] In some embodiments, pharmaceutical composition are provided comprising one or more antibodies described herein or a nucleic acid molecule encoding the same.

[0021] In some embodiments, nucleic acid molecules encoding an antibody or an amino acid sequence provided herein are provided.

[0022] In some embodiments, methods of modulating Claudin 6 activity by contacting a cell expressing Claudin 6 with a Claudin 6 antibody or a pharmaceutical composition comprising the same that binds to Claudin 6 on the cell surface are provided.

[0023] In some embodimetns, methods for inhibiting the function of Claudin 6 by contacting a cell expressing Claudin 6 with an antibody or a pharmaceutical composition comprising the same that inhibits the function of Claudin 6 by binding to Claudin 6 are provided.

[0024] In some embodiments, methods of treating a subject with a Claudin 6 mediated disorder, the method comprising administering a pharmaceutical composition comprising a Claudin 6 antibody to the subject, such as any antibody provided herein or a nucleic acid molecule encoding the same are provided.

[0025] In some embodiments, methods of treating cancer in a subject, the method comprising administering a therapeutic that specifically binds to claudin 6 and binds to CD3 and/or 4-1BB are provided.

[0026] In some embodiments, methods of treating cancer in a subject, the method comprising administering to the subject a pharmaceutical composition comprising an antibody that binds to residue Q156 of Claudin 6 or nucleic acid molecule encoding the same are provided.

[0027] In some embodimentts, chimeric receptors comprising an antibody domain as provided herein are provided.

[0028] In some embodiments, compositions comprising an antibody an antibody domain as provided herein linked to a drug or other therapeutic are provided.

[0029] In some embodiments, compositions comprising a peptide as provided herein, such as a peptide comprising one or more sequences of SEQ ID NO: 2-135 are provided.

[0030] In some embodiments, methods of detecting the presence or absence of Claudin 6 in a sample comprising contacting a sample with an antibody as provided herein and any of the preceding claims and detecting the binding to a Claudin 6 antigen by the antibody, wherein the detection of the binding indicates the presence Claudin 6; or the absence of the detection of the binding to the Claudin 6 indicates the absence of the Claudin 6 are provided.

[0031] In some embodiments, methods of delivering a composition to a cell expressing Claudin 6, the method comprising contacting a cell with an antibody as provided herein, wherein the antibody is linked to another molecule to be delivered to the cell expressing Claudin 6 are provided.

[0032] In some embodiments, methods of contacting a composition to a cell expressing Claudin 6, the method comprising contacting a cell with an antibody as provided herein, wherein the antibody is linked to another molecule to contact with the cell expressing Claudin 6 are provided.

Brief Description of Drawings

[0033] FIG. 1 illustrates the binding of exemplary, not-limiting, embodiments of antibodies that bind to Claudin 6.

[0034] FIG. 2 illustrates various embodiments as provided for herein.

[0035] FIG. 3 illustrates various embodiments as provided for herein.

[0036] FIG. 4 illustrates various embodiments as provided for herein, including showing that IM136 and IM171 binding to PA-1 cells naturally expressing Claudin-6, which was detected by flow cytometry.

[0037] FIG. 5 illustrates various embodiments as provided for herein, including MAb binding to PA-1 cells naturally expressing Claudin-6, which was detected by flow cytometry..

[0038] FIG. 6 illustrates various embodiments as provided for herein, including showing that MAb IM171 binding to a proteome array, consisting of 5,300 human membrane proteins expressed in human HEK-293 cells and demonstrating that IM171 is highly specific for Claudin 6.

[0039] FIG. 7 illustrates various embodiments as provided for herein, including showing that CAR-T cells expressing claudin 6 antibody IM136 are activated by cells expressing human or murine claudin 6. CAR-T cells without the claudin antibody ('CAR-Negative T-cells') are not activated by cells expressing claudin 6. Cell activation is measured by expression of CD69 after overnight co-incubation of the cells, as detected by flow cytometry with an anti-CD69 antibody..

[0040] FIG. 8 illustrates various embodiments as provided herein.

Detailed Description:

[0041] Here it is described and disclosed the isolation and characterization of MAbs (monoclonal antibodies) that recognize Claudin 6. In some embodiments, MAbs against Claudin 6 were generated using virus-like particles (VLPs) to present this multispanning membrane protein in its native conformation. In some embodiments, the antibodies bind to Claudin 6, but do not significantly bind to Claudin 9. In some emboidments, the antibody binds to the Claudin 6 with an affinity, EC_{50}, or K_D at least, or about, 10, 20, 30, 40, 50, 75, 100, 200, or 300 times

greater than it binds to Claudin 9. In some embodiments, the antibodies bind to Claudin 6, but do not significantly bind to Claudin 3. In some emboidments, the antibody binds to the Claudin 6 with an affinity, EC_{50}, or K_D at least, or about, 10, 20, 30, 40, 50, 75, 100, 200, or 300 times greater than it binds to Claudin 3. In some embodiments, the antibodies bind to Claudin 6, but do not significantly bind to Claudin 4. In some emboidments, the antibody binds to the Claudin 6 with an affinity, EC_{50}, or K_D at least, or about, 10, 20, 30, 40, 50, 75, 100, 200, or 300 times greater than it binds to Claudin 4.

[0042] In some embodiments, Claudin 6 comprises an amino acid sequence comprising:

Claudin 6 (human)	SEQ ID NO: 1	MASAGMQILGVVLTLLGWVNGLVSCALPMWKVTAFIGN SIVVAQVVWEGLWMSCVVQSTGQMQCKVYDSLLALPQD LQAARALCVIALLVALFGLLVYLAGAKCTTCVEEKDSKA RLVLTSGIVFVISGVLTLIPVCWTAHAVIRDFYNPLVAEAQ KRELGASLYLGWAASGLLLLGGGLLCCTCPSGGSQGPSH YMARYSTSAPAISRGPSEYPTKNYV

[0043] The term "antibody" as used herein is meant in a broad sense and includes immunoglobulin or antibody molecules including polyclonal antibodies, monoclonal antibodies including murine, human, humanized and chimeric monoclonal antibodies and antibody fragments, such as ScFv or hexabodies (PLOS Biology | DOI:10.1371/journal.pbio.1002344 January 6, 2016, which is hereby incorporated by reference in its entirety).

[0044] The term "humanized antibody", "engineered antibody", "human framework adapted", and "HFA" as used herein, is intended to include antibodies having variable region frameworks derived from sequences of human origin. Furthermore, if the antibody contains a constant region, the constant region can be derived from such human sequences, e.g., human germline sequences, or naturally occurring (e.g., allotypes) or mutated versions of human germline sequences. The humanized antibodies may include amino acid residues not encoded by human sequences (e.g., mutations introduced by random or site-specific mutagenesis in vitro or by somatic mutation in vivo).

[0045] In general, antibodies are proteins or polypeptides that exhibit binding specificity to a specific antigen. Intact antibodies are heterotetrameric glycoproteins, composed of two identical light chains and two identical heavy chains. Typically, each light chain is linked to a heavy chain by one covalent disulfide bond, while the number of disulfide linkages varies between the heavy chains of different immunoglobulin isotypes. Each heavy and light chain also has regularly spaced intrachain disulfide bridges. Each heavy chain has at one end a variable domain (V_H)

followed by a number of constant domains. Each light chain has a variable domain at one end (V_L) and a constant domain at its other end; the constant domain of the light chain is aligned with the first constant domain of the heavy chain and the light chain variable domain is aligned with the variable domain of the heavy chain. Antibody light chains of any vertebrate species can be assigned to one of two clearly distinct types, namely kappa and lambda, based on the amino acid sequences of their constant domains. Immunoglobulins can be assigned to five major classes, namely IgA, IgD, IgE, IgG and IgM, depending on the heavy chain constant domain amino acid sequence. IgA and IgG are further sub-classified as the isotypes IgA_1, IgA_2, IgG_1, IgG_2, IgG_3 and IgG_4.

[0046] The term "antibody fragment" means a portion of an intact antibody, generally the antigen binding or variable region of the intact antibody. Examples of antibody fragments include Fab, Fab', $F(ab')_2$ and Fv fragments, diabodies, single chain antibody molecules and multispecific antibodies formed from at least two intact antibodies.

[0047] The term "antigen" as used herein means any molecule that has the ability to generate antibodies either directly or indirectly. Included within the definition of "antigen" is a protein-encoding nucleic acid.

[0048] As used herein, "specific binding" or "immunospecific binding" or "binds immunospecifically" refer to antibody binding to a predetermined antigen (*e.g.* Claudin 6) or epitope present on the antigen. In some embodiments, the antibody binds with a dissociation constant (K_D) of 10^{-7} M or less, and binds to the predetermined antigen with a K_D that is at least two-fold less than its K_D for binding to a non-specific antigen (e.g., BSA, casein, or another non-specific polypeptide) other than the predetermined antigen. The phrases "an antibody recognizing Claudin 6" and "an antibody specific for Claudin 6" are used interchangeably herein with the term "an antibody which binds immunospecifically to Claudin 6." Reference in the present disclosure may be made to Claudin 6. In some embodiments, the antibody is specific for Claudin 6 and does not specifically bind to claudin 3, claudin 4, and/or claudin 9.

[0049] "CDRs" are defined as the complementarity determining region amino acid sequences of an antibody which are the hypervariable regions of immunoglobulin heavy and light chains. See, e.g., Kabat et al., Sequences of Proteins of Immunological Interest, 4th ed., U.S. Department of Health and Human Services, National Institutes of Health (1987). There are three heavy chain

and three light chain CDRs or CDR regions in the variable portion of an immunoglobulin. Thus, "CDRs" as used herein refers to all three heavy chain CDRs, or all three light chain CDRs or both all heavy and all light chain CDRs, if appropriate.

[0050] CDRs provide the majority of contact residues for the binding of the antibody to the antigen or epitope. CDRs of interest can be derived from donor antibody variable heavy and light chain sequences, and include analogs of the naturally occurring CDRs, which analogs also share or retain the same antigen binding specificity and/or neutralizing ability as the donor antibody from which they were derived.

[0051] The term "homolog" means protein sequences having between 40% and 100% sequence identity to a reference sequence. Percent identity between two peptide chains can be determined by pair wise alignment using the default settings of the AlignX module of Vector NTI v.9.0.0 (Invitrogen Corp., Carslbad, Calif.). In some embodiments, the an antibody or fragment thereof has at least 50, 60, 70, 80, 90, 91, 92, 93, 94, 95, 96, 97, 98, or 99% identity to a sequence described herein. In some embodiments, the antibody has conservative substitutions as compared to a sequence described herein. In some emobdiments, the number of substitutions can be 1, 2, 3, 4, 5, 6, 7, 8, or 9. These molecules that differ based on % identity or substitutions can also be referred to as "variants." Antibodies having conservative substitutions in the heavy and light chain sequences shown in Table 1 are encompassed within the scope of the disclosed subject matter. The conservative substitution may reside in the framework regions, or in antigen-binding sites, as long they do not adversely affect the properties of the antibody. Substitutions may be made to improve antibody properties, for example stability or affinity. Conservative substitutions will produce molecules having functional and chemical characteristics similar to those molecules into which such modifications are made. Exemplary amino acid substitutions are shown in the table below.

Table: Exemplary Conservative Substitutions:	
Original Residue	Exemplary Conservative Substitutions
Ala	Val, Leu, Ile
Arg	Lys, Gln, Asn
Asn	Gln
Asp	Glu
Cys	Ser, Ala
Gln	Asn
Gly	Pro, Ala

His	Asn, Gln, Lys, Arg
Ile	Leu, Val, Met, Ala, Phe
Leu	Ile, Val, Met, Ala, Phe
Lys	Arg, Gln, Asn
Met	Leu, Phe, Ile
Phe	Leu, Val, Ile, Ala, Tyr
Pro	Ala
Ser	Thr, Ala, Cys
Thr	Ser
Trp	Tyr, Phe
Tyr	Trp, Phe, Thr, Ser
Val	Ile, Met, Leu, Phe, Ala

[0052] The term "in combination with" as used herein means that the described agents can be administered to an animal together in a mixture, concurrently as single agents or sequentially as single agents in any order.

[0053] Polyclonal antibodies are heterogeneous populations of antibody molecules derived from the sera of animals immunized with an antigen. A monoclonal antibody contains a substantially homogeneous population of antibodies specific to antigens, which population contains substantially similar epitope binding sites. MAbs may be obtained by methods known to those skilled in the art. See, for example Kohler and Milstein, Nature 256:495 497 (1975); U.S. Pat. No. 4,376,110; Ausubel et al., eds., Current Protocols in Molecular Biology, Greene Publishing Assoc. and Wiley Interscience, N.Y., (1987, 1992); and Harlow and Lane ANTIBODIES: A Laboratory Manual Cold Spring Harbor Laboratory (1988); Colligan et al., eds., Current Protocols in Immunology, Greene Publishing Assoc. and Wiley Interscience, N.Y., (1992, 1993), the contents of which references are incorporated entirely herein by reference. Such antibodies may be of any immunoglobulin class including IgG, IgM, IgE, IgA, GILD and any subclass thereof. A hybridoma producing a mAb may be cultivated in vitro, in situ or in vivo. Production of high titers of mAbs in vivo or in situ makes this the presently preferred method of production.

[0054] Chimeric antibodies are molecules different portions of which are derived from different animal species, such as those having variable region derived from a murine mAb and a human immunoglobulin constant region, which are primarily used to reduce immunogenicity in application and to increase yields in production, for example, where murine mAbs have higher yields from hybridomas but higher immunogenicity in humans, such that human/murine chimeric

mAbs are used. Chimeric antibodies and methods for their production are known in the art (Cabilly et al., Proc. Natl. Acad. Sci. USA 81:3273 3277 (1984); Morrison et al., Proc. Natl. Acad. Sci. USA 81:6851 6855 (1984); Boulianne et al., Nature 312:643 646 (1984); Cabilly et al., European Patent Application 125023 (published Nov. 14, 1984); Neuberger et al., Nature 314:268 270 (1985); Taniguchi et al., European Patent Application 171496 (published Feb. 19, 1985); Morrison et al., European Patent Application 173494 (published Mar. 5, 1986); Neuberger et al., PCT Application WO 86/01533, (published Mar. 13, 1986); Kudo et al., European Patent Application 184187 (published Jun. 11, 1986); Morrison et al., European Patent Application 173494 (published Mar. 5, 1986); Sahagan et al., J. Immunol. 137:1066 1074 (1986); Robinson et al., International Patent Publication WO 1987/002671 (published May 7, 1987); Liu et al., Proc. Natl. Acad. Sci. USA 84:3439 3443 (1987); Sun et al., Proc. Natl. Acad. Sci. USA 84:214 218 (1987); Better et al., Science 240:1041 1043 (1988); and Harlow and Lane Antibodies. a Laboratory Manual Cold Spring Harbor Laboratory (1988)). These references are entirely incorporated herein by reference.

[0055] An anti-idiotypic (anti-Id) antibody is an antibody which recognizes unique determinants generally associated with the antigen-binding site of an antibody. An Id antibody can be prepared by immunizing an animal of the same species and genetic type (e.g., mouse strain) as the source of the mAb with the mAb to which an anti-Id is being prepared. The immunized animal will recognize and respond to the idiotypic determinants of the immunizing antibody by producing an antibody to these idiotypic determinants (the anti-Id antibody). See, for example, U.S. Pat. No. 4,699,880, which is herein entirely incorporated by reference. The anti-Id antibody may also be used as an "immunogen" to induce an immune response in yet another animal, producing a so-called anti-anti-Id antibody. The anti-anti-Id may be epitopically identical to the original mAb which induced the anti-Id. Thus, by using antibodies to the idiotypic determinants of a mAb, it is possible to identify other clones expressing antibodies of identical specificity.

[0056] The term "monoclonal antibody" (mAb) as used herein means an antibody (or antibody fragment) obtained from a population of substantially homogeneous antibodies. Monoclonal antibodies are highly specific, typically being directed against a single antigenic determinant. The modifier "monoclonal" indicates the substantially homogeneous character of the antibody and does not require production of the antibody by any particular method. For example, murine

mAbs can be made by the hybridoma method of Kohler et al., Nature 256:495-497 (1975). Chimeric mAbs containing a light chain and heavy chain variable region derived from a donor antibody (typically murine) in association with light and heavy chain constant regions derived from an acceptor antibody (typically another mammalian species such as human) can be prepared by the method disclosed in U.S. Pat. No. 4,816,567. Humanized mAbs having CDRs derived from a non-human donor immunoglobulin (typically murine) and the remaining immunoglobulin-derived parts of the molecule being derived from one or more human immunoglobulins, optionally having altered framework support residues to preserve binding affinity, can be obtained by the techniques disclosed in Queen et al., Proc. Natl. Acad. Sci. (USA), 86:10029-10032 (1989) and Hodgson et al., Bio/Technology, 9:421 (1991).

[0057] In addition to the antibodies described herein, exemplary human framework sequences useful for humanization are disclosed at, e.g., www“dot”ncbi“dot”nlm“dot”nih“dot”gov/entrez/query“dot”fcgi; www“dot”ncbi“dot”nih“dot”gov/igblast; www“dot”atcc“dot”org/phage/hdb“dot”html; www“dot”mrc-cpe“dot”cam“dot”ac“dot”uk/ALIGNMENTS“dot”php; “dot” www“dot”kabatdatabase“dot”com/top“dot”html; ftp“dot”ncbi“dot”nih“dot”gov/repository/kabat; www“dot”sciquest“dot”com; www“dot”abcam“dot”com; www“dot”antibodyresource“dot”com/onlinecomp“dot”html; www“dot”public“dot”iastate“dot”edu/“dot”about“dot”pedro/research_tools“dot”html; www“dot”whfreeman“dot”com/immunology/CH05/kuby05“dot”htm; www“dot”hhmi“dot”org/grants/lectures/1996/vlab; www“dot”path“dot”cam“dot”ac“dot”uk/“dot”about“dot”mrc7/mikeimages“dot”html; mcb“dot”harvard“dot”edu/BioLinks/Immunology“dot”html; www“dot”immunologylink“dot”com; pathbox“dot”wustl“dot”edu/“dot”about“dot”hcenter/index“dot”html; www“dot”appliedbiosystems“dot”com; www“dot”nal“dot”usda“dot”gov/awic/pubs/antibody; www“dot”m“dot”ehime-u“dot”ac“dot”jp/“dot”about“dot”yasuhito/Elisa“dot”html; www“dot”biodesign“dot”com; www“dot”cancerresearchuk“dot”org; www“dot”biotech“dot”ufl“dot”edu; www“dot”isac-net“dot”org; baserv“dot”uci“dot”kun“dot”nl/“dot”about“dot”jraats/links1“dot”html;

www“dot”recab“dot”uni-hd“dot”de/immuno“dot”bme“dot”nwu“dot”edu; www“dot”mrc-cpe“dot”cam“dot”ac“dot”uk; www“dot”ibt“dot”unam“dot”mx/vir/V_mice“dot”html; http://www“dot”bioinf“dot”org“dot”uk/abs; antibody“dot”bath“dot”ac“dot”uk; www“dot”unizh“dot”ch; www“dot”cryst“dot”bbk“dot”ac“dot”uk/“dot”about“dot”ubcg07s; www“dot”nimr“dot”mrc“dot”ac“dot”uk/CC/ccaewg/ccaewg“dot”html; www“dot”path“dot”cam“dot”ac“dot”uk/“dot”about“dot”mrc7/humanisation/TAHHP“dot”html; www“dot”ibt“dot”unam“dot”mx/vir/structure/stat_aim“dot”html; www“dot”biosci“dot”missouri“dot”edu/smithgp/index“dot”html; www“dot”jerini“dot”de; imgt“dot”cines“dot”fr; and Kabat et al., Sequences of Proteins of Immunological Interest, U.S. Dept. Health (1987), each entirely incorporated herein by reference. The “dot” in the world wide web addresses referenced herein can be replaced with a “.” as appropriate.

[0058] The antibodies described herein can include, but are not limited to, at least one of a heavy chain constant region (H_c), a heavy chain variable region (H_v), a light chain variable region (L_v) and a light chain constant region (L_c), wherein a polyclonal Ab, monoclonal Ab, fragment and/or regions thereof include at least one heavy chain variable region (H_v) or light chain variable region (L_v) which binds a portion of a Claudin 6 and can be used to detect the antigen. The antibodies can also be monoclonal antibodies that are made by immunizing chickens. The variable chains from the nucleic acid sequences encoding the isolated monoclonal antibodies can be isolated by using techniques, such as but not limited to, PCR. The variable chains isolated by these techniques can then be placed in a scFv vector with a human Fc. Accordingly, the antibodies can be antibodies that have a human Fc and two scFv arms. The antibodies, such as those described here and throughout the present disclosure can then be modified to be human or humanized antibodies. Examples of how to modify an antibody, including chicken antibodies, can be found in, for example, Riechmann L, Clark M, Waldmann H, Winter G (1988). Reshaping human antibodies for therapy”. Nature 332 (6162): 332–323; Tsurushita N, Park M, Pakabunto K, Ong K, Avdalovic A, Fu H, Jia A, Vásquez M, Kumar S. (2004); and “Humanization of a chicken anti-IL-12 monoclonal antibody” Immunol Methods 295 (1-2): 9-19; Nishibori N, Horiuchi H, Furusawa S, Matsuda H. (2006) “Humanization of chicken monoclonal antibody using phage display system” Mol Immunol. 43 (6): 634-42, each of which is incorporated by reference in its entirety.

[0059] Methods for determining mAb specificity and affinity by competitive inhibition can be found in Harlow, et al., Antibodies: A Laboratory Manual, Cold Spring Harbor Laboratory Press, Cold Spring Harbor, N.Y., 1988), Colligan et al., eds., Current Protocols in Immunology, Greene Publishing Assoc. and Wiley Interscience, N.Y., (1992, 1993), and Muller, Meth. Enzymol. 92:589 601 (1983), which references are entirely incorporated herein by reference.

[0060] The techniques to raise antibodies to small peptide sequences that recognize and bind to those sequences in the free or conjugated form or when presented as a native sequence in the context of a large protein are well known in the art. Such antibodies include murine, murine-human and human-human antibodies produced by hybridoma or recombinant techniques known in the art. Antibodies can also be produced in chickens, goats, rabbits, or other small animals.

[0061] As used herein, the term "antigen binding region" refers to that portion of an antibody molecule which contains the amino acid residues that interact with an antigen (*e.g.* Claudin 6) and confer on the antibody its specificity and affinity for the antigen. The antibody region includes the "framework" amino acid residues necessary to maintain the proper conformation of the antigen-binding residues. In some embodiments, the antigen binding region will be of murine origin. In some embodiments, the antigen binding region can be derived from other animal species, in particular rodents such as rabbit, rat or hamster, or birds such as chickens. It has been shown that the antigen-binding function of an antibody can be performed by fragments of a full-length antibody. Examples of binding fragments encompassed within the term "antigen-binding portion" of an antibody include a Fab fragment, a monovalent fragment having the VL, VH, CL and CH1 domains; a $F(ab)_2$ fragment, a bivalent fragment comprising two Fab fragments linked by a disulfide bridge(s) at a hinge region; a Fd fragment having the VH and CH1 domains; a Fv fragment having the VL and VH domains of a single arm of an antibody; a domain antibody or dAb fragment (Ward et al., 1989 Nature 341:544-546), which consists of a VH domain; and an isolated complementarity determining region (CDR), especially a CDR3 (See for example the WO03/025019, the contents of which are incorporated herein by reference).

[0062] The term "Complementarity Determining Regions (CDRs)" is based on sequence variability (Wu and Kabat, J. Exp. Med. 132:211-250, 1970). There are six CDRs--three in the variable heavy chain, or VH, and are typically designated H-CDR1, H-CDR2, and H-CDR3, and three CDRs in the variable light chain, or VL, and are typically designated L-CDR1, L-CDR2,

and L-CDR3 (Kabat et al., Sequences of Proteins of Immunological Interest, 5th Ed. Public Health Service, National Institutes of Health, Bethesda, Md., 1991). "Hypervariable region", "HVR", or "HV" refer to the regions of an antibody variable domain which are variable in structure as defined by Chothia and Lesk (Chothia and Lesk, Mol. Biol. 196:901-917, 1987). There are six HVRs, three in VH (H1, H2, H3) and three in VL (L1, L2, L3). Chothia and Lesk refer to structurally conserved HVs as "canonical structures." Another method of describing the regions that form the antigen-binding site has been proposed by Lefranc (Lefranc et al., Developmental & Comparative Immunology 27:55-77, 2003) based on the comparison of V domains from immunoglobulins and T-cell receptors (Lefranc et al., Developmental & Comparative Immunology 27:55-77, 2003). The antigen-binding site can also be delineated based on "Specificity Determining Residue Usage (SDRU)", according to Almagro (Almagro, Mol. Recognit. 17:132-43, 2004), where SDRU refers to amino acid residues of an immunoglobulin that are directly involved in antigen contact.

[0063] Furthermore, although the two domains of the Fv fragment, VL and VH, are encoded by separate genes naturally, they can be joined, using recombinant methods, by a synthetic linker that enables them to be made as a single protein chain in which the VL and VH regions pair to form monovalent molecules (known as single chain Fv (scFv); see e.g., Bird et al., 1988 Science 242:423-426; and Huston et al., 1988 Proc. Nat. Acad. Sci. 85:5879-5883). Such single chain antibodies are encompassed by the term "antigen-binding portion" of an antibody. These antibody fragments are obtained using conventional techniques known to those of skill in the art, and can be used in the same manner as intact antibodies.

[0064] An "isolated antibody," as used herein, refers to an antibody that is substantially free of other antibodies having different antigenic specificities (e.g., an isolated antibody that specifically binds Claudin 6 is substantially free of antibodies that specifically bind antigens other than Claudin 6). Moreover, an isolated antibody may be substantially free of other cellular material and/or chemicals. An isolated antibody can also be sterile or pyrogen free or formulated as injectable pharmaceutical as described herein.

[0065] In some embodiments, the source for the DNA encoding a non-human antibody include cell lines which produce antibody, such as hybrid cell lines commonly known as hybridomas.

[0066] An "antigen" is a molecule or a portion of a molecule capable of being bound by an antibody which is additionally capable of inducing an animal to produce antibody capable of binding to an epitope of that antigen. An antigen can have one or more than one epitope. The specific reaction referred to above is meant to indicate that the antigen will react, in a highly selective manner, with its corresponding antibody and not with the multitude of other antibodies which can be evoked by other antigens. In some embodiments, antigens that bind antibodies, fragments and regions of the antibodies include at least 5 amino acids. In some embodiments, the antigen is the Claudin 6 protein expressed on the surface of a cell or particle. In some embodiments, the cell is an intact cell. An intact cell is a cell that has not been lysed or broken open with the use of detergents or other reagents. A cell that has been treated with detergents or other reagents that breaks up the cellular membrane or punches holes in a cellular membrane is not an intact cell. By expressing the receptor on the surface of the cell or particle, *e.g.* lipoparticle, the receptor can present conformational epitopes that may otherwise not be present if purified protein is used. An example is provided herein. In some embodiments, an adjuvant is not used, but an adjuvant can be used. In some embodiments, the particles are injected into a bird (*e.g.* chicken) to stimulate an immune response and generate antibodies against the protein present on the surface of the particle. Particles suitable for the generation of antibodies are described in U.S. Patent Nos.: 8,377,691, 7,763,258, 8,158,130 and U.S. Patent Application Publication Nos. 20050123563 and 20120195882, each of which is hereby incorporated by reference. These publications and patents describe the generation of various particles, including lipoparticles, that can be used to express membrane spanning proteins (*e.g.* multiple-membrane spanning proteins, ion channels, and the like).

[0067] The term "epitope" is meant to refer to that portion of any molecule capable of being recognized by and bound by an antibody at one or more of the Ab's antigen binding regions. Epitopes usually consist of chemically active surface groupings of molecules such as amino acids or sugar side chains and have specific three dimensional structural characteristics as well as specific charge characteristics. Example of epitopes include, but are not limited to,

[0068] As used herein, the term "chimeric antibody" includes monovalent, divalent or polyvalent immunoglobulins. A monovalent chimeric antibody is a dimer (HL) formed by a chimeric H chain associated through disulfide bridges with a chimeric L chain. A divalent chimeric antibody

is tetramer (H_2L_2) formed by two HL dimers associated through at least one disulfide bridge. A polyvalent chimeric antibody can also be produced, for example, by employing a C_H region that aggregates (e.g., from an IgM H chain, or μ. chain). In some embodiments, murine and chimeric antibodies, fragments and regions comprise individual heavy (H) and/or light (L) immunoglobulin chains.

[0069] Antibodies, fragments or derivatives having chimeric H chains and L chains of the same or different variable region binding specificity, can also be prepared by appropriate association of the individual polypeptide chains, according to known method steps, e.g., according to Ausubel infra, Harlow infra, and Colligan infra, the contents of which references are incorporated entirely herein by reference. With this approach, hosts expressing chimeric H chains (or their derivatives) are separately cultured from hosts expressing chimeric L chains (or their derivatives), and the immunoglobulin chains are separately recovered and then associated. Alternatively, the hosts can be co-cultured and the chains allowed to associate spontaneously in the culture medium, followed by recovery of the assembled immunoglobulin, fragment or derivative.

[0070] The hybrid cells are formed by the fusion of a non-human antibody-producing cell, typically a spleen cell of an animal immunized against either natural or recombinant antigen, or a peptide fragment of the antigen protein sequence. Alternatively, the non-human antibody-producing cell can be a B lymphocyte obtained from the blood, spleen, lymph nodes or other tissue of an animal immunized with the antigen.

[0071] The second fusion partner, which provides the immortalizing function, can be a lymphoblastoid cell or a plasmacytoma or myeloma cell, which is not itself an antibody producing cell, but is malignant. Fusion partner cells include, but are not limited to, the hybridoma SP2/0-Ag14, abbreviated as SP2/0 (ATCC CRL1581) and the myeloma P3X63Ag8 (ATCC TIB9), or its derivatives. See, e.g., Ausubel infra, Harlow infra, and Colligan infra, the contents of which references are incorporated entirely herein by reference.

[0072] The antibodies can be generated according the examples provided herein. Once the sequences are known, the antibodies can also be generated according to known methods. The antibodies can also be converted to different types, such as being converted to Human IgGs and the like. By converting the antibodies to a human antibody, a human subject should not identify

the antibodies as foreign. This will lead to a more effective response. The conversion of a non-human IgG antibody to a human IgG antibody is well known and can routinely be done once the native sequence is known. As discussed herein, the antibodies can be modified according to known methods. Such methods are described in, for example, Riechmann L, Clark M, Waldmann H, Winter G (1988). Reshaping human antibodies for therapy". Nature 332 (6162): 332–323; Tsurushita N, Park M, Pakabunto K, Ong K, Avdalovic A, Fu H, Jia A, Vásquez M, Kumar S. (2004); and "Humanization of a chicken anti-IL-12 monoclonal antibody" Immunol Methods 295 (1-2): 9-19; Nishibori N, Horiuchi H, Furusawa S, Matsuda H. (2006) "Humanization of chicken monoclonal antibody using phage display system" Mol Immunol. 43 (6): 634-42, each of which is incorporated by reference in its entirety.

[0073] The antibody-producing cell contributing the nucleotide sequences encoding the antigen-binding region of the chimeric antibody can also be produced by transformation of a non-human, such as a primate, or a human cell. For example, a B lymphocyte which produces the antibody can be infected and transformed with a virus such as Epstein-Barr virus to yield an immortal antibody producing cell (Kozbor et al., Immunol. Today 4:72 79 (1983)). Alternatively, the B lymphocyte can be transformed by providing a transforming gene or transforming gene product, as is well-known in the art. See, e.g., Ausubel infra, Harlow infra, and Colligan infra, the contents of which references are incorporated entirely herein by reference.

[0074] The cell fusions are accomplished by standard procedures well known to those skilled in the field of immunology. Fusion partner cell lines and methods for fusing and selecting hybridomas and screening for mAbs are well known in the art. See, e.g., Ausubel infra, Harlow infra, and Colligan infra, the contents of which references are incorporated entirely herein by reference.

[0075] The antigen-specific murine or chimeric mAb can be produced in large quantities by injecting hybridoma or transfectoma cells secreting the antibody into the peritoneal cavity of mice and, after appropriate time, harvesting the ascites fluid which contains a high titer of the mAb, and isolating the mAb therefrom. For such *in vivo* production of the mAb with a non-murine hybridoma (e.g., rat or human), hybridoma cells are preferably grown in irradiated or athymic nude mice. Alternatively, the antibodies can be produced by culturing hybridoma or

transfectoma cells in vitro and isolating secreted mAb from the cell culture medium or recombinantly, in eukaryotic or prokaryotic cells.

[0076] In some embodiments, the antibody is a MAb which binds to Claudin 6. In some embodiments, the antibody binds to amino acids of an epitope of the Claudin 6. The epitopes are described herein, such as in the Tables provided in the figures and described in the Examples. In some embodiments, the antibody binds specifically to the proteins and antigens described herein.

[0077] In some embodiments, the antibody comprises a sequence as provided for herein.

[0078] The sequences of the antibodies can be modified to yield human IgG antibodies. The conversion of the sequences provided herein can be modified to yield other types of antibodies. The CDRs can also be linked to other antibodies, proteins, or molecules to create antibody fragments that bind to Claudin 6. The CDRs and antibody sequences provided herein also be humanized or made fully human according to known methods. The sequences can also be made into chimeric antibodies as described herein.

[0079] In some embodiments, the antibody comprises an amino acid sequence comprising a sequence provided for herein or a fragment thereof. In some embodiments, the antibody comprises one or more amino acid sequences as provided herein, an antigen binding fragments, thereof, or a human IgG variant thereof. "A human IgG variant thereof" refers to an antibody that has been modified to be a human IgG when the starting antibody is not a human IgG antibody.

[0080] As described herein the production of antibodies with a known sequence is routine and can be done by any method. Accordingly, in some embodiments, a nucleic acid encoding an antibody or fragment thereof is provided. In some embodiments, the nucleic acid encodes a sequence provided for herein. The antibodies can also be modified to be chimeric antibodies or human antibodies. The antibodies can also be used in injectable pharmaceutical compositions. As also described herein, the antibodies can be isolated antibodies or engineered antibodies.

[0081] . In some embodiments, "derivatives" of the antibodies, fragments, regions or derivatives thereof, which term includes those proteins encoded by truncated or modified genes to yield molecular species functionally resembling the immunoglobulin fragments are provided. The modifications include, but are not limited to, addition of genetic sequences coding for cytotoxic proteins such as plant and bacterial toxins. The modification can also include a reporter protein,

such as a fluorescent or chemiluminescent tag. The fragments and derivatives can be produced in any manner.

[0082] Fragments include, for example, Fab, Fab', $F(ab')_2$ and Fv. These fragments lack the Fc fragment of intact antibody, clear more rapidly from the circulation, and can have less non-specific tissue binding than an intact antibody (Wahl et al., J. Nucl. Med. 24:316 325 (1983)). These fragments are produced from intact antibodies using methods well known in the art, for example by proteolytic cleavage with enzymes such as papain (to produce Fab fragments) or pepsin (to produce $F(ab')_f$ fragments).

[0083] The identification of these antigen binding region and/or epitopes recognized by Abs described herein provide the information necessary to generate additional monoclonal antibodies with similar binding characteristics and therapeutic or diagnostic utility that parallel the embodiments of this application.

[0084] The nucleic acid sequence encoding an antibody described herein can be genomic DNA or cDNA, or RNA (*e.g.* mRNA) which encodes at least one of the variable regions described herein. A convenient alternative to the use of chromosomal gene fragments as the source of DNA encoding the V region antigen-binding segment is the use of cDNA for the construction of chimeric immunoglobulin genes, e.g., as reported by Liu et al. (Proc. Natl. Acad. Sci., USA 84:3439 (1987) and J. Immunology 139:3521 (1987), which references are hereby entirely incorporated herein by reference. The use of cDNA requires that gene expression elements appropriate for the host cell be combined with the gene in order to achieve synthesis of the desired protein. The use of cDNA sequences is advantageous over genomic sequences (which contain introns), in that cDNA sequences can be expressed in bacteria or other hosts which lack appropriate RNA splicing systems.

[0085] For example, a cDNA encoding a V region antigen-binding segment able to detect, bind, to or neutralize a Claudin 6 antigen can be provided using known methods based on the use of the amino acid sequences provided herein. Because the genetic code is degenerate, more than one codon can be used to encode a particular amino acid (Watson, et al., infra). Using the genetic code, one or more different oligonucleotides can be identified, each of which would be capable of encoding the amino acid. The probability that a particular oligonucleotide will, in fact, constitute the actual encoding sequence can be estimated by considering abnormal base pairing

relationships and the frequency with which a particular codon is actually used (to encode a particular amino acid) in eukaryotic or prokaryotic cells expressing an antibody or fragment. Such "codon usage rules" are disclosed by Lathe, et al., J. Molec. Biol. 183:1 12 (1985). Using the "codon usage rules" of Lathe, a single oligonucleotide, or a set of oligonucleotides, that contains a theoretical "most probable" nucleotide sequence capable of encoding an antibody variable or constant region sequences is identified.

[0086] The variable regions described herein can be combined with any type of constant region including a human constant region or murine constant region. Human genes which encode the constant (C) regions of the antibodies, fragments and regions can be derived from a human fetal liver library, by known methods. Human C regions genes can be derived from any human cell including those which express and produce human immunoglobulins. The human C_H region can be derived from any of the known classes or isotypes of human H chains, including gamma, μ, α, δ or ε, and subtypes thereof, such as G1, G2, G3 and G4. Since the H chain isotype is responsible for the various effector functions of an antibody, the choice of C_H region will be guided by the desired effector functions, such as complement fixation, or activity in antibody-dependent cellular cytotoxicity (ADCC). Preferably, the C_H region is derived from gamma 1 (IgG1), gamma 3 (IgG3), gamma 4 (IgG4), or μ (IgM). The human C_L region can be derived from either human L chain isotype, kappa or lambda.

[0087] Genes encoding human immunoglobulin C regions can be obtained from human cells by standard cloning techniques (Sambrook, et al. (Molecular Cloning: A Laboratory Manual, 2nd Edition, Cold Spring Harbor Press, Cold Spring Harbor, N.Y. (1989) and Ausubel et al., eds. Current Protocols in Molecular Biology (1987 1993)). Human C region genes are readily available from known clones containing genes representing the two classes of L chains, the five classes of H chains and subclasses thereof. Chimeric antibody fragments, such as $F(ab')_2$ and Fab, can be prepared by designing a chimeric H chain gene which is appropriately truncated. For example, a chimeric gene encoding an H chain portion of an $F(ab')_2$ fragment would include DNA sequences encoding the CH_1 domain and hinge region of the H chain, followed by a translational stop codon to yield the truncated molecule.

[0088] Generally, the murine, human or murine and chimeric antibodies, fragments and regions of the antibodies described herein are produced by cloning DNA segments encoding the H and L

chain antigen-binding regions of a Claudin 6 antigen specific antibody, and joining these DNA segments to DNA segments encoding C_H and C_L regions, respectively, to produce murine, human or chimeric immunoglobulin-encoding genes.

[0089] Thus, in some embodiments, a fused chimeric gene is created which comprises a first DNA segment that encodes at least the antigen-binding region of non-human origin, such as a functionally rearranged V region with joining (J) segment, linked to a second DNA segment encoding at least a part of a human C region.

[0090] Therefore, cDNA encoding the antibody V and C regions, the method of producing the chimeric antibody according to some of the embodiments described herein involve several steps, as exemplified below: 1. isolation of messenger RNA (mRNA) from the cell line producing an anti- Claudin 6 antigen antibody and from optional additional antibodies supplying heavy and light constant regions; cloning and cDNA production therefrom; 2. preparation of a full length cDNA library from purified mRNA from which the appropriate V and/or C region gene segments of the L and H chain genes can be: (i) identified with appropriate probes, (ii) sequenced, and (iii) made compatible with a C or V gene segment from another antibody for a chimeric antibody; 3. Construction of complete H or L chain coding sequences by linkage of the cloned specific V region gene segments to cloned C region gene, as described above; 4. Expression and production of L and H chains in selected hosts, including prokaryotic and eukaryotic cells to provide murine-murine, human-murine, human-human or human murine antibodies.

[0091] One common feature of all immunoglobulin H and L chain genes and their encoded mRNAs is the J region. H and L chain J regions have different sequences, but a high degree of sequence homology exists (greater than 80%) among each group, especially near the C region. This homology is exploited in this method and consensus sequences of H and L chain J regions can be used to design oligonucleotides for use as primers for introducing useful restriction sites into the J region for subsequent linkage of V region segments to human C region segments.

[0092] C region cDNA vectors prepared from human cells can be modified by site-directed mutagenesis to place a restriction site at the analogous position in the human sequence. For example, one can clone the complete human kappa chain C (C_k) region and the complete human gamma-1 C region (Cγ-1). In this case, the alternative method based upon genomic C region

clones as the source for C region vectors would not allow these genes to be expressed in bacterial systems where enzymes needed to remove intervening sequences are absent. Cloned V region segments are excised and ligated to L or H chain C region vectors. Alternatively, the human Cγ-1 region can be modified by introducing a termination codon thereby generating a gene sequence which encodes the H chain portion of an Fab molecule. The coding sequences with linked V and C regions are then transferred into appropriate expression vehicles for expression in appropriate hosts, prokaryotic or eukaryotic.

[0093] Two coding DNA sequences are said to be "operably linked" if the linkage results in a continuously translatable sequence without alteration or interruption of the triplet reading frame. A DNA coding sequence is operably linked to a gene expression element if the linkage results in the proper function of that gene expression element to result in expression of the coding sequence.

[0094] Expression vehicles include plasmids or other vectors. Preferred among these are vehicles carrying a functionally complete human C_H or C_L chain sequence having appropriate restriction sites engineered so that any V_H or V_L chain sequence with appropriate cohesive ends can be easily inserted therein. Human C_H or C_L chain sequence-containing vehicles thus serve as intermediates for the expression of any desired complete H or L chain in any appropriate host.

[0095] A chimeric antibody, such as a mouse-human or human-human, will typically be synthesized from genes driven by the chromosomal gene promoters native to the mouse H and L chain V regions used in the constructs; splicing usually occurs between the splice donor site in the mouse J region and the splice acceptor site preceding the human C region and also at the splice regions that occur within the human C region; polyadenylation and transcription termination occur at native chromosomal sites downstream of the human coding regions.

[0096] As used herein and unless otherwise indicated, the term "about" is intended to mean ± 5% of the value it modifies. Thus, about 100 means 95 to 105.

[0097] In some embodiments, the antibodies described herein are used to detect the presence of the antigen. The present antibody can be used in any device or method to detect the presence of the antigen.

[0098] The term "purified" with referenced to an antibody refers to an antibody that is substantially free of other material that associates with the molecule in its natural environment.

For instance, a purified protein is substantially free of the cellular material or other proteins from the cell or tissue from which it is derived. The term refers to preparations where the isolated protein is sufficiently pure to be analyzed, or at least 70% to 80% (w/w) pure, at least 80%-90% (w/w) pure, 90-95% pure; and, at least 95%, 96%, 97%, 98%, 99%, or 100% (w/w) pure. In some embodiments, the antibody is purified.

[0099] The terms "specific binding," "specifically binds," and the like, mean that two or more molecules form a complex that is measurable under physiologic or assay conditions and is selective. An antibody or antigen binding protein or other molecule is said to "specifically bind" to a protein, antigen, or epitope if, under appropriately selected conditions, such binding is not substantially inhibited, while at the same time non-specific binding is inhibited. Specific binding is characterized by a high affinity and is selective for the compound, protein, epitope, or antigen. Nonspecific binding usually has a low affinity. Binding in IgG antibodies for example is generally characterized by an affinity of at least about 10^{-7} M or higher, such as at least about 10^{-8} M or higher, or at least about 10^{-9} M or higher, or at least about 10^{-10} or higher, or at least about 10^{-11} M or higher, or at least about 10^{-12} M or higher. The term is also applicable where, e.g., an antigen-binding domain is specific for a particular epitope that is not carried by numerous antigens, in which case the antibody or antigen binding protein carrying the antigen-binding domain will generally not bind other antigens. In some embodiments, the capture reagent has a Kd equal or less than 10^{-9}M, 10^{-10}M, or 10^{-11}M for its binding partner (*e.g.* antigen). In some embodiments, the capture reagent has a Ka greater than or equal to $10^{9}M^{-1}$ for its binding partner.

[00100] Intact antibodies, also known as immunoglobulins, are typically tetrameric glycosylated proteins composed of two light (L) chains of approximately 25 kDa each, and two heavy (H) chains of approximately 50 kDa each. Two types of light chain, termed lambda and kappa, exist in antibodies. Depending on the amino acid sequence of the constant domain of heavy chains, immunoglobulins are assigned to five major classes: A, D, E, G, and M, and several of these may be further divided into subclasses (isotypes), e.g., IgG1, IgG2, IgG3, IgG4, IgA1, and IgA2. Each light chain is composed of an N-terminal variable (V) domain (VL) and a constant (C) domain (CL). Each heavy chain is composed of an N-terminal V domain (VH), three or four C domains (CHs), and a hinge region. The CH domain most proximal to VH is designated CH1. The VH and VL domains consist of four regions of relatively conserved

sequences named framework regions (FR1, FR2, FR3, and FR4), which form a scaffold for three regions of hypervariable sequences (complementarity determining regions, CDRs). The CDRs contain most of the residues responsible for specific interactions of the antibody or antigen binding protein with the antigen. CDRs are referred to as CDR1, CDR2, and CDR3. Accordingly, CDR constituents on the heavy chain are referred to as H1, H2, and H3, while CDR constituents on the light chain are referred to as L1, L2, and L3. CDR3 is the greatest source of molecular diversity within the antibody or antigen binding protein-binding site. H3, for example, can be as short as two amino acid residues or greater than 26 amino acids. The subunit structures and three-dimensional configurations of different classes of immunoglobulins are well known in the art. For a review of the antibody structure, see Antibodies: A Laboratory Manual, Cold Spring Harbor Laboratory, Eds. Harlow et al., 1988. One of skill in the art will recognize that each subunit structure, e.g., a CH, VH, CL, VL, CDR, and/or FR structure, comprises active fragments. For example, active fragments may consist of the portion of the VH, VL, or CDR subunit that binds the antigen, i.e., the antigen-binding fragment, or the portion of the CH subunit that binds to and/or activates an Fc receptor and/or complement.

[00101] In addition to the fragments described herein, non-limiting examples of binding fragments encompassed within the term "antigen-specific antibody" used herein include: (i) an Fab fragment, a monovalent fragment consisting of the VL, VH, CL and CH1 domains; (ii) an F(ab')2 fragment, a bivalent fragment comprising two Fab fragments linked by a disulfide bridge at the hinge region; (iii) an Fd fragment consisting of the VH and CH1 domains; (iv) an Fv fragment consisting of the VL and VH domains of a single arm of an antibody, (v) a dAb fragment, which consists of a VH domain; and (vi) an isolated CDR. Furthermore, although the two domains of the Fv fragment, VL and VH, are coded for by separate genes, they may be recombinantly joined by a synthetic linker, creating a single protein chain in which the VL and VH domains pair to form monovalent molecules (known as single chain Fv (scFv)). The most commonly used linker is a 15-residue $(Gly4Ser)_3$ peptide, but other linkers are also known in the art. Single chain antibodies are also intended to be encompassed within the terms "antibody or antigen binding protein," or "antigen-binding fragment" of an antibody. The antibody can also be a polyclonal antibody, monoclonal antibody, chimeric antibody, antigen-binding fragment, Fc fragment, single chain antibodies, or any derivatives thereof.

[00102] These antibodies can be obtained using conventional techniques known to those skilled in the art and described herein, and the fragments are used in the same manner as intact antibodies. Antibody diversity is created by multiple germline genes encoding variable domains and a variety of somatic events. The somatic events include recombination of variable gene segments with diversity (D) and joining (J) gene segments to make a complete VH domain, and the recombination of variable and joining gene segments to make a complete VL domain. The recombination process itself is imprecise, resulting in the loss or addition of amino acids at the V(D)J junctions. These mechanisms of diversity occur in the developing B cell prior to antigen exposure. After antigenic stimulation, the expressed antibody genes in B cells undergo somatic mutation. Based on the estimated number of germline gene segments, the random recombination of these segments, and random VH-VL pairing, up to $1.6X10^7$ different antibodies may be produced (Fundamental Immunology, 3rd ed. (1993), ed. Paul, Raven Press, New York, N.Y.). When other processes that contribute to antibody diversity (such as somatic mutation) are taken into account, it is thought that upwards of $1X10^{10}$ different antibodies may be generated (Immunoglobulin Genes, 2nd ed. (1995), eds. Jonio et al., Academic Press, San Diego, Calif.). Because of the many processes involved in generating antibody diversity, it is unlikely that independently derived monoclonal antibodies with the same antigen specificity will have identical amino acid sequences.

[00103] Antibody or antigen binding protein molecules capable of specifically interacting with the antigens, epitopes, or other molecules described herein may be produced by methods well known to those skilled in the art. For example, monoclonal antibodies can be produced by generation of hybridomas in accordance with known methods. Hybridomas formed in this manner can then be screened using standard methods, such as enzyme-linked immunosorbent assay (ELISA) and biosensor analysis, to identify one or more hybridomas that produce an antibody that specifically interacts with a molecule or compound of interest.

[00104] As an alternative to preparing monoclonal antibody-secreting hybridomas, a monoclonal antibody to a polypeptide may be identified and isolated by screening a recombinant combinatorial immunoglobulin library (e.g., an antibody phage display library) with a polypeptide described herein to thereby isolate immunoglobulin library members that bind to the polypeptide. Techniques and commercially available kits for generating and screening phage

display libraries are well known to those skilled in the art. Additionally, examples of methods and reagents particularly amenable for use in generating and screening antibody or antigen binding protein display libraries can be found in the literature. Thus, the epitopes described herein can be used to screen for other antibodies that can be used therapeutically, diagnostically, or as research tools.

[00105] Administration, Compositions, and Kits Comprising the Antibodies

[00106] Whereas, an isolated antibody binds an epitope on a Claudin 6 protein, or other protein described herein, and displays in vitro and/or in vivo Claudin 6 inhibiting or therapeutic activities, the antibodies or antigen binding fragments thereof, capable of inhibiting Claudin 6 function, are suitable both as therapeutic and prophylactic agents for treating or preventing Claudin 6-associated conditions in humans and animals. These conditions include, but are not limited to, benign and metastatic forms of cancer, for example, ovarian cancer (*e.g.* ovarian carcinoma), reproductive cancers (breast, cervical, testicular, uterine, and placental cancers), lung cancer, gastric cancer, hepatic cancer, pancreatic cancer, bile duct cancer, cancer of the urinary bladder, kidney cancer, colon cancer, small bowel cancer, skin cancer, head and neck cancer, sarcoma, and germ cell tumors, among others.

[00107] In some embodiments, the methods comprise administering a therapeutically or prophylactically effective amount of one or more monoclonal antibodies or antigen binding fragments of the antibodies described herein to a susceptible subject or to one exhibiting a condition in which Claudin 6 is known to have caused the pathology observed. Any active form of the antibody can be administered, including, but not limited to Fab and F(ab')2 fragments.

[00108] As used herein, a Claudin 6 associated pathology refers to conditions that are caused by the function or aberrant function of a Claudin 6 receptor. These conditions include, but are not limited to, benign and metastatic forms of cancer, for example, ovarian cancer (*e.g.* ovarian carcinoma), reproductive cancers (breast, cervical, testicular, uterine, and placental cancers), lung cancer, gastric cancer, hepatic cancer, pancreatic cancer, bile duct cancer, cancer of the urinary bladder, kidney cancer, colon cancer, small bowel cancer, skin cancer, head and neck cancer, sarcoma, germ cell tumors, and the like.

[00109] In some embodiments, the antibodies used are compatible with the recipient species such that the immune response to the MAbs does not result in an unacceptably short

circulating half-life or induce an immune response to the MAbs in the subject. In some embodiments, the MAbs administered exhibit some secondary functions such as binding to Fc receptors of the subject and activation of antibody dependent cell mediated cytotoxicity (ADCC) mechanisms.

[00110] Treatment of individuals may comprise the administration of a therapeutically effective amount of the antibodies described herein. The antibodies can be provided in a kit as described below. The antibodies can be used or administered alone or in admixture with another therapeutic, analgesic, or diagnostic agent. In providing a patient with an antibody, or fragment thereof, capable of binding to Claudin 6, or an antibody capable of protecting against Claudin 6, pathology in a recipient patient, the dosage of administered agent will vary depending upon such factors as the patient's age, weight, height, sex, general medical condition, previous medical history, etc.

[00111] Suitable vehicles and their formulation and packaging are described, for example, in Remington: The Science and Practice of Pharmacy (21st ed., Troy, D. ed., Lippincott Williams & Wilkins, Baltimore, Md. (2005) Chapters 40 and 41). Additional pharmaceutical methods may be employed to control the duration of action. Controlled release preparations may be achieved through the use of polymers to complex or absorb the compounds. Another possible method to control the duration of action by controlled release preparations is to incorporate the compounds of into particles of a polymeric material such as polyesters, polyamino acids, hydrogels, poly(lactic acid) or ethylene vinylacetate copolymers. Alternatively, instead of incorporating these agents into polymeric particles, it is possible to entrap these materials in microcapsules prepared, for example, interfacial polymerization, for example, hydroxymethylcellulose or gelatin-microcapsules and poly(methylmethacylate)-microcapsules, respectively, or in colloidal drug delivery systems, for example, liposomes, albumin microspheres, microemulsions, nanoparticles, and nanocapsules or in macroemulsions.

[00112] In general, if administering a systemic dose of the antibody, it is desirable to provide the recipient with a dosage of antibody which is in the range of from about 1 ng/kg-100 ng/kg, 100 ng/kg-500 ng/kg, 500 ng/kg-1 ug/kg, 1 ug/kg-100 ug/kg, 100 ug/kg-500 ug/kg, 500 ug/kg-1 mg/kg, 1 mg/kg-50 mg/kg, 50 mg/kg-100 mg/kg, 100 mg/kg-500 mg/kg (body weight of recipient), although a lower or higher dosage may be administered. Dosages as low as about 1.0

mg/kg may be expected to show some efficacy. Preferably, about 5 mg/kg is an acceptable dosage, although dosage levels up to about 50 mg/kg are also preferred especially for therapeutic use. Alternatively, administration of a specific amount of the antibody may be given which is not based upon the weight of the patient such as an amount in the range of 1 ug-100 ug, 1 mg-100 mg, or 1 gm-100 gm. For example, site specific administration may be to body compartment or cavity such as intrarticular, intrabronchial, intraabdominal, intracapsular, intracartilaginous, intracavitary, intracelial, intracelebellar, intracerebroventricular, intracolic, intracervical, intragastric, intrahepatic, intramyocardial, intraosteal, intrapelvic, intrapericardiac, intraperitoneal, intrapleural, intraprostatic, intrapulmonary, intrarectal, intrarenal, intraretinal, intraspinal, intrasynovial, intrathoracic, intrauterine, intravesical, intralesional, vaginal, rectal, buccal, sublingual, intranasal, or transdermal means.

[00113] The antibody compositions described herein can be prepared for use for parenteral (subcutaneous, intramuscular or intravenous) or any other administration particularly in the form of liquid solutions or suspensions. The formulation can also be suitable for an injectable formulation. In some embodiments, the injectable formulation is sterile. In some embodiments, the injectable formulation is pyrogen free. In some embodiments, the formulation is free of other antibodies that bind to other antigens other than an antigen described herein.

[00114] An antibody, capable treating a condition associated with Claudin 6 activity or use to treat a Claudin 6 related pathology, is intended to be provided to subjects in an amount sufficient to affect a reduction, resolution, or amelioration in the Claudin 6 related symptom or pathology. Such a pathology includes benign or metastatic cancer, for example, ovarian cancer (*e.g.*, ovarian carcinoma), reproductive cancer (breast, cervical, testicular, uterine, or placental cancer), lung cancer, gastric cancer, hepatic cancer, pancreatic cancer, bile duct cancer, cancer of the urinary bladder, kidney cancer, colon cancer, small bowel cancer, skin cancer, head and neck cancer, sarcoma, or germ cell tumor, in a subject.

[00115] An amount is said to be sufficient or a "therapeutically effective amount" to "affect" the reduction of symptoms if the dosage, route of administration, and dosing schedule of the agent are sufficient to influence such a response. Responses to antibody administration can be measured by analysis of subject's affected tissues, organs, or cells as by imaging techniques or by ex vivo analysis of tissue samples. An agent is physiologically significant if its presence

results in a detectable change in the physiology of a recipient patient. In some embodiments, an amount is a therapeutically effective amount if it is an amount that can be used to treat, ameliorate or prevent benign and metastatic forms of cancer, for example, ovarian cancer (*e.g.*, ovarian carcinomas), reproductive cancers (breast, cervical, testicular, uterine, and placental cancers), lung cancer, gastric cancer, hepatic cancer, pancreatic cancer, bile duct cancer, cancer of the urinary bladder, kidney cancer, colon cancer, small bowel cancer, skin cancer, head and neck cancer, sarcoma, and germ cell tumors, by, for example, but not limited to modulating Claudin 6 function, Claudin 6-mediated regulation of the tight junction integrity, and the like. In some embodiments, the antibody or the therapeutic does not bind to other claudin proteins, such as but not limited to claudin 9, claudin 3, and/or claudin 4. In some embodiments, the antibody is specific for Claudin 6.

[00116] The antibodies can be formulated according to known methods to prepare pharmaceutically useful compositions, whereby these materials, or their functional derivatives, are combined in admixture with a pharmaceutically acceptable carrier vehicle. The treatment may be given in a single dose schedule, or a multiple dose schedule in which a primary course of treatment may be with 1-10 separate doses, followed by other doses given at subsequent time intervals required to maintain and or reinforce the response, for example, at 1-4 months for a second dose, and if needed, a subsequent dose(s) after several months. Examples of suitable treatment schedules include: (i) 0, 1 month and 6 months, (ii) 0, 7 days and 1 month, (iii) 0 and 1 month, (iv) 0 and 6 months, or other schedules sufficient to elicit the desired responses expected to reduce disease symptoms, or reduce severity of disease.

[00117] Kits are also provided which are useful for carrying out embodiments described herein. The present kits comprise a first container containing or packaged in association with the above-described antibodies. The kit may also comprise another container containing or packaged in association solutions necessary or convenient for carrying out the embodiments. The containers can be made of glass, plastic or foil and can be a vial, bottle, pouch, tube, bag, etc. The kit may also contain written information, such as procedures for carrying out the embodiments or analytical information, such as the amount of reagent contained in the first container means. The container may be in another container apparatus, e.g. a box or a bag, along with the written information.

[00118] Yet another aspect provided for herein is a kit for detecting Claudin 6 protein in a biological sample. The kit includes a container holding one or more antibodies which binds an epitope of Claudin 6 protein and instructions for using the antibody for the purpose of binding to Claudin 6 protein to form an immunological complex and detecting the formation of the immunological complex such that the presence or absence of the immunological complex correlates with presence or absence of Claudin 6 protein in the sample. Examples of containers include multiwell plates which allow simultaneous detection of Claudin 6 protein in multiple samples.

[00119] In some embodiments, antibodies that bind to a Claudin 6 protein are provided. In some embodiments, antibodies, such as a monoclonal antibody or ScFv, that bind to an epitope on Claudin 6 whose binding residues include T33, N38, D68, P74, D76, D146, V152, A153, E154, Q156, R158, or any combination thereof, are provided. In some embodiments, the antibody binds to an epitope on Claudin 6 that includes residues E48, D68, P74, D76, and R158 of Claudin 6. In some embodiments, the antibody binds to an epitope on Claudin 6 that includes residues T33, N38, E48, D76, A153, E154, Q156, and R158 of Claudin 6. In some embodiments, the antibody binds to an epitope of Claudin 6 that includes residues N38, E48, Y67, P74, D76, D146, V152, E154, Q156, and R158 on Claudin 6. In some embodiments, the antibody binds to an epitope of Claudin 6 that includes residues E48, Y67, Q156, and R158 of Claudin 6. In some embodiments, the antibody binds to an epitope of Claudin 6 that includes residue Q156.

[00120] In some embodiments, the antibody is isolated. In some embodiments, the antibody binds specifically. In some embodiments, the antibody binds to a Claudin 6 protein that is properly folded. In some embodiments, the antibody binds to a Claudin 6 protein in a cell membrane. In some embodiments, the antibody binds to a Claudin 6 protein that is in a cell membrane in an intact cell. In some embodiments, the antibody inhibits or neutralizes the function of a Claudin 6 protein. As used herein, the term "neutralize" means that the activity or function of the protein is inhibited. In some embodiments, the antibody inhibits regulation of the tight junction integrity by Claudin 6. In some embodiments, the antibody is used as a targeting moiety to deliver another therapeutic to the cells expressing (*e.g.* tumor cells) to Claudin 6. In some embodiments, the claudin 6 antibody is part of a multi-specific therapeutic where one part of the molecule binds to Claudin 6 and another part of the therapeutic binds to another target. In

some embodiments, the other part is CD3 binding molecule (*e.g.* CD3 antibody) or another molecule that facilitates ADC, ADCC, or CAR-T therapy. The inhibition can be complete or partial. In some embodiments, the activity or function of the protein is inhibited at least 10, 20, 30, 40, 50, 60, 70, 80, 90, 95, or 99%. The percent inhibition can be based upon the function or activity of the protein in the absence of the antibody. In some embodiments, the antibody inhibits the interactions or functions facilitated by Claudin 6.

[00121] In some embodiments, the antibody comprises a sequence as provided for herein or antigen binding fragment thereof. In some embodiments, the antibody comprises a heavy chain CDR or an antigen binding fragment thereof described herein. The heavy chain may be one or more of the heavy chains described herein. In some embodiments, the antibody comprises a light chain, or an antigen binding fragment thereof as described herein.

[00122] In some embodiments, methods of treating, inhibiting or ameliorating a Claudin 6, associated pathology are provided. In some embodiments, the methods comprise administering an antibody described herein or a pharmaceutical composition described herein to a subject to treat, inhibit or ameliorate a Claudin 6 associated pathology. In some embodiments, the pathology is benign or metastatic cancer, for example, ovarian cancer (*e.g.*, ovarian carcinoma), reproductive cancer (breast, cervical, testicular, uterine, endometrial, or placental cancer), lung cancer, gastric cancer, stomach cancer, hepatic cancer, pancreatic cancer, bile duct cancer, cancer of the urinary bladder, kidney cancer, colon cancer, small bowel cancer, lung cancer (e.g. lung adenocarcinoma), skin cancer, head and neck cancer, sarcoma, or germ cell tumor.

[00123] In some embodiments, the antibodies provided herein are administered to the subject as nucleic acid molecule encoding the antibody. In some embodiments, the nucleic acid molecule is a DNA molecule, RNA, or mRNA molecule encoding the antibody. The nucleic acid molecule can be delivered in any form suitable for expression *in vivo*, such as a viral vector, plasmid, linear nucleic acid molecule, and the like. In some embodiments, the antibody produced by the nucleic acid molecule can function as a vaccine or circulating antibody that is used to identify and kill cells that express Claudin 6. The expression of the antibdoy can be prolonged or controlled expression that is stimulated. Without being bound to any thoery, in some embodimetns, a subject that develops cancer that expresses Claudin 6 would be treated by the circulating antibody that would recognize the cancer cell. Thus, in some embodiments, the

antibody being delivered by a nucleic acid molecule can be used ot treat or prevent the growth of the cancer. In some embodiments, the nucleic acid molecule encoding the antibody is integrated into the genome of a cell of the subject so that the expression is persistent. Examples of viral vectors that could be used include, but are not limited to, AAV, AV, retrorival vectors that integrate intot the genome, and the like.

[00124] In some embodiments, methods of detecting the presence or absence of a Claudin 6 in a sample are provided, the method comprising contacting a sample with one or more antibodies described herein detecting the binding to a Claudin 6 antigen by the antibody. In some embodiments, the detection of the binding indicates the presence Claudin 6 antigen; or the absence of the detection of the binding to the Claudin 6 antigen indicates the absence of the Claudin 6 antigen. The detecting can be done with any known method, such as using a biosensor, ELISA, sandwich assay, and the like. However, in some embodiments, the method comprises detecting the presence of the protein in non-denaturing conditions. The non-denaturing conditions can be used so that the protein of interest is detected in its native, or properly folded form.

[00125] In some embodiments, methods of identifying a test antibody that binds to an epitope on Claudin 6 protein, are provided, the method comprising contacting a test antibody with the epitope on Claudin 6 protein and determining whether the test antibody binds to the epitope. In some embodiments, the determining comprises determining whether the test antibody binds to the protein and is competitively inhibited by an antibody comprising a sequence as provided herein. In some embodiments, the determining comprises mutating one or more residues of epitope or protein and determining binding of the test antibody to the mutated epitope, wherein if the mutation reduces binding of the test antibody as compared to the non-mutated epitope, the test antibody is deemed to bind to that epitope.

[00126] In some embodiments, methods of inducing an immune response against a Claudin 6 antigen are provided, the methods comprising administering a Claudin 6 antigen to a subject under conditions sufficient to induce an immune response. In some embodiments, the Claudin 6 antigen is delivered as a nucleic acid molecule encoding the Claudin 6 antigen. As discussed herein, in some embodiments, the methods comprise administering a lipoparticle comprising a Claudin 6 antigen to the subject to induce the immune response. In some

embodiments, antibodies produced by the immune response are isolated. The antibodies can then be cloned, isolated and/or otherwise modified as described herein. In some embodiments, the subject is a chicken.

[00127] In some of the embodiments of the methods provided herein, the antibody is any antibody or fragment thereof as provided herein.

[00128] In some embodiments, the antibody comprises a V_H and a V_L sequence as forth in the following table:

IM Ab ID	V_H	V_L
136	AVTLDESGGGLQTPGGVLSLVCKASGFSFSSY DMGWVRQAPGKGLEWVASIYSSASSTYYAPA VKGRATITRDNGQSTVRLQLNNLRAEDTGTY YCAKAAGRTYRGWATYIADSIDAWGHGTEVI VSS (SEQ ID NO: 2)	ALTQPSSVSANPGESVEITCSGDSSWYGYGW YQQKSPGSAPVTLIYESGKRPSDIPSRFSGSTS GSTATLTITGVQADDEAVYYCGSADSNSIGIF GAGTTLTVL (SEQ ID NO: 3)
171	AVTLDESGGGLQTPGGALSLVCKASGFDFSSY AMNWVRQAPGKGLEWVAGIGSTGSSTGYGP AVKGRATISRDNGQSTLRLQLNNLRAEDTAIY YCAKSVGNGNSWSGYIATSIDAWGHGTEVIVS S (SEQ ID NO: 4)	ALTQPSSVSANLGGTVKLTCSGGSSGYGWY QQKSPGSAPVTVIYSNDKRPSDIPSRFSGSLS GSTGTLTITGVQADDEAVYFCGSTDNSYVGI FGAGTTLTVL (SEQ ID NO: 5)
172	AVTLDESGGGLQTPGGALSLVCKGSGFSISSYT MQWVRQAPGKGLEWVAGIYSGSRTYYGAAV QGRATISRDNGQSTVRLQLNNLRAEDTGTYY CAKSSYCTAWTGCDVYAGGSIDAWGHGTEVI VSS (SEQ ID NO: 6)	ALTQPSSVSATPGGTVEITCSGDSSDDGSYY YGWYQQKSPGSAPVTVIYSNDKRPSSIPSRFS GSASGSTATLTITGVQADDEAVYFCGSYDSS TGIFGAGTTLTVL (SEQ ID NO: 7)
173	AVTLDESGGGLQTPGGALSLVCKASGFTFSSY SMFWVRRAPGKGLEWVAGIDSGSTTFYGSAV KGRATISRDNGQSTVRLQLNNLRAEDTATYY CAKDAYGYCGWSGCSADSIDAWGHGTEVIVS S (SEQ ID NO: 8)	ALTQPSSVSANPGGTVEITCSGGNNYYGWY QQKSPGSAPVTVIYYNDKRPSDIPSRFSGSKS GSTGTLTITGVQADDEAVYFCGGWDSSGGIF GAGTTLTVL (SEQ ID NO: 9)
179	EVQLLESGGGLVQPGGSLRLSCAASGFSFSSY DMGWVRQAPGKGLEWVASIYSSASSTYYADS VKGRFTISRDNSKNTLYLQMNSLRAEDTAVY YCAKAAGRTYRGWATYIADSIDAWGQGTLVT VSS (SEQ ID NO: 10)	SYELTQPPSVSVSPGQTARITCSGDSSWYGY GWYQQKPGQAPVLVIYESGKRPSGIPERFSG SSSGTTVTLTISGVQAEDEADYYCGSADSNSI GIFGGGTKLTVL (SEQ ID NO: 11)
180	EVQLLESGGGLVQPGGSLRLSCAASGFDFSSY AMNWVRQAPGKGLEWVAGIGSTGSSTGYAD SVKGRFTISRDNSKNTLYLQMNSLRAEDTAVY YCAKSVGNGNSWSGYIATSIDAWGQGTLVTV SS (SEQ ID NO: 12)	SYELTQPPSVSVSPGQTARITCSGGSSGYGW YQQKPGQAPVLVIYSNDKRPSGIPERFSGSSS GTTVTLTISGVQAEDEADYYCGSTDNSYVGI FGGGTKLTVL (SEQ ID NO: 13)
181	EVQLLESGGGLVQPGGSLRLSCAASGFSISSYT MQWVRQAPGKGLEWVAGIYSGSRTYYADSV KGRFTISRDNSKNTLYLQMNSLRAEDTAVYY CAKSSYCTAWTGCDVYAGGSIDAWGQGTLV TVSS (SEQ ID NO: 14)	SYELTQPPSVSVSPGQTARITCSGDDGSYYY GWYQQKPGQAPVLVIYSNDKRPSGIPERFSG SSSGTTVTLTISGVQAEDEADYYCGSYDSST GIFGGGTKLTVL (SEQ ID NO: 15)
182	EVQLLESGGGLVQPGGSLRLSCAASGFTFSSYS MFWVRQAPGKGLEWVAGIDSGSTTFYADSVK GRFTISRDNSKNTLYLQMNSLRAEDTAVYYC AKDAYGYCGWSGCSADSIDAWGQGTLVTVSS	SYELTQPPSVSVSPGQTARITCSGGNNYYGW YQQKPGQAPVLVIYYNDKRPSGIPERFSGSSS GTTVTLTISGVQAEDEADYYCGGWDSSGGIF GGGTKLTVL (SEQ ID NO: 17)

	(SEQ ID NO: 16)	
271	EVQLLESGGGLVQPGGSLRLSCAASGFTFSSY AMSWVRQAPGKGLEWVAGISSSGRYTGYADS VKGRFTISRDNSKNTLYLQMNSLRAEDTAVY YCAKSVGNGNSWSGYIATSIDAWGQGTLVTV SS (SEQ ID NO: 18)	SYELTQPPSVSVSPGQTARITCSGGSGSYGW YQQKPGQAPVLVIYGTNKRPSGIPERFSGSSS GTTVTLTISGVQAEDEADYYCGSADSSTNAG IFGGGTKLTVL (SEQ ID NO: 19)
272	EVQLLESGGGLVQPGGSLRLSCAASGFTFSSY AMNWVRQAPGKGLEWVAGISSSGRYTGYAD SVKGRFTISRDNSKNTLYLQMNSLRAEDTAVY YCAKSVGNGNSWSGYIATSIDAWGQGTLVTV SS (SEQ ID NO: 20)	SYELTQPPSVSVSPGQTARITCSGGSGSYGW YQQKPGQAPVTVIYGTNKRPSGIPERFSGSSS GTTVTLTISGVQAEDEADYYCGSADSSTNAG IFGGGTKLTVL (SEQ ID NO: 21)
CH-HAMF5-1HAQ	EVQLLESGGGLVQPGGSLRLSCAASGFTFSSY AMSWVRQAPGKGLEWVAGISSSGRYTGYADS VKGRFTISRDNSKNTLYLQMNSLRAEDTAVY YCAKSVGNGNSWSGYVATSIDAWGQGTLVT VSS (SEQ ID NO: 103)	SYELTQPPSVSVSPGQTARITCSGGSGSYGW YQQKPGQAPVLVIYGTNKRPSGIPERFSGSSS GTTVTLTISGVQAEDEADYYCGSADSSTNAG IFGGGTKLTVL (SEQ ID NO: 104)
CH-HAMF5-1HBF	EVQLLESGGGLVQPGGSLRLSCAASGFTFSSY AMNWVRQAPGKGLEWVAGISSSGRYTGYAD SVKGRFTISRDNSKNTLYLQMNSLRAEDTAVY YCAKSVGSGVSWSGYVATSIDAWGQGTLVTV SS (SEQ ID NO: 105)	SYELTQPPSVSVSPGQTARITCSAGSGLYGW YQQKPGQAPVLVIYGTNKRPSGIPERFSGSSS GTTVTLTISGVQAEDEADYYCGSADSSTNAG IFGGGTKLTVL (SEQ ID NO: 106)
CH-HAMF5-1HBG	EVQLLESGGGLVQPGGSLRLSCAASGFTFSSY AMNWVRQAPGKGLEWVAGISSSGRYTGYAD SVKGRFTISRDNSKNTLYLQMNSLRAEDTAVY YCAKSMGSGVSWSGYVATSIDAWGQGTLVT VSS (SEQ ID NO: 107)	SYELTQPPSVSVSPGQTARITCSAGSGLYGW YQQKPGQAPVLVIYGTNKRPSGIPERFSGSSS GTTVTLTISGVQAEDEADYYCGSADSSTNAG IFGGGTKLTVL (SEQ ID NO: 108)
CH-HAMF5-1HFJ	EVQLLESGGGLVQPGGSLRLSCAASGFTFSSY AMNWVRQAPGKGLEWVAGISSSGRYTGYAD SVKGRFTISRDNSKNTLYLQMNSLRAEDTAVY YCAKSMGSGVSWSGYVATSIDVWGQGTLVT VSS (SEQ ID NO: 109)	SYELTQPPSVSVSPGQTARITCSAGSGLYGW YQQKPGQAPVLVIYGTNKRPSGIPERFSGSSS GTTVTLTISGVQAEDEADYYCGSADSSTNAG IFGGGTKLTVL (SEQ ID NO: 110)
CH-HAMF5-1HEP	EVQLLESGGGLVQPGGSLRLSCAASGFTFSSY AMNWVRQAPGKGLEWVAGISSSGRYTGYAD SVKGRFTISRDNSKNTLYLQMNSLRAEDTAVY YCAKSVGSGVSWSGYVATSLDAWGQGTLVT VSS (SEQ ID NO: 111)	SYELTQPPSVSVSPGQTARITCSAGSGLYGW YQQKPGQAPVLVIYGTNKRPSGIPERFSGSSS GTTVTLTISGVQAEDEADYYCGSADSSTNAG IFGGGTKLTVL (SEQ ID NO: 112)
CH-HAMF5-1HFB	EVQLLESGGGLVQPGGSLRLSCAASGFTFSSY AMNWVRQAPGKGLEWVAGISSSGRYTGYAD SVKGRFTISRDNSKNTLYLQMNSLRAEDTAVY YCAKSMGSGVSWSGYVATSIDAWGQGTLVT VSS (SEQ ID NO: 113)	SYELTQPPSVSVSPGQTARITCSGGSGSYGW YQQKPGQAPVLVIYGTYKRPSGIPERFSGSSS GTTVTLTISGVQAEDEADYYCGSADSSTNAG IFGGGTKLTVL (SEQ ID NO: 114)
CH-HAMF5-1HHR	EVQLLESGGGLVQPGGSLRLSCAASGFTFSSY AMNWVRQAPGKGLEWVAGISSSGRYTGYAD SVKGRFTISRDNSKNTLYLQMNSLRAEDTAVY YCAKSMGSGVSWSGYVATSLDVWGQGTLVT VSS (SEQ ID NO: 115)	SYELTQPPSVSVSPGQTARITCSGGSGSYGW YQQKPGQAPVLVIYGTYKRPSGIPERFSGSSS GTTVTLTISGVQAEDEADYYCGSADSSTNAG IFGGGTKLTVL (SEQ ID NO: 116)
CH-HAMF5-1HHP	EVQLLESGGGLVQPGGSLRLSCAASGFTFSSY AMNWVRQAPGKGLEWVAGISSSGRYTGYAD SVKGRFTISRDNSKNTLYLQMNSLRAEDTAVY YCAKSVGSGVSWSGYVATSLDVWGQGTLVT VSS (SEQ ID NO: 117)	SYELTQPPSVSVSPGQTARITCSGGSGSYGW YQQKPGQAPVLVIYGTYKRPSGIPERFSGSSS GTTVTLTISGVQAEDEADYYCGSADSSTNAG IFGGGTKLTVL (SEQ ID NO: 118)
CH-HAMF5-	EVQLLESGGGLVQPGGSLRLSCAASGFTFSSY AMNWVRQAPGKGLEWVAGISSSGRYTGYAD SVKGRFTISRDNSKNTLYLQMNSLRAEDTAVY	SYELTQPPSVSVSPGQTARITCSAGSGLYGW YQQKPGQAPVLVIYGTNKRPSGIPERFSGSSS GTTVTLTISGVQAEDEADYYCGSNDASTNA

1HGT	YCAKSVGSGVSWSGYVATSLDVWGQGTLVT VSS (SEQ ID NO: 119)	GIFGGGTKLTVL (SEQ ID NO: 120)
35-N1F09-1HA	EVQLLESGGGLVQPGGSLRLSCAASGFTFSSY GMSWVRQAPGKGLEWVAGIGSSGIYTHYADS VKGRFTISRDNSKNTLYLQMNSLRAEDTAVY YCAKSPGDSDWCGWAGYGIYSCRVAGFIDA WGQGTLVTVSS (SEQ ID NO: 121)	SYELTQPPSVSVSPGQTARITCSGGYNGHYG WYQQKPGQAPVLVIYGTNKRPSGIPERFSGS SSGTTVTLTISGVQAEDEADYYCGGYDSSAG IFGGGTKLTVL (SEQ ID NO: 122)
35-N2H07-1HA	EVQLLESGGGLVQPGGSLRLSCAASGFTFSGY AMSWVRQAPGKGLEWVAGIYSSGSYTFYADS VKGRFTISRDNSKNTLYLQMNSLRAEDTAVY YCAKGTGYCDWSGWCYSGAANIDAWGQGTL VTVSS (SEQ ID NO: 123)	SYELTQPPSVSVSPGQTARITCSGGSGSYGYY GWYQQKPGQAPVLVIYGTNKRPSGIPERFSG SSSGTTVTLTISGVQAEDEADYYCGSEDSSS GAGIFGGGTKLTVL (SEQ ID NO: 124)

[00129] As provided herein, variants of any of the sequences described herein are also provided for. For example, in some embodiments, peptides that are at least, or about, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, or 99% are also provided. In some embodiments, the a protein comprising a sequence that is at least, or about, 60%, 70%, 80%, 85%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, or 99% identical to such sequences disclosed herein are provided. In some embodiments, the sequences or variants have 1, 2, 3, 4, 5, 6, 7, 8, or 9 substitutions as compared to the sequences provided for herein. In some embodiments, the substitution is a conservative substitution. In some embodiments, the mutation or substitution is in the framework region of the light chain or the heavy chain. In some embodiments, the substitution is in the CDR regions, such as CDR1, CDR2, or CDR3. In some embodiments, the mutation or substitution is in CDR1 and not in CDR2 or CDR3. In some embodiments, the heavy chain comprises substitutions or changes in the framework region and not in the CDR regions as provided herein. In some embodiments, the heavy chain proteins are provided wherein the sequence is at least, or about 50%, 60%, 70%, 80%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, or 99% identical to SEQ ID NO: 2, SEQ ID NO: 4, SEQ ID NO: 6, SEQ ID NO: 8, SEQ ID NO: 10, SEQ ID NO: 12, SEQ ID NO: 14, SEQ ID NO: 16, SEQ ID NO: 18, SEQ ID NO: 20, SEQ ID NO: 103, SEQ ID NO: 105, SEQ ID NO: 107, SEQ ID NO: 109, SEQ ID NO: 111, SEQ ID NO: 113, SEQ ID NO: 115, SEQ ID NO: 117, SEQ ID NO: 119, SEQ ID NO: 121, SEQ ID NO: 123, provided that the sequence comprises a first amino acid sequence or a first CDR selected from the group consisting of: SEQ ID NOs: 25, 31, 37, 43, 53, 55, 56, 62, 71, 76, 80, 90, 95, 139, 141, 143, or 145; a second amino acid sequence or second CDR selected from the group consisting of: 26, 32, 38, 44, 46, 48, 49, 54, 125, 72, 77, 81, 86, 91, 96, 101, 102, 140, 142, 144, or 146; and a third amino acid sequence or third CDR selected from the group

consisting of: 27, 33, 39, 45, 57, 61, 63, 65, 66, 67, 126, 69, 73, 82, 57, 92, or 97. Thus, in some embodiments, the CDRs of the heavy chains are not variants of those provided herein.

[00130] In some embodiments, the antibody comprises a V_H chain comprising the sequence of SEQ ID NO: 2, SEQ ID NO: 4, SEQ ID NO: 6, SEQ ID NO: 8, SEQ ID NO: 10, SEQ ID NO: 12, SEQ ID NO: 14, SEQ ID NO: 16, SEQ ID NO: 18, SEQ ID NO: 20, SEQ ID NO: 103, SEQ ID NO: 105, SEQ ID NO: 107, SEQ ID NO: 109, SEQ ID NO: 111, SEQ ID NO: 113, SEQ ID NO: 115, SEQ ID NO: 117, SEQ ID NO: 119, SEQ ID NO: 121, or SEQ ID NO: 123, or a variant thereof.

[00131] In some embodiments, the light chain proteins are provided wherein the sequence is at least, or about 50%, 60%, 70%, 80%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, or 99% identical to SEQ ID NO: 3, SEQ ID NO: 5, SEQ ID NO: 7, SEQ ID NO: 9, SEQ ID NO: 11, SEQ ID NO: 13, SEQ ID NO: 15, SEQ ID NO: 17, SEQ ID NO: 19, SEQ ID NO: 21, SEQ ID NO: 104, SEQ ID NO: 106, SEQ ID NO: 108, SEQ ID NO: 110, SEQ ID NO: 112, SEQ ID NO: 114, SEQ ID NO: 116, SEQ ID NO: 118, SEQ ID NO: 120, SEQ ID NO: 122, or SEQ ID NO: 124, provided that the sequence comprise a first amino acid sequence or a first CDR selected from the group consisting of: SEQ ID NOs: 22, 28, 34, 40, 47, 50, 58, 64, 74, 83, 87, 93, or 98; a second amino acid sequence or second CDR selected from the group consisting of: 23, 29, 41, 51, 59, 68, 84, 88, or 99; and a third amino acid sequence or third CDR selected from the group consisting of: 24, 30, 36, 42, 52, 60, 70, 75, 79, 85, 89, 94. Thus, in some embodiments, the CDRs of the heavy chains are not variants of those provided herein.

[00132] In some embodiments, the antibody comprises a V_L chain comprising the sequence of SEQ ID NO: 3, SEQ ID NO: 5, SEQ ID NO: 7, SEQ ID NO: 9, SEQ ID NO: 11, SEQ ID NO: 13, SEQ ID NO: 15, SEQ ID NO: 17, SEQ ID NO: 19, SEQ ID NO: 21, SEQ ID NO: 104, SEQ ID NO: 106, SEQ ID NO: 108, SEQ ID NO: 110, SEQ ID NO: 112, SEQ ID NO: 114, SEQ ID NO: 116, SEQ ID NO: 118, SEQ ID NO: 120, SEQ ID NO: 122, or SEQ ID NO: 124, or a variant thereof.

[00133] In some embodiments, the antibody comprises a V_H and a V_L chain comprising the sequence of SEQ ID NO: 2 and SEQ ID NO: 3, SEQ ID NO: 4 and SEQ ID NO: 5, SEQ ID NO: 6 and SEQ ID NO: 7, SEQ ID NO: 8 and SEQ ID NO: 9, SEQ ID NO: 10 and SEQ ID NO: 11, SEQ ID NO: 12 and SEQ ID NO: 13, SEQ ID NO: 14 and SEQ ID NO: 15, SEQ ID NO: 16

and SEQ ID NO: 17, SEQ ID NO: 18 and SEQ ID NO: 19, SEQ ID NO: 20 and SEQ ID NO: 21, SEQ ID NO: 103 and SEQ ID NO: 104, SEQ ID NO: 105 and SEQ ID NO: 106, SEQ ID NO: 107 and SEQ ID NO: 108, SEQ ID NO: 109 and SEQ ID NO: 110, SEQ ID NO: 111 and SEQ ID NO: 112, SEQ ID NO: 113 and SEQ ID NO: 114, SEQ ID NO: 115 and SEQ ID NO: 116, SEQ ID NO: 117 and SEQ ID NO: 118, SEQ ID NO: 119 and SEQ ID NO: 120, SEQ ID NO: 121 and SEQ ID NO: 122, or SEQ ID NO: 123 and SEQ ID NO: 123.

[00134] In some embodiments, the sequence is at least 80, 85, 90, 91 , 92, 93, 94, 95, 96, 97, 98, or 99% homologous or identical to the sequence provided herein, which includes the V_H, V_L, and/or CDR sequences provided for herein. The sequences can also be a variant if it has 1, 2, 3, 4, 5, 6, 7, 8, or 9 substitutions, deletions, or insertions. In some embodiments, the substitution (mutation) is a conservative substitution.

[00135] In some embodiments, the CDRs of the peptides or antibodies are as follows:

ID#	LCDR1	LCDR2	LCDR3	HCDR1	HCDR2	HCDR3
136	CSGDSS WYGYG (SEQ ID NO: 22)	IYESGK RP (SEQ ID NO: 23)	CGSADSNSIGI F (SEQ ID NO: 24)	GFSFSSYDMGWV (SEQ ID NO: 25)	VASIYSSASSTYYA (SEQ ID NO: 26)	CAKAAGRTYRGWAT YIADSIDA (SEQ ID NO: 27)
171	CSGGSS GYG (SEQ ID NO: 28)	IYSNDK RP (SEQ ID NO: 29)	CGSTDNSYVG IF (SEQ ID NO: 30)	GFDFSSYAMNW V (SEQ ID NO: 31)	VAGIGSTGSSTGYG (SEQ ID NO: 32)	CAKSVGNGNSWSGYI ATSIDA (SEQ ID NO: 33)
172	CSGDSS DDGSY YYG (SEQ ID NO: 34)	IYSNDK RP (SEQ ID NO: 29)	CGSYDSSTGIF (SEQ ID NO: 36)	GFSISSYTMQWV (SEQ ID NO: 37)	VAGIYSGSRTYYG (SEQ ID NO: 38)	CAKSSYCTAWTGCD VYAGGSIDA (SEQ ID NO: 39)
173	CSGGN NYYG (SEQ ID NO: 40)	IYYNDK RP (SEQ ID NO: 41)	CGGWDSSGGI F (SEQ ID NO: 42)	GFTFSSYSMFWV (SEQ ID NO: 43)	VAGIDSGSTTFYG (SEQ ID NO: 44)	CAKDAYGYCGWSGC SADSIDA (SEQ ID NO: 45)
179	CSGDSS WYGYG (SEQ ID NO: 22)	IYESGK RP (SEQ ID NO: 23)	CGSADSNSIGI F (SEQ ID NO: 24)	GFSFSSYDMGWV (SEQ ID NO: 25)	VASIYSSASSTYYA (SEQ ID NO: 26)	CAKAAGRTYRGWAT YIADSIDA (SEQ ID NO: 27)
55	CSGGSS GYG (SEQ ID NO: 28)	IYSNDK RP (SEQ ID NO: 29)	CGSTDNSYVG IF (SEQ ID NO: 30)	GFDFSSYAMNW V (SEQ ID NO: 31)	VAGIGSTGSSTGYA (SEQ ID NO: 46)	CAKSVGNGNSWSGYI ATSIDA (SEQ ID NO: 33)
181	CSGDD GSYYY G (SEQ ID NO: 47)	IYSNDK RP (SEQ ID NO: 29)	CGSYDSSTGIF (SEQ ID NO: 36)	GFSISSYTMQWV (SEQ ID NO: 37)	VAGIYSGSRTYYA (SEQ ID NO: 48)	CAKSSYCTAWTGCD VYAGGSIDA (SEQ ID NO: 39)
182	CSGGN NYYG (SEQ ID NO: 40)	IYYNDK RP (SEQ ID NO: 41)	CGGWDSSGGI F (SEQ ID NO: 42)	GFTFSSYSMFWV (SEQ ID NO: 43)	VAGIDSGSTTFYA (SEQ ID NO: 49)	CAKDAYGYCGWSGC SADSIDA (SEQ ID NO: 45)
271	CSGGSG	IYGTNK	CGSADSSTNA	GFTFSSYAMSWV	VAGISSSGRYTGYA	CAKSVGNGNSWSGYI

	SYG (SEQ ID NO: 50)	RP (SEQ ID NO: 51)	GIF (SEQ ID NO: 52)	(SEQ ID NO: 53)	(SEQ ID NO: 54)	ATSIDA (SEQ ID NO: 33)
272	CSGGSG SYG (SEQ ID NO: 50)	IYGTNK RP (SEQ ID NO: 51)	CGSADSSTNA GIF (SEQ ID NO: 52)	GFTFSSYAMNWV (SEQ ID NO: 55)	VAGISSSGRYTGYA (SEQ ID NO: 54)	CAKSVGNGNSWSGYI ATSIDA (SEQ ID NO: 33)

[00136] In some embodiments, the CDRs of the peptides or antibodies are as follows:

ID#	HCDR1	HCDR2	HCDR3	LCDR1	LCDR2	LCDR3
VH-CH-HAMF5-1HU	SYAMS (SEQ ID NO: 56)	GISSSG RYTGYA DSVKG (SEQ ID NO: 125)	SVGNGNSWSG YIATSIDA (SEQ ID NO: 57)	SGGSGSYG (SEQ ID NO: 58)	GTNKRPS (SEQ ID NO: 59)	GSADSSTNAGI (SEQ ID NO: 60)
VH-CH-HAMF5-1HAQ	SYAMS (SEQ ID NO: 56)	GISSSG RYTGYA DSVKG (SEQ ID NO: 125)	SVGNGNSWSG YVATSIDA (SEQ ID NO: 61)	SGGSGSYG (SEQ ID NO: 58)	GTNKRPS (SEQ ID NO: 59)	GSADSSTNAGI (SEQ ID NO: 60)
VH-CH-HAMF5-1HBF	SYAMN (SEQ ID NO: 62)	GISSSG RYTGYA DSVKG (SEQ ID NO: 125)	SVGSGVSWSG YVATSIDA (SEQ ID NO: 63)	SAGSGLYG (SEQ ID NO: 64)	GTNKRPS (SEQ ID NO: 59)	GSADSSTNAGI (SEQ ID NO: 60)
VH-CH-HAMF5-1HBG	SYAMN (SEQ ID NO: 62)	GISSSG RYTGYA DSVKG (SEQ ID NO: 125)	SMGSGVSWSG YVATSIDA (SEQ ID NO: 65)	SAGSGLYG (SEQ ID NO: 64)	GTNKRPS (SEQ ID NO: 59)	GSADSSTNAGI (SEQ ID NO: 60)
VH-CH-HAMF5-1HFJ	SYAMN (SEQ ID NO: 62)	GISSSG RYTGYA DSVKG (SEQ ID NO: 125)	SMGSGVSWSG YVATSIDV (SEQ ID NO: 66)	SAGSGLYG (SEQ ID NO: 64)	GTNKRPS (SEQ ID NO: 59)	GSADSSTNAGI (SEQ ID NO: 60)
VH-CH-HAMF5-1HEP	SYAMN (SEQ ID NO: 62)	GISSSG RYTGYA DSVKG (SEQ ID NO: 125)	SVGSGVSWSG YVATSLDA (SEQ ID NO: 67)	SAGSGLYG (SEQ ID NO: 64)	GTNKRPS (SEQ ID NO: 59)	GSADSSTNAGI (SEQ ID NO: 60)
VH-CH-HAMF5-1HFB	SYAMN (SEQ ID NO: 62)	GISSSG RYTGYA DSVKG (SEQ ID NO: 125)	SMGSGVSWSG YVATSIDA (SEQ ID NO: 65)	SGGSGSYG (SEQ ID NO: 58)	GTYKRPS (SEQ ID NO: 68)	GSADSSTNAGI (SEQ ID NO: 60)
VH-CH-	SYAMN (SEQ	GISSSG RYTGYA	SMGSGVSWSG YVATSLDV	SGGSGSYG (SEQ ID NO:	GTYKRPS (SEQ ID NO: 68)	GSADSSTNAGI (SEQ ID NO: 60)

HAMF 5-1HHR	ID NO: 62)	DSVKG (SEQ ID NO: 125)	(SEQ ID NO: 126)	58)		
VH-CH-HAMF 5-1HHP	SYAMN (SEQ ID NO: 62)	GISSSG RYTGYA DSVKG (SEQ ID NO: 125)	SVGSGVSWSG YVATSLDV (SEQ ID NO: 69)	SGGSGSYG (SEQ ID NO: 58)	GTYKRPS (SEQ ID NO: 68)	GSADSSTNAGI (SEQ ID NO: 60)
VH-CH-HAMF 5-1HGT	SYAMN (SEQ ID NO: 62)	GISSSG RYTGYA DSVKG (SEQ ID NO: 125)	SVGSGVSWSG YVATSLDV (SEQ ID NO: 69)	SAGSGLYG (SEQ ID NO: 64)	GTNKRPS (SEQ ID NO: 59)	GSNDASTNAGI (SEQ ID NO: 70)
VH-35-N1F0 9-1HA	SYGMS (SEQ ID NO: 71)	GIGSSG IYTHYA DSVKG (SEQ ID NO: 72)	SPGDSDWCGW AGYGIYSCRV AGFIDA (SEQ ID NO: 73)	SGGYNGHYG (SEQ ID NO: 74)	GTNKRPS (SEQ ID NO: 59)	GGYDSSAGI (SEQ ID NO: 75)
VH-35-N2H0 7-1HA	GYAMS (SEQ ID NO: 76)	GIYSSG SYTFYA DSVKG (SEQ ID NO: 77)	GTGYCDWSGW CYSGAANIDA (SEQ ID NO: 78)	SGGSGSYG (SEQ ID NO: 58)	GTNKRPS (SEQ ID NO: 59)	GSEDSSSGAGI (SEQ ID NO: 79)
VH-30-08F1 2-1CA	SYDMG (SEQ ID NO: 80)	SIYSSA SSTYYA PAVKG (SEQ ID NO: 81)	AAGRTYRGWA TYIADSIDA (SEQ ID NO: 82)	SGDSSWYGYG (SEQ ID NO: 83)	ESGKRPS (SEQ ID NO: 84)	GSADSNSIGI (SEQ ID NO: 85)
VH-30-18G0 1-1CA	SYAMN (SEQ ID NO: 62)	GIGSTG SSTGYG PAVKG (SEQ ID NO: 86)	SVGNGNSWSG YIATSIDA (SEQ ID NO: 57)	SGGSSGYG (SEQ ID NO: 87)	SNDKRPS (SEQ ID NO: 88)	GSTDNSYVGI (SEQ ID NO: 89)
VH-30-19B0 6-1CA	SYTMQ (SEQ ID NO: 90)	GIYSGS RTYYGA AVQG (SEQ ID NO: 91)	SSYCTAWTGC DVYAGGSIDA (SEQ ID NO: 92)	SGDSSDDGSYYY G (SEQ ID NO: 93)	SNDKRPS (SEQ ID NO: 88)	GSYDSSTGI (SEQ ID NO: 94)
VH-30-20D1 0-1CA	SYSMF (SEQ ID NO: 95)	GIDSGS TTFYGS AVKG (SEQ ID NO: 96)	DAYGYCGWSG CSADSIDA (SEQ ID NO: 97)	SGGNNYYG (SEQ ID NO: 98)	YNDKRPS (SEQ ID NO: 99)	GGWDSSGGI (SEQ ID NO: 100)
VH-CHAM F5-	SYAMN (SEQ ID NO:	GISSSG RYTGYA DSVKG	SVGNGNSWSG YIATSIDA (SEQ ID	SGGSGSYG (SEQ ID NO: 58)	GTNKRPS (SEQ ID NO: 59)	GSADSSTNAGI (SEQ ID NO: 60)

1HQ	62)	(SEQ ID NO: 101)	NO: 57)			
30-18G01-1HA	SYAMN (SEQ ID NO: 62)	GIGSTGSSTGYADSVKG (SEQ ID NO: 102)	SVGNGNSWSGYIATSIDA (SEQ ID NO: 57)	SGGSSGYG (SEQ ID NO: 87)	SNDKRPS (SEQ ID NO: 88)	GSTDNSYVGI (SEQ ID NO: 89)

[00137] In some embodiments, the V_H chain comprises one or more CDRs selected from the tables provided herein or from the group consisting of: GFSFSSY (SEQ ID NO: 139); YSSASSTY (SEQ ID NO: 140); AAGRTYRGWATYIADSIDA (SEQ ID NO: 82); GFDFSSY (SEQ ID NO: 141); GSTGSS (SEQ ID NO: 142); SVGNGNSWSGYIATSIDA (SEQ ID NO: 57); GFSISSY (SEQ ID NO: 143); YSGSR (SEQ ID NO: 144); SSYCTAWTGCDVYAGGSIDA (SEQ ID NO: 92); GFTFSSY (SEQ ID NO: 145); DSGST (SEQ ID NO: 146); DAYGYCGWSGCSADSIDA (SEQ ID NO: 97); CSGDSSWYGYG (SEQ ID NO: 22); IYESGKRP (SEQ ID NO: 23); CGSADSNSIGIF (SEQ ID NO: 24); GFSFSSYDMGWV (SEQ ID NO: 25); VASIYSSASSTYYA (SEQ ID NO: 26); CAKAAGRTYRGWATYIADSIDA (SEQ ID NO: 27); CSGGSSGYG (SEQ ID NO: 28); IYSNDKRP (SEQ ID NO: 29); CGSTDNSYVGIF (SEQ ID NO: 30); GFDFSSYAMNWV (SEQ ID NO: 31); VAGIGSTGSSTGYG (SEQ ID NO: 32); CAKSVGNGNSWSGYIATSIDA (SEQ ID NO: 33); CSGDSSDDGSYYYG (SEQ ID NO: 34); IYSNDKRP (SEQ ID NO: 29); CGSYDSSTGIF (SEQ ID NO: 36); GFSISSYTMQWV (SEQ ID NO: 37); VAGIYSGSRTYYG (SEQ ID NO: 38); CAKSSYCTAWTGCDVYAGGSIDA (SEQ ID NO: 39); CSGGNNYYG (SEQ ID NO: 40); IYYNDKRP (SEQ ID NO: 41); CGGWDSSGGIF (SEQ ID NO: 42); GFTFSSYSMFWV (SEQ ID NO: 43); VAGIDSGSTTFYG (SEQ ID NO: 44); CAKDAYGYCGWSGCSADSIDA (SEQ ID NO: 45); CSGDSSWYGYG (SEQ ID NO: 22); IYESGKRP (SEQ ID NO: 23); CGSADSNSIGIF (SEQ ID NO: 24); GFSFSSYDMGWV (SEQ ID NO: 25); VASIYSSASSTYYA (SEQ ID NO: 26); CAKAAGRTYRGWATYIADSIDA (SEQ ID NO: 27); CSGGSSGYG (SEQ ID NO: 28); IYSNDKRP (SEQ ID NO: 29); CGSTDNSYVGIF (SEQ ID NO: 30); GFDFSSYAMNWV (SEQ ID NO: 31); VAGIGSTGSSTGYA (SEQ ID NO: 46); CAKSVGNGNSWSGYIATSIDA (SEQ ID NO: 33); CSGDDGSYYYG (SEQ ID NO: 47); IYSNDKRP (SEQ ID NO: 29); CGSYDSSTGIF (SEQ ID

NO: 36); GFSISSYTMQWV (SEQ ID NO: 37); VAGIYSGSRTYYA (SEQ ID NO: 48); CAKSSYCTAWTGCDVYAGGSIDA (SEQ ID NO: 39); CSGGNNYYG (SEQ ID NO: 40); IYYNDKRP (SEQ ID NO: 41); CGGWDSSGGIF (SEQ ID NO: 42); GFTFSSYSMFWV (SEQ ID NO: 43); VAGIDSGSTTFYA (SEQ ID NO: 49); CAKDAYGYCGWSGCSADSIDA (SEQ ID NO: 45); CSGGSGSYG (SEQ ID NO: 50); IYGTNKRP (SEQ ID NO: 51); CGSADSSTNAGIF (SEQ ID NO: 52); GFTFSSYAMSWV (SEQ ID NO: 53); VAGISSSGRYTGYA (SEQ ID NO: 54); CAKSVGNGNSWSGYIATSIDA (SEQ ID NO: 33); CSGGSGSYG (SEQ ID NO: 50); IYGTNKRP (SEQ ID NO: 51); CGSADSSTNAGIF (SEQ ID NO: 52); GFTFSSYAMNWV (SEQ ID NO: 55); VAGISSSGRYTGYA (SEQ ID NO: 54); CAKSVGNGNSWSGYIATSIDA (SEQ ID NO: 33), SYAMS (SEQ ID NO: 56); GISSSGRYTGYADSVKG (SEQ ID NO: 101); SVGNGNSWSGYIATSIDA (SEQ ID NO: 57); SVGNGNSWSGYVATSIDA (SEQ ID NO: 61); SYAMN (SEQ ID NO: 62); SVGSGVSWSGYVATSIDA (SEQ ID NO: 63); GISSSGRYTGYADSVKG (SEQ ID NO: 101); SMGSGVSWSGYVATSIDA (SEQ ID NO: 65); SMGSGVSWSGYVATSIDV (SEQ ID NO: 66); SVGSGVSWSGYVATSLDA (SEQ ID NO: 67); SMGSGVSWSGYVATSIDA (SEQ ID NO: 65); SMGSGVSWSGYVATSLDV (SEQ ID NO: 126); SVGSGVSWSGYVATSLDV (SEQ ID NO: 69); SVGSGVSWSGYVATSLDV (SEQ ID NO: 69); SYGMS (SEQ ID NO: 71); GIGSSGIYTHYADSVKG (SEQ ID NO: 72); SPGDSDWCGWAGYGIYSCRVAGFIDA (SEQ ID NO: 73); GYAMS (SEQ ID NO: 76); GIYSSGSYTFYADSVKG (SEQ ID NO: 77); GTGYCDWSGWCYSGAANIDA (SEQ ID NO: 78); SYDMG (SEQ ID NO: 80); SIYSSASSTYYAPAVKG (SEQ ID NO: 81); AAGRTYRGWATYIADSIDA (SEQ ID NO: 82); GIGSTGSSTGYGPAVKG (SEQ ID NO: 86); SVGNGNSWSGYIATSIDA (SEQ ID NO: 57); SYTMQ (SEQ ID NO: 90); GIYSGSRTYYGAAVQG (SEQ ID NO: 91); SSYCTAWTGCDVYAGGSIDA (SEQ ID NO: 92); SYSMF (SEQ ID NO: 95); GIDSGSTTFYGSAVKG (SEQ ID NO: 96); DAYGYCGWSGCSADSIDA (SEQ ID NO: 97); GISSSGRYTGYADSVKG (SEQ ID NO: 101); SVGNGNSWSGYIATSIDA (SEQ ID NO: 57); GIGSTGSSTGYADSVKG (SEQ ID NO: 102); or SVGNGNSWSGYIATSIDA (SEQ ID NO: 57).

[00138] In some embodiments, the V_H chain compries the CDRs of:

[00139] 1H. GFSFSSY (SEQ ID NO: 139); YSSASSTY (SEQ ID NO: 140); and AAGRTYRGWATYIADSIDA (SEQ ID NO: 82); or

[00140] 2H. GFDFSSY (SEQ ID NO: 141); GSTGSS (SEQ ID NO: 142); and SVGNGNSWSGYIATSIDA (SEQ ID NO: 57); or

[00141] 3H. GFSISSY (SEQ ID NO: 143); YSGSR (SEQ ID NO: 144); and SSYCTAWTGCDVYAGGSIDA (SEQ ID NO: 92); or

[00142] 4H. GFTFSSY (SEQ ID NO: 145); DSGST (SEQ ID NO: 146); and DAYGYCGWSGCSADSIDA (SEQ ID NO: 97); or

[00143] 5H. GFSFSSYDMGWV (SEQ ID NO: 25); VASIYSSASSTYYA (SEQ ID NO: 26); and CAKAAGRTYRGWATYIADSIDA (SEQ ID NO: 27); or

[00144] 6H. GFDFSSYAMNWV (SEQ ID NO: 31); VAGIGSTGSSTGYG (SEQ ID NO: 32); and CAKSVGNGNSWSGYIATSIDA (SEQ ID NO: 33); or

[00145] 7H. GFSISSYTMQWV (SEQ ID NO: 37); VAGIYSGSRTYYG (SEQ ID NO: 38); and CAKSSYCTAWTGCDVYAGGSIDA (SEQ ID NO: 39); or

[00146] 8H. GFTFSSYSMFWV (SEQ ID NO: 43); VAGIDSGSTTFYG (SEQ ID NO: 44); and CAKDAYGYCGWSGCSADSIDA (SEQ ID NO: 45); or

[00147] 9H. GFSFSSYDMGWV (SEQ ID NO: 25); VASIYSSASSTYYA (SEQ ID NO: 26); and CAKAAGRTYRGWATYIADSIDA (SEQ ID NO: 27); or

[00148] 10H. GFDFSSYAMNWV (SEQ ID NO: 31); VAGIGSTGSSTGYA (SEQ ID NO: 46); and CAKSVGNGNSWSGYIATSIDA (SEQ ID NO: 33); or

[00149] 11H. GFSISSYTMQWV (SEQ ID NO: 37); VAGIYSGSRTYYA (SEQ ID NO: 48); and CAKSSYCTAWTGCDVYAGGSIDA (SEQ ID NO: 39); or

[00150] 12H. GFTFSSYSMFWV (SEQ ID NO: 43); VAGIDSGSTTFYA (SEQ ID NO: 49); and CAKDAYGYCGWSGCSADSIDA (SEQ ID NO: 45); or

[00151] 13H. GFTFSSYAMSWV (SEQ ID NO: 53); VAGISSSGRYTGYA (SEQ ID NO: 54); and CAKSVGNGNSWSGYIATSIDA (SEQ ID NO: 33); or

[00152] 14H. GFTFSSYAMNWV (SEQ ID NO: 55); VAGISSSGRYTGYA (SEQ ID NO: 54); and CAKSVGNGNSWSGYIATSIDA (SEQ ID NO: 33); or

[00153] 15H. SYAMS (SEQ ID NO: 56); GISSSGRYTGYADSVKG (SEQ ID NO: 101); and SVGNGNSWSGYIATSIDA (SEQ ID NO: 57); or

[00154] 16H. SYAMS (SEQ ID NO: 56); GISSSGRYTGYADSVKG (SEQ ID NO: 101); and SVGNGNSWSGYVATSIDA (SEQ ID NO: 61); or

[00155] 17H. SYAMN (SEQ ID NO: 62); GISSSGRYTGYADSVKG (SEQ ID NO: 101); and SVGSGVSWSGYVATSIDA (SEQ ID NO: 63); or

[00156] 18H. SYAMN (SEQ ID NO: 62); GISSSGRYTGYADSVKG (SEQ ID NO: 101); and SMGSGVSWSGYVATSIDA (SEQ ID NO: 65); or

[00157] 19H. SYAMN (SEQ ID NO: 62); GISSSGRYTGYADSVKG (SEQ ID NO: 101); and SMGSGVSWSGYVATSIDV (SEQ ID NO: 66); or

[00158] 20H. SYAMN (SEQ ID NO: 62); GISSSGRYTGYADSVKG (SEQ ID NO: 101); and SVGSGVSWSGYVATSLDA (SEQ ID NO: 67); or

[00159] 21H. SYAMN (SEQ ID NO: 62); GISSSGRYTGYADSVKG (SEQ ID NO: 101); and SMGSGVSWSGYVATSIDA (SEQ ID NO: 65); or

[00160] 22H. SYAMN (SEQ ID NO: 62); GISSSGRYTGYADSVKG (SEQ ID NO: 101); and SMGSGVSWSGYVATSLDV (SEQ ID NO: 126); or

[00161] 23H. SYAMN (SEQ ID NO: 62); GISSSGRYTGYADSVKG (SEQ ID NO: 101); and SVGSGVSWSGYVATSLDV (SEQ ID NO: 69); or

[00162] 24H. SYAMN (SEQ ID NO: 62); GISSSGRYTGYADSVKG (SEQ ID NO: 101); and SVGSGVSWSGYVATSLDV (SEQ ID NO: 69); or

[00163] 25H. SYGMS (SEQ ID NO: 71); GIGSSGIYTHYADSVKG (SEQ ID NO: 72); and SPGDSDWCGWAGYGIYSCRVAGFIDA (SEQ ID NO: 73); or

[00164] 26H. GYAMS (SEQ ID NO: 76); GIYSSGSYTFYADSVKG (SEQ ID NO: 77); and GTGYCDWSGWCYSGAANIDA (SEQ ID NO: 78); or

[00165] 27H. SYDMG (SEQ ID NO: 80); SIYSSASSTYYAPAVKG (SEQ ID NO: 81); and AAGRTYRGWATYIADSIDA (SEQ ID NO: 82); or

[00166] 28H. SYAMN (SEQ ID NO: 62); GIGSTGSSTGYGPAVKG (SEQ ID NO: 86); and SVGNGNSWSGYIATSIDA (SEQ ID NO: 57); or

[00167] 29H. SYTMQ (SEQ ID NO: 90); GIYSGSRTYYGAAVQG (SEQ ID NO: 91); and SSYCTAWTGCDVYAGGSIDA (SEQ ID NO: 92); or

[00168] 30H. SYSMF (SEQ ID NO: 95); GIDSGSTTFYGSAVKG (SEQ ID NO: 96); and DAYGYCGWSGCSADSIDA (SEQ ID NO: 97); or

[00169] 31H. SYAMN (SEQ ID NO: 62); GISSSGRYTGYADSVKG (SEQ ID NO: 101); and SVGNGNSWSGYIATSIDA (SEQ ID NO: 57); or

[00170] 32H. SYAMN (SEQ ID NO: 62); GIGSTGSSTGYADSVKG (SEQ ID NO: 102); and SVGNGNSWSGYIATSIDA (SEQ ID NO: 57).

[00171] In some embodiments, the antibody comprises a V_L chain comprising the sequence of:

IM Ab ID	V_L
136	ALTQPSSVSANPGESVEITCSGDSSWYGYGWYQQKSPGSAPVTLIYESGKRPSDIPSRFSGSTSGS TATLTITGVQADDEAVYYCGSADSNSIGIFGAGTTLTVL (SEQ ID NO: 3)
171	ALTQPSSVSANLGGTVKLTCSGGSSGYGWYQQKSPGSAPVTVIYSNDKRPSDIPSRFSGSLSGSTG TLTITGVQADDEAVYFCGSTDNSYVGIFGAGTTLTVL (SEQ ID NO: 5)
172	ALTQPSSVSATPGGTVEITCSGDSSDDGSYYYGWYQQKSPGSAPVTVIYSNDKRPSSIPSRFSGSA SGSTATLTITGVQADDEAVYFCGSYDSSTGIFGAGTTLTVL (SEQ ID NO: 7)
173	ALTQPSSVSANPGGTVEITCSGGNNYYGWYQQKSPGSAPVTVIYYNDKRPSDIPSRFSGSKSGSTG TLTITGVQADDEAVYFCGGWDSSGGIFGAGTTLTVL (SEQ ID NO: 9)
179	SYELTQPPSVSVSPGQTARITCSGDSSWYGYGWYQQKPGQAPVLVIYESGKRPSGIPERFSGSSSG TTVTLTISGVQAEDEADYYCGSADSNSIGIFGGGTKLTVL (SEQ ID NO: 11)
180	SYELTQPPSVSVSPGQTARITCSGGSSGYGWYQQKPGQAPVLVIYSNDKRPSGIPERFSGSSSGTT VTLTISGVQAEDEADYYCGSTDNSYVGIFGGGTKLTVL (SEQ ID NO: 13)
181	SYELTQPPSVSVSPGQTARITCSGDDGSYYYGWYQQKPGQAPVLVIYSNDKRPSGIPERFSGSSSG TTVTLTISGVQAEDEADYYCGSYDSSTGIFGGGTKLTVL (SEQ ID NO: 15)
182	SYELTQPPSVSVSPGQTARITCSGGNNYYGWYQQKPGQAPVLVIYYNDKRPSGIPERFSGSSSGTT VTLTISGVQAEDEADYYCGGWDSSGGIFGGGTKLTVL (SEQ ID NO: 17)
271	SYELTQPPSVSVSPGQTARITCSGGSGSYGWYQQKPGQAPVLVIYGTNKRPSGIPERFSGSSSGTT VTLTISGVQAEDEADYYCGSADSSTNAGIFGGGTKLTVL (SEQ ID NO: 19)
272	SYELTQPPSVSVSPGQTARITCSGGSGSYGWYQQKPGQAPVTVIYGTNKRPSGIPERFSGSSSGTT VTLTISGVQAEDEADYYCGSADSSTNAGIFGGGTKLTVL (SEQ ID NO: 21)
CH-HAMF5-1HAQ	SYELTQPPSVSVSPGQTARITCSGGSGSYGWYQQKPGQAPVLVIYGTNKRPSGIPERFSGSSSGTT VTLTISGVQAEDEADYYCGSADSSTNAGIFGGGTKLTVL (SEQ ID NO: 104)
CH-HAMF5-1HBF	SYELTQPPSVSVSPGQTARITCSAGSGLYGWYQQKPGQAPVLVIYGTNKRPSGIPERFSGSSSGTT VTLTISGVQAEDEADYYCGSADSSTNAGIFGGGTKLTVL (SEQ ID NO: 106)
CH-HAMF5-1HBG	SYELTQPPSVSVSPGQTARITCSAGSGLYGWYQQKPGQAPVLVIYGTNKRPSGIPERFSGSSSGTT VTLTISGVQAEDEADYYCGSADSSTNAGIFGGGTKLTVL (SEQ ID NO: 108)
CH-HAMF5-1HFJ	SYELTQPPSVSVSPGQTARITCSAGSGLYGWYQQKPGQAPVLVIYGTNKRPSGIPERFSGSSSGTT VTLTISGVQAEDEADYYCGSADSSTNAGIFGGGTKLTVL (SEQ ID NO: 110)
CH-HAMF5-1HEP	SYELTQPPSVSVSPGQTARITCSAGSGLYGWYQQKPGQAPVLVIYGTNKRPSGIPERFSGSSSGTT VTLTISGVQAEDEADYYCGSADSSTNAGIFGGGTKLTVL (SEQ ID NO: 112)
CH-HAMF5-1HFB	SYELTQPPSVSVSPGQTARITCSGGSGSYGWYQQKPGQAPVLVIYGTYKRPSGIPERFSGSSSGTT VTLTISGVQAEDEADYYCGSADSSTNAGIFGGGTKLTVL (SEQ ID NO: 114)
CH-HAMF5-1HHR	SYELTQPPSVSVSPGQTARITCSGGSGSYGWYQQKPGQAPVLVIYGTYKRPSGIPERFSGSSSGTT VTLTISGVQAEDEADYYCGSADSSTNAGIFGGGTKLTVL (SEQ ID NO: 116)

CH-HAMF5-1HHP	SYELTQPPSVSVSPGQTARITCSGGSGSYGWYQQKPGQAPVLVIYGTYKRPSGIPERFSGSSSGTTVTLTISGVQAEDEADYYCGSADSSTNAGIFGGGTKLTVL (SEQ ID NO: 118)
CH-HAMF5-1HGT	SYELTQPPSVSVSPGQTARITCSAGSGLYGWYQQKPGQAPVLVIYGTNKRPSGIPERFSGSSSGTTVTLTISGVQAEDEADYYCGSNDASTNAGIFGGGTKLTVL (SEQ ID NO: 120)
35-N1F09-1HA	SYELTQPPSVSVSPGQTARITCSGGYNGHYGWYQQKPGQAPVLVIYGTNKRPSGIPERFSGSSSGTTVTLTISGVQAEDEADYYCGGYDSSAGIFGGGTKLTVL (SEQ ID NO: 122)
35-N2H07-1HA	SYELTQPPSVSVSPGQTARITCSGGSGSYGYYGWYQQKPGQAPVLVIYGTNKRPSGIPERFSGSSSGTTVTLTISGVQAEDEADYYCGSEDSSSGAGIFGGGTKLTVL (SEQ ID NO: 124)

In some embodiments, the VL comprises a sequence of:

ID	V_L Sequence
F10-VL	ALTQPSSVSANPGETVKITCSGGYNGHYGWYQQKSPGSAPVTVIYSNNQRPSNIPSRFSGSTSGSTSTLTITGVRAEDEAVYFCGGYDSSAGIFGAGTTLTVL (SEQ ID NO: 127)
F10h-VL	SYELTQPPSVSVSPGQTARITCSGGYNGHYGWYQQKPGQAPVLVIYSNNQRPSGIPERFSGSSSGTTVTLTISGVQAEDEADYYCGGYDSSAGIFGGGTKLTVL (SEQ ID NO: 128)
B9-VL	ALTQPSSVSANPGETVKITCSGGGSSNYYGWYQQKSPGSAPVTLIYGTNKRPSDIPSRFSGSKSGSTGTLTITGVQADDEAVYFCGSADSSTNAGIFGAGTTLTVL (SEQ ID NO: 129)
B9h-VL	SYELTQPPSVSVSPGQTARITCSGGGSSNYAGWYGYYQQKPGQAPVTVIYGTNKRPSGIPERFSGSSSGTTVTLTISGVQAEDEAVYYCGSADSSTNAGIFGAGTKLTVL (SEQ ID NO: 130)
N6-G3	SYELTQPPSVSVSPGQTARITCSGGSGSYGYYGWYQQKPGQAPVLVIYGTNKRPSGIPERFSGSSSGTTVTLTISGVQAEDEADYYCGSTDSNYVGIFGGGTKLTVL (SEQ ID NO: 131)
N6-C5	SYELTQPPSVSVSPGQTARITCSGGYNGHYGWYQQKPGQAPVLVIYSNNQRPSGIPERFSGSSSGTTVTLTISGVQAEDEADYYCGNADSNYVGIFGGGTKLTVL (SEQ ID NO: 132)
N6-F11	SYELTQPPSVSVSPGQTARITCSGGGSSNYYGWYQQKPGQAPVLVIYSNNQRPSGIPERFSGSSSGTTVTLTISGVQAEDEADYYCGSADSSTNAGIFG

	GGTKLTVL (SEQ ID NO: 133)
N5-B4	SYELTQPPSVSVSPGQTARITCSGGSGSYGYYGWYQQKPGQAPVLVIYS NNQRPSGIPERFSGSSSGTTVTLTISGVQAEDEADYYCGSADSSTNAGIF GGGTKLTVL (SEQ ID NO: 134)
N5-B7	SYELTQPPSVSVSPGQTARITCSGGSGSYGYYGWYQQKPGQAPVLVIYG TNKRPSGIPERFSGSSSGTTVTLTISGVQAEDEADYYCGSADSSTNAGIF GGGTKLTVL (SEQ ID NO: 135)

[00172] The V_L sequence can comprise a V_L sequence, CDR, CDR set or FW set, or any combination thereof as provided in PCT Application No PCT/US2020/018026, filed February 13, 2020 and/or U.S. Application No. 16/789,626, filed, February 13, 2020, each of which is incorporated by reference in its entirety.

[00173] In some embodiments, any of the V_H chains, or a V_H chain comprising one or more (such as 3) CDRs, as provided for herein can be combined with any of the V_L chains provided for herein. As demonstrated herein, the V_L chains can be swapped and the antibodies can still bind to Claudin 6. In some embodiments, the V_H is combined with one of F10-VL; 2. F10h-VL; 3. B9-VL; or B9h-VL.

[00174] In some embodiments, the sequence is at least 80, 85, 90, 95, 96, 97, 98, or 99% homologous or identical to the sequence provided herein, which includes the VH, VL, and CDR sequences. In some embodiments, the V_L chain comprises one or more CDRs selected from the group consisting of: SGDSSWYGYG (SEQ ID NO: 83); ESGKRPS (SEQ ID NO: 84); GSADSNSIGI (SEQ ID NO: 85); SGGSSGYG (SEQ ID NO: 87); SNDKRPS (SEQ ID NO: 88); GSTDNSYVGI (SEQ ID NO: 89); SGDSSDDGSYYYG (SEQ ID NO: 93); SNDKRPS (SEQ ID NO: 88); GSYDSSTGI (SEQ ID NO: 94); SGGNNYYG (SEQ ID NO: 98); YNDKRPS (SEQ ID NO: 99); GGWDSSGGI (SEQ ID NO: 100), CSGDSSWYGYG (SEQ ID NO: 22); IYESGKRP (SEQ ID NO: 23); CGSADSNSIGIF (SEQ ID NO: 24); CSGGSSGYG (SEQ ID NO: 28); IYSNDKRP (SEQ ID NO: 29); CGSTDNSYVGIF (SEQ ID NO: 30); CSGDSSDDGSYYYG (SEQ ID NO: 34); IYSNDKRP (SEQ ID NO: 29); CGSYDSSTGIF (SEQ ID NO: 36); CSGGNNYYG (SEQ ID NO: 40); IYYNDKRP (SEQ ID NO: 41); CGGWDSSGGIF (SEQ ID NO: 42); CSGDSSWYGYG (SEQ ID NO: 22); IYESGKRP (SEQ

ID NO: 23); CGSADSNSIGIF (SEQ ID NO: 24); CSGGSSGYG (SEQ ID NO: 28); IYSNDKRP (SEQ ID NO: 29); CGSTDNSYVGIF (SEQ ID NO: 30); CSGDDGSYYYG (SEQ ID NO: 47); IYSNDKRP (SEQ ID NO: 29); CGSYDSSTGIF (SEQ ID NO: 36); CSGGNNYYG (SEQ ID NO: 40); IYYNDKRP (SEQ ID NO: 41); CGGWDSSGGIF (SEQ ID NO: 42); CSGGSGSYG (SEQ ID NO: 50); IYGTNKRP (SEQ ID NO: 51); CGSADSSTNAGIF (SEQ ID NO: 52); CSGGSGSYG (SEQ ID NO: 50); IYGTNKRP (SEQ ID NO: 51); and CGSADSSTNAGIF (SEQ ID NO: 52); SGGSGSYG (SEQ ID NO: 58); GTNKRPS (SEQ ID NO: 59); GSADSSTNAGI (SEQ ID NO: 60); SAGSGLYG (SEQ ID NO: 64); GTYKRPS (SEQ ID NO: 68); GSNDASTNAGI (SEQ ID NO: 70); SGGYNGHYG (SEQ ID NO: 74); GGYDSSAGI (SEQ ID NO: 75); SGGSGSYGYYG; or GSEDSSSGAGI (SEQ ID NO: 79).

[00175] In some embodiments, the V_L chain comprises the CDRs of:

[00176] 1L. SGDSSWYGYG (SEQ ID NO: 83); ESGKRPS (SEQ ID NO: 84); and GSADSNSIGI (SEQ ID NO: 85); or

[00177] 2L. SGGSSGYG (SEQ ID NO: 87); SNDKRPS (SEQ ID NO: 88); and GSTDNSYVGI (SEQ ID NO: 89); or

[00178] 3L. SGDSSDDGSYYYG (SEQ ID NO: 93); SNDKRPS (SEQ ID NO: 88); and GSYDSSTGI (SEQ ID NO: 94); or

[00179] 4L. SGGNNYYG (SEQ ID NO: 98); YNDKRPS (SEQ ID NO: 99); and GGWDSSGGI (SEQ ID NO: 100); or

[00180] 5L. CSGDSSWYGYG (SEQ ID NO: 22); IYESGKRP (SEQ ID NO: 23); and CGSADSNSIGIF (SEQ ID NO: 24); or

[00181] 6L. CSGGSSGYG (SEQ ID NO: 28); IYSNDKRP (SEQ ID NO: 29); and CGSTDNSYVGIF (SEQ ID NO: 30); or

[00182] 7L. CSGDSSDDGSYYYG (SEQ ID NO: 34); IYSNDKRP (SEQ ID NO: 29); and CGSYDSSTGIF (SEQ ID NO: 36); or

[00183] 8L. CSGGNNYYG (SEQ ID NO: 40); IYYNDKRP (SEQ ID NO: 41); and CGGWDSSGGIF (SEQ ID NO: 42); or

[00184] 9L. CSGDSSWYGYG (SEQ ID NO: 22); IYESGKRP (SEQ ID NO: 23); and CGSADSNSIGIF (SEQ ID NO: 24); or

[00185] 10L. CSGGSSGYG (SEQ ID NO: 28); IYSNDKRP (SEQ ID NO: 29); and CGSTDNSYVGIF (SEQ ID NO: 30); or

[00186] 11L. CSGDDGSYYYG (SEQ ID NO: 47); IYSNDKRP (SEQ ID NO: 29); and CGSYDSSTGIF (SEQ ID NO: 36); or

[00187] 12L. CSGGNNYYG (SEQ ID NO: 40); IYYNDKRP (SEQ ID NO: 41); and CGGWDSSGGIF (SEQ ID NO: 42); or

[00188] 13L. CSGGSGSYG (SEQ ID NO: 50); IYGTNKRP (SEQ ID NO: 51); and CGSADSSTNAGIF (SEQ ID NO: 52); or

[00189] 14L. CSGGSGSYG (SEQ ID NO: 50); IYGTNKRP (SEQ ID NO: 51); and CGSADSSTNAGIF (SEQ ID NO: 52);

[00190] 15L. SGGSGSYG (SEQ ID NO: 58); GTNKRPS (SEQ ID NO: 59); and GSADSSTNAGI (SEQ ID NO: 60); or

[00191] 16L. SGGSGSYG (SEQ ID NO: 58); GTNKRPS (SEQ ID NO: 59); and GSADSSTNAGI (SEQ ID NO: 60); or

[00192] 17L. SAGSGLYG (SEQ ID NO: 64); GTNKRPS (SEQ ID NO: 59); and GSADSSTNAGI (SEQ ID NO: 60); or

[00193] 18L. SAGSGLYG (SEQ ID NO: 64); GTNKRPS (SEQ ID NO: 59); and GSADSSTNAGI (SEQ ID NO: 60); or

[00194] 19L. SAGSGLYG (SEQ ID NO: 64); GTNKRPS (SEQ ID NO: 59); and GSADSSTNAGI (SEQ ID NO: 60); or

[00195] 20L. SAGSGLYG (SEQ ID NO: 64); GTNKRPS (SEQ ID NO: 59); and GSADSSTNAGI (SEQ ID NO: 60); or

[00196] 21L. SGGSGSYG (SEQ ID NO: 58); GTYKRPS (SEQ ID NO: 68); and GSADSSTNAGI (SEQ ID NO: 60); or

[00197] 22L. SGGSGSYG (SEQ ID NO: 58); GTYKRPS (SEQ ID NO: 68); and GSADSSTNAGI (SEQ ID NO: 60); or

[00198] 23L. SGGSGSYG (SEQ ID NO: 58); GTYKRPS (SEQ ID NO: 68); and GSADSSTNAGI (SEQ ID NO: 60); or

[00199] 24L. SAGSGLYG (SEQ ID NO: 64); GTNKRPS (SEQ ID NO: 59); and GSNDASTNAGI (SEQ ID NO: 70); or

[00200] 25L. SGGYNGHYG (SEQ ID NO: 74); GTNKRPS (SEQ ID NO: 59); and GGYDSSAGI (SEQ ID NO: 75); or

[00201] 26L. SGGSGSYGYYG; GTNKRPS (SEQ ID NO: 59); and GSEDSSSGAGI (SEQ ID NO: 79); or

[00202] 27L. SGDSSWYGYG (SEQ ID NO: 83); ESGKRPS (SEQ ID NO: 84); and GSADSNSIGI (SEQ ID NO: 85); or

[00203] 28L. SGGSSGYG (SEQ ID NO: 87); SNDKRPS (SEQ ID NO: 88); and GSTDNSYVGI (SEQ ID NO: 89); or

[00204] 29L. SGDSSDDGSYYYG (SEQ ID NO: 93); SNDKRPS (SEQ ID NO: 88); and GSYDSSTGI (SEQ ID NO: 94); or

[00205] 30L. SGGNNYYG (SEQ ID NO: 98); YNDKRPS (SEQ ID NO: 99); and GGWDSSGGI (SEQ ID NO: 100); or

[00206] 31L. SGGSGSYG (SEQ ID NO: 58); GTNKRPS (SEQ ID NO: 59); and GSADSSTNAGI (SEQ ID NO: 60); or

[00207] 32L. SGGSSGYG (SEQ ID NO: 87); SNDKRPS (SEQ ID NO: 88); and GSTDNSYVGI (SEQ ID NO: 89).

[00208] In some embodiments, the antibody comprises the CDRs of 1H and 1L, 1H and 2L, 1H and 3L, 1H and 4L, 1H and 5L, 1H and 6L, 1H and 7L, 1H and 8L, 1H and 9L, 1H and 10L, 1H and 11L, 1H and 12L, 1H and 13L, 1H and 14L, 1H and 15L, 1H and 16L, 1H and 17L, 1H and 18L, 1H and 19L, 1H and 20L, 1H and 21L, 1H and 22L, 1H and 23L, 1H and 24L, 1H and 25L, 1H and 26L, 1H and 27L, 1H and 28L, 1H and 29L, 1H and 30L, 1H and 31L, 1H and 32L, 2H and 1L, 2H and 2L, 2H and 3L, 2H and 4L, 2H and 5L, 2H and 6L, 2H and 7L, 2H and 8L, 2H and 9L, 2H and 10L, 2H and 11L, 2H and 12L, 2H and 13L, 2H and 14L, 2H and 15L, 2H and 16L, 2H and 17L, 2H and 18L, 2H and 19L, 2H and 20L, 2H and 21L, 2H and 22L, 2H and 23L, 2H and 24L, 2H and 25L, 2H and 26L, 2H and 27L, 2H and 28L, 2H and 29L, 2H and 30L, 2H and 31L, 2H and 32L, 3H and 1L, 3H and 2L, 3H and 3L, 3H and 4L, 3H and 5L, 3H and 6L, 3H and 7L, 3H and 8L, 3H and 9L, 3H and 10L, 3H and 11L, 3H and 12L, 3H and 13L, 3H and 14L, 3H and 15L, 3H and 16L, 3H and 17L, 3H and 18L, 3H and 19L, 3H and 20L, 3H and 21L, 3H and 22L, 3H and 23L, 3H and 24L, 3H and 25L, 3H and 26L, 3H and 27L, 3H and 28L, 3H and 29L, 3H and 30L, 3H and 31L, 3H and 32L, 4H and 1L, 4H and 2L, 4H and 3L, 4H

and 4L, 4H and 5L, 4H and 6L, 4H and 7L, 4H and 8L, 4H and 9L, 4H and 10L, 4H and 11L, 4H and 12L, 4H and 13L, 4H and 14L, 4H and 15L, 4H and 16L, 4H and 17L, 4H and 18L, 4H and 19L, 4H and 20L, 4H and 21L, 4H and 22L, 4H and 23L, 4H and 24L, 4H and 25L, 4H and 26L, 4H and 27L, 4H and 28L, 4H and 29L, 4H and 30L, 4H and 31L, 4H and 32L, 5H and 1L, 5H and 2L, 5H and 3L, 5H and 4L, 5H and 5L, 5H and 6L, 5H and 7L, 5H and 8L, 5H and 9L, 5H and 10L, 5H and 11L, 5H and 12L, 5H and 13L, 5H and 14L, 5H and 15L, 5H and 16L, 5H and 17L, 5H and 18L, 5H and 19L, 5H and 20L, 5H and 21L, 5H and 22L, 5H and 23L, 5H and 24L, 5H and 25L, 5H and 26L, 5H and 27L, 5H and 28L, 5H and 29L, 5H and 30L, 5H and 31L, 5H and 32L, 6H and 1L, 6H and 2L, 6H and 3L, 6H and 4L, 6H and 5L, 6H and 6L, 6H and 7L, 6H and 8L, 6H and 9L, 6H and 10L, 6H and 11L, 6H and 12L, 6H and 13L, 6H and 14L, 6H and 15L, 6H and 16L, 6H and 17L, 6H and 18L, 6H and 19L, 6H and 20L, 6H and 21L, 6H and 22L, 6H and 23L, 6H and 24L, 6H and 25L, 6H and 26L, 6H and 27L, 6H and 28L, 6H and 29L, 6H and 30L, 6H and 31L, 6H and 32L, 7H and 1L, 7H and 2L, 7H and 3L, 7H and 4L, 7H and 5L, 7H and 6L, 7H and 7L, 7H and 8L, 7H and 9L, 7H and 10L, 7H and 11L, 7H and 12L, 7H and 13L, 7H and 14L, 7H and 15L, 7H and 16L, 7H and 17L, 7H and 18L, 7H and 19L, 7H and 20L, 7H and 21L, 7H and 22L, 7H and 23L, 7H and 24L, 7H and 25L, 7H and 26L, 7H and 27L, 7H and 28L, 7H and 29L, 7H and 30L, 7H and 31L, 7H and 32L, 8H and 1L, 8H and 2L, 8H and 3L, 8H and 4L, 8H and 5L, 8H and 6L, 8H and 7L, 8H and 8L, 8H and 9L, 8H and 10L, 8H and 11L, 8H and 12L, 8H and 13L, 8H and 14L, 8H and 15L, 8H and 16L, 8H and 17L, 8H and 18L, 8H and 19L, 8H and 20L, 8H and 21L, 8H and 22L, 8H and 23L, 8H and 24L, 8H and 25L, 8H and 26L, 8H and 27L, 8H and 28L, 8H and 29L, 8H and 30L, 8H and 31L, 8H and 32L, 9H and 1L, 9H and 2L, 9H and 3L, 9H and 4L, 9H and 5L, 9H and 6L, 9H and 7L, 9H and 8L, 9H and 9L, 9H and 10L, 9H and 11L, 9H and 12L, 9H and 13L, 9H and 14L, 9H and 15L, 9H and 16L, 9H and 17L, 9H and 18L, 9H and 19L, 9H and 20L, 9H and 21L, 9H and 22L, 9H and 23L, 9H and 24L, 9H and 25L, 9H and 26L, 9H and 27L, 9H and 28L, 9H and 29L, 9H and 30L, 9H and 31L, 9H and 32L, 10H and 1L, 10H and 2L, 10H and 3L, 10H and 4L, 10H and 5L, 10H and 6L, 10H and 7L, 10H and 8L, 10H and 9L, 10H and 10L, 10H and 11L, 10H and 12L, 10H and 13L, 10H and 14L, 10H and 15L, 10H and 16L, 10H and 17L, 10H and 18L, 10H and 19L, 10H and 20L, 10H and 21L, 10H and 22L, 10H and 23L, 10H and 24L, 10H and 25L, 10H and 26L, 10H and 27L, 10H and 28L, 10H and 29L, 10H and 30L, 10H and 31L, 10H and 32L, 11H and 1L, 11H

and 2L, 11H and 3L, 11H and 4L, 11H and 5L, 11H and 6L, 11H and 7L, 11H and 8L, 11H and 9L, 11H and 10L, 11H and 11L, 11H and 12L, 11H and 13L, 11H and 14L, 11H and 15L, 11H and 16L, 11H and 17L, 11H and 18L, 11H and 19L, 11H and 20L, 11H and 21L, 11H and 22L, 11H and 23L, 11H and 24L, 11H and 25L, 11H and 26L, 11H and 27L, 11H and 28L, 11H and 29L, 11H and 30L, 11H and 31L, 11H and 32L, 12H and 1L, 12H and 2L, 12H and 3L, 12H and 4L, 12H and 5L, 12H and 6L, 12H and 7L, 12H and 8L, 12H and 9L, 12H and 10L, 12H and 11L, 12H and 12L, 12H and 13L, 12H and 14L, 12H and 15L, 12H and 16L, 12H and 17L, 12H and 18L, 12H and 19L, 12H and 20L, 12H and 21L, 12H and 22L, 12H and 23L, 12H and 24L, 12H and 25L, 12H and 26L, 12H and 27L, 12H and 28L, 12H and 29L, 12H and 30L, 12H and 31L, 12H and 32L, 13H and 1L, 13H and 2L, 13H and 3L, 13H and 4L, 13H and 5L, 13H and 6L, 13H and 7L, 13H and 8L, 13H and 9L, 13H and 10L, 13H and 11L, 13H and 12L, 13H and 13L, 13H and 14L, 13H and 15L, 13H and 16L, 13H and 17L, 13H and 18L, 13H and 19L, 13H and 20L, 13H and 21L, 13H and 22L, 13H and 23L, 13H and 24L, 13H and 25L, 13H and 26L, 13H and 27L, 13H and 28L, 13H and 29L, 13H and 30L, 13H and 31L, 13H and 32L, 14H and 1L, 14H and 2L, 14H and 3L, 14H and 4L, 14H and 5L, 14H and 6L, 14H and 7L, 14H and 8L, 14H and 9L, 14H and 10L, 14H and 11L, 14H and 12L, 14H and 13L, 14H and 14L, 14H and 15L, 14H and 16L, 14H and 17L, 14H and 18L, 14H and 19L, 14H and 20L, 14H and 21L, 14H and 22L, 14H and 23L, 14H and 24L, 14H and 25L, 14H and 26L, 14H and 27L, 14H and 28L, 14H and 29L, 14H and 30L, 14H and 31L, 14H and 32L, 15H and 1L, 15H and 2L, 15H and 3L, 15H and 4L, 15H and 5L, 15H and 6L, 15H and 7L, 15H and 8L, 15H and 9L, 15H and 10L, 15H and 11L, 15H and 12L, 15H and 13L, 15H and 14L, 15H and 15L, 15H and 16L, 15H and 17L, 15H and 18L, 15H and 19L, 15H and 20L, 15H and 21L, 15H and 22L, 15H and 23L, 15H and 24L, 15H and 25L, 15H and 26L, 15H and 27L, 15H and 28L, 15H and 29L, 15H and 30L, 15H and 31L, 15H and 32L, 16H and 1L, 16H and 2L, 16H and 3L, 16H and 4L, 16H and 5L, 16H and 6L, 16H and 7L, 16H and 8L, 16H and 9L, 16H and 10L, 16H and 11L, 16H and 12L, 16H and 13L, 16H and 14L, 16H and 15L, 16H and 16L, 16H and 17L, 16H and 18L, 16H and 19L, 16H and 20L, 16H and 21L, 16H and 22L, 16H and 23L, 16H and 24L, 16H and 25L, 16H and 26L, 16H and 27L, 16H and 28L, 16H and 29L, 16H and 30L, 16H and 31L, 16H and 32L, 17H and 1L, 17H and 2L, 17H and 3L, 17H and 4L, 17H and 5L, 17H and 6L, 17H and 7L, 17H and 8L, 17H and 9L, 17H and 10L, 17H and 11L, 17H and 12L, 17H and 13L, 17H and 14L,

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and 27L, 23H and 28L, 23H and 29L, 23H and 30L, 23H and 31L, 23H and 32L, 24H and 1L, 24H and 2L, 24H and 3L, 24H and 4L, 24H and 5L, 24H and 6L, 24H and 7L, 24H and 8L, 24H and 9L, 24H and 10L, 24H and 11L, 24H and 12L, 24H and 13L, 24H and 14L, 24H and 15L, 24H and 16L, 24H and 17L, 24H and 18L, 24H and 19L, 24H and 20L, 24H and 21L, 24H and 22L, 24H and 23L, 24H and 24L, 24H and 25L, 24H and 26L, 24H and 27L, 24H and 28L, 24H and 29L, 24H and 30L, 24H and 31L, 24H and 32L, 25H and 1L, 25H and 2L, 25H and 3L, 25H and 4L, 25H and 5L, 25H and 6L, 25H and 7L, 25H and 8L, 25H and 9L, 25H and 10L, 25H and 11L, 25H and 12L, 25H and 13L, 25H and 14L, 25H and 15L, 25H and 16L, 25H and 17L, 25H and 18L, 25H and 19L, 25H and 20L, 25H and 21L, 25H and 22L, 25H and 23L, 25H and 24L, 25H and 25L, 25H and 26L, 25H and 27L, 25H and 28L, 25H and 29L, 25H and 30L, 25H and 31L, 25H and 32L, 26H and 1L, 26H and 2L, 26H and 3L, 26H and 4L, 26H and 5L, 26H and 6L, 26H and 7L, 26H and 8L, 26H and 9L, 26H and 10L, 26H and 11L, 26H and 12L, 26H and 13L, 26H and 14L, 26H and 15L, 26H and 16L, 26H and 17L, 26H and 18L, 26H and 19L, 26H and 20L, 26H and 21L, 26H and 22L, 26H and 23L, 26H and 24L, 26H and 25L, 26H and 26L, 26H and 27L, 26H and 28L, 26H and 29L, 26H and 30L, 26H and 31L, 26H and 32L, 27H and 1L, 27H and 2L, 27H and 3L, 27H and 4L, 27H and 5L, 27H and 6L, 27H and 7L, 27H and 8L, 27H and 9L, 27H and 10L, 27H and 11L, 27H and 12L, 27H and 13L, 27H and 14L, 27H and 15L, 27H and 16L, 27H and 17L, 27H and 18L, 27H and 19L, 27H and 20L, 27H and 21L, 27H and 22L, 27H and 23L, 27H and 24L, 27H and 25L, 27H and 26L, 27H and 27L, 27H and 28L, 27H and 29L, 27H and 30L, 27H and 31L, 27H and 32L, 28H and 1L, 28H and 2L, 28H and 3L, 28H and 4L, 28H and 5L, 28H and 6L, 28H and 7L, 28H and 8L, 28H and 9L, 28H and 10L, 28H and 11L, 28H and 12L, 28H and 13L, 28H and 14L, 28H and 15L, 28H and 16L, 28H and 17L, 28H and 18L, 28H and 19L, 28H and 20L, 28H and 21L, 28H and 22L, 28H and 23L, 28H and 24L, 28H and 25L, 28H and 26L, 28H and 27L, 28H and 28L, 28H and 29L, 28H and 30L, 28H and 31L, 28H and 32L, 29H and 1L, 29H and 2L, 29H and 3L, 29H and 4L, 29H and 5L, 29H and 6L, 29H and 7L, 29H and 8L, 29H and 9L, 29H and 10L, 29H and 11L, 29H and 12L, 29H and 13L, 29H and 14L, 29H and 15L, 29H and 16L, 29H and 17L, 29H and 18L, 29H and 19L, 29H and 20L, 29H and 21L, 29H and 22L, 29H and 23L, 29H and 24L, 29H and 25L, 29H and 26L, 29H and 27L, 29H and 28L, 29H and 29L, 29H and 30L, 29H and 31L, 29H and 32L, 30H and 1L, 30H and 2L, 30H and 3L, 30H and 4L, 30H and 5L, 30H and 6L, 30H and 7L, 30H

and 8L, 30H and 9L, 30H and 10L, 30H and 11L, 30H and 12L, 30H and 13L, 30H and 14L, 30H and 15L, 30H and 16L, 30H and 17L, 30H and 18L, 30H and 19L, 30H and 20L, 30H and 21L, 30H and 22L, 30H and 23L, 30H and 24L, 30H and 25L, 30H and 26L, 30H and 27L, 30H and 28L, 30H and 29L, 30H and 30L, 30H and 31L, 30H and 32L, 31H and 1L, 31H and 2L, 31H and 3L, 31H and 4L, 31H and 5L, 31H and 6L, 31H and 7L, 31H and 8L, 31H and 9L, 31H and 10L, 31H and 11L, 31H and 12L, 31H and 13L, 31H and 14L, 31H and 15L, 31H and 16L, 31H and 17L, 31H and 18L, 31H and 19L, 31H and 20L, 31H and 21L, 31H and 22L, 31H and 23L, 31H and 24L, 31H and 25L, 31H and 26L, 31H and 27L, 31H and 28L, 31H and 29L, 31H and 30L, 31H and 31L, 31H and 32L, 32H and 1L, 32H and 2L, 32H and 3L, 32H and 4L, 32H and 5L, 32H and 6L, 32H and 7L, 32H and 8L, 32H and 9L, 32H and 10L, 32H and 11L, 32H and 12L, 32H and 13L, 32H and 14L, 32H and 15L, 32H and 16L, 32H and 17L, 32H and 18L, 32H and 19L, 32H and 20L, 32H and 21L, 32H and 22L, 32H and 23L, 32H and 24L, 32H and 25L, 32H and 26L, 32H and 27L, 32H and 28L, 32H and 29L, 32H and 30L, 32H and 31L, or 32H and 32L.

[00209] In some embodiments, a peptide comprising the CDRs of 1H, 2H, 3H, 4H, 5H, 6H, 7H, 8H, 9H, 10H, 11H, 12H, 13H, 14H, 15H, 16H, 17H, 18H, 19H, 20H, 21H, 22H, 23H, 24H, 25H, 26H, 27H, 28H, 29H, 30H, 31H, or 32H are combined or linked or expressed in conjunction with a peptide comprising SEQ ID NO: 82; SEQ ID NO: 83; SEQ ID NO: 84; SEQ ID NO: 85; SEQ ID NO: 86; SEQ ID NO: 87; SEQ ID NO: 88; SEQ ID NO: 89; SEQ ID NO: 90, or a variant thereof. In some embodiments, the sequences are at least, or about 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, or 99% identical to the sequence.

[00210] In some embodiments, an antibody is provided, including an isolated form thereof, wherein the antibody comprises a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 25, 31, 37, 43, 53, 55, 56, 62, 71, 76, 80, 90, or 95; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 26, 32, 38, 44, 46, 48, 49, 54, 125, 72, 77, 81, 86, 91, 96, 101, or 102 and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 27, 33, 39, 45, 57, 61, 63, 65, 66, 67, 126, 69, 73, 82, 57, 92, or 97 or variants of any of the foregoing.

[00211] In some embodiments, the antibody, or an isolated form thereof, comprises a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 25; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 26; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 27, or variants of any of the foregoing.

[00212] In some embodiments, the antibody, or an isolated form thereof, comprises a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 31; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 32; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 33, or variants of any of the foregoing.

[00213] In some embodiments, the antibody, or an isolated form thereof, comprises a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 37; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 38; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 39, or variants of any of the foregoing.

[00214] In some embodiments, the antibody, or an isolated form thereof, comprises a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 43; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 44; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 45, or variants of any of the foregoing.

[00215] In some embodiments, the antibody, or an isolated form thereof, comprises a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 31; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 46; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 33, or variants of any of the foregoing.

[00216] In some embodiments, the antibody, or an isolated form thereof, comprises a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 37; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 48; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 39, or variants of any of the foregoing.

[00217] In some embodiments, the antibody, or an isolated form thereof, comprises a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 43; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 49; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 45, or variants of any of the foregoing.

[00218] In some embodiments, the antibody, or an isolated form thereof, comprises a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 53; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 54; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 33, or variants of any of the foregoing.

[00219] In some embodiments, the antibody, or an isolated form thereof, comprises a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 55; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 54; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 33, or variants of any of the foregoing;

[00220] In some embodiments, the antibody, or an isolated form thereof, comprises a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 56; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 57, or variants of any of the foregoing.

[00221] In some embodiments, the antibody, or an isolated form thereof, comprises a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 56; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 61, or variants of any of the foregoing.

[00222] In some embodiments, the antibody, or an isolated form thereof, comprises a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 63, or variants of any of the foregoing.

[00223] In some embodiments, the antibody, or an isolated form thereof, comprises a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 65, or variants of any of the foregoing.

[00224] In some embodiments, the antibody, or an isolated form thereof, comprises a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 66, or variants of any of the foregoing.

[00225] In some embodiments, the antibody, or an isolated form thereof, comprises a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 67, or variants of any of the foregoing.

[00226] In some embodiments, the antibody, or an isolated form thereof, comprises a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 126, or variants of any of the foregoing.

[00227] In some embodiments, the antibody, or an isolated form thereof, comprises a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 69, or variants of any of the foregoing.

[00228] In some embodiments, the antibody, or an isolated form thereof, comprises a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 71; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 72; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 73, or variants of any of the foregoing.

[00229] In some embodiments, the antibody, or an isolated form thereof, comprises a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 76; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 77; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 78, or variants of any of the foregoing.

[00230] In some embodiments, the antibody, or an isolated form thereof, comprises a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 80; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 81; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 82, or variants of any of the foregoing.

[00231] In some embodiments, the antibody, or an isolated form thereof, comprises a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 86; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 57, or variants of any of the foregoing.

[00232] In some embodiments, the antibody, or an isolated form thereof, comprises a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 90; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 91; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 92, or variants of any of the foregoing.

[00233] In some embodiments, the antibody, or an isolated form thereof, comprises a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 95; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 96; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 97, or variants of any of the foregoing.

[00234] In some embodiments, the antibody, or an isolated form thereof, comprises a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 101; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 57, or variants of any of the foregoing.

[00235] In some embodiments, the antibody, or an isolated form thereof, comprises a heavy chain variable region comprising heavy chain CDR1, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 102; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 57, or variants of any of the foregoing.

[00236] In some embodiments, the heavy chain variable region or proteins provided herein are linked to a light chain variable region. In some embodiments, the linker is a peptide linker, such as, but not limited to, GQSSRSSGGGGSSGGGGS (SEQ ID NO: 136); $(GGGGS)_n$ (SEQ ID NO: 137), $(GGGGA)_n$ (SEQ ID NO: 138), or any combination thereof, wherein each n is independently 1-5. The linked peptide format can be represented by a formula of V_H-Z-V_L or V_L-Z-V_H, wherein Z is the peptide linker. In some embodiments, Z GQSSRSSGGGGSSGGGGS (SEQ ID NO: 136); $(GGGGS)_n$ (SEQ ID NO: 137), $(GGGGA)_n$ (SEQ ID NO: 138), or any combination thereof, wherein each n is independently 1-5.

[00237] In some embodiments, the light chain variable region comprising a sequence of any one of sequences as set forth in SEQ ID NOs: 127-135. In some embodiments, the light chain variable region comprises light chain CDR1, CDR2, and CDR3 peptide sequences, wherein the light chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 22, 28, 34, 40, 47, 50, 58, 64, 74, 83, 87, 93, or 98; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 23, 29, 41, 51, 59, 68, 84, 88, or 99, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 24, 30, 36, 42, 52, 60, 70, 75, 79, 85, 89, 94, or variants of any of the foregoing.

[00238] In some embodiments, the antibody, or an isolated form thereof, comprises a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 22; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 23, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 24, or variants of any of the foregoing.

[00239] In some embodiments, the antibody, or an isolated form thereof, comprises a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 28; the light chain CDR2

sequence has the amino acid sequence of SEQ ID NO: 29, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 30, or variants of any of the foregoing.

[00240] In some embodiments, the antibody, or an isolated form thereof, comprises a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 34; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 29, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 36, or variants of any of the foregoing.

[00241] In some embodiments, the antibody, or an isolated form thereof, comprises a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 40; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 41, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 42, or variants of any of the foregoing.

[00242] In some embodiments, the antibody, or an isolated form thereof, comprises a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 47; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 29, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 36, or variants of any of the foregoing.

[00243] In some embodiments, the antibody, or an isolated form thereof, comprises a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 50; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 51, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 52, or variants of any of the foregoing.

[00244] In some embodiments, the antibody, or an isolated form thereof, comprises a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 58; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 59, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 60, or variants of any of the foregoing.

[00245] In some embodiments, the antibody, or an isolated form thereof, comprises a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 64; the light chain CDR2

sequence has the amino acid sequence of SEQ ID NO: 59, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 60, or variants of any of the foregoing.

[00246] In some embodiments, the antibody, or an isolated form thereof, comprises a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 58; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 68, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 60, or variants of any of the foregoing.

[00247] In some embodiments, the antibody, or an isolated form thereof, comprises a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 64; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 59, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 70, or variants of any of the foregoing.

[00248] In some embodiments, the antibody, or an isolated form thereof, comprises a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 74; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 59, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 75, or variants of any of the foregoing.

[00249] In some embodiments, the antibody, or an isolated form thereof, comprises a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 58; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 59, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 79, or variants of any of the foregoing.

[00250] In some embodiments, the antibody, or an isolated form thereof, comprises a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 83; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 84, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 85, or variants of any of the foregoing.

[00251] In some embodiments, the antibody, or an isolated form thereof, comprises a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 87; the light chain CDR2

sequence has the amino acid sequence of SEQ ID NO: 88, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 89, or variants of any of the foregoing.

[00252] In some embodiments, the antibody, or an isolated form thereof, comprises a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 93; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 88, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 94, or variants of any of the foregoing.

[00253] In some embodiments, the antibody, or an isolated form thereof, comprises a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 98; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 99, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 100, or variants of any of the foregoing.

[00254] In some embodiments, an antibody, or an antigen binding fragment thereof, is provided wherein the antibody, or antigen binding fragment thereof, comprises: (i) a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 25, 31, 37, 43, 53, 55, 56, 62, 71, 76, 80, 90, or 95; the heavy chain CDR2 has the amino acid sequence of 26, 32, 38, 44, 46, 48, 49, 54, 125, 72, 77, 81, 86, 91, 96, 101, or 102 and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 27, 33, 39, 45, 57, 61, 63, 65, 66, 67, 126, 69, 73, 82, 57, 92, or 97 or variants of any of the foregoing; and (ii) a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence 22, 28, 34, 40, 47, 50, 58, 64, 74, 83, 87, 93, or 98; the light chain CDR2 sequence has the amino acid sequence of 23, 29, 41, 51, 59, 68, 84, 88, or 99, and the light chain CDR3 sequence has the amino acid sequence of 24, 30, 36, 42, 52, 60, 70, 75, 79, 85, 89, or 94, or variants of any of the foregoing.

[00255] In some embodiments, the following embodiments are provided herein:

1. An antibody, or an isolated form thereof, that binds to claudin 6 with an affinity of less than 10 nM and with at least 100 fold greater EC_{50} than claudin 9, claudin 3, and/or claudin 4.
2. The antibody of embodiment 1, or an isolated form thereof, wherein the

antibody comprises a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 25, 31, 37, 43, 53, 55, 56, 62, 71, 76, 80, 90, or 95; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 26, 32, 38, 44, 46, 48, 49, 54, 125, 72, 77, 81, 86, 91, 96, 101, or 102 and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 27, 33, 39, 45, 57, 61, 63, 65, 66, 67, 126, 69, 73, 82, 57, 92, or 97 or variants of any of the foregoing.

3. The antibody of embodiment 1, or an isolated form thereof, wherein the antibody comprises:

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 25; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 26; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 27, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 31; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 32; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 33, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 37; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 38; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 39, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 43; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 44; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 45, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 31; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 46; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 33, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 37; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 48; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 39, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 43; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 49; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 45, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 53; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 54; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 33, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 55; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 54; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 33, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 56; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 57, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 56; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 61, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 63, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 65, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 66, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 67, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 126, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 69, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 71; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 72; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 73, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 76; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 77; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 78, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 80; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 81; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 82, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 86; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 57, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 90; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 91; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 92, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 95; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 96; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 97, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 101; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 57, or variants of any of the foregoing; or

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 102; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 57, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 139; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 140; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 82, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 141; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 142; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 57, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 143; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 144; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 92, or variants of any of the foregoing; or

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 145; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 146; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 97, or variants of any of the foregoing.

4. The antibody of any one of embodiments 1-3, wherein the antibody comprises a light chain variable region comprising a sequence of any one of sequences as set forth in SEQ ID NOs: 127-135.

5. The antibody of any one of embodiments 1-3, wherein the antibody comprises a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 22, 28, 34, 40, 47, 50, 58, 64, 74, 83, 87, 93, or 98; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 23, 29, 41, 51, 59, 68, 84, 88, or 99, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 24, 30, 36, 42, 52, 60, 70, 75, 79, 85, 89, 94, or variants of any of the foregoing.

6. The antibody of embodiment 5, wherein antibody comprises:

a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 22; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 23, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 24, or variants of any of the foregoing;

a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 28; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 29, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 30, or variants of any of the foregoing;

a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 34; the light chain CDR2 sequence has the amino acid

sequence of SEQ ID NO: 29, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 36, or variants of any of the foregoing;

a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 40; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 41, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 42, or variants of any of the foregoing;

a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 47; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 29, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 36, or variants of any of the foregoing;

a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 50; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 51, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 52, or variants of any of the foregoing;

a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 58; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 59, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 60, or variants of any of the foregoing;

a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 64; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 59, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 60, or variants of any of the foregoing;

a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 58; the light chain CDR2 sequence has the amino acid

sequence of SEQ ID NO: 68, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 60, or variants of any of the foregoing;

a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 64; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 59, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 70, or variants of any of the foregoing;

a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 74; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 59, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 75, or variants of any of the foregoing;

a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 58; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 59, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 79, or variants of any of the foregoing;

a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 83; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 84, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 85, or variants of any of the foregoing;

a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 87; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 88, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 89, or variants of any of the foregoing;

a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 93; the light chain CDR2 sequence has the amino acid

sequence of SEQ ID NO: 88, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 94, or variants of any of the foregoing; or

a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 98; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 99, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 100, or variants of any of the foregoing.

7. The antibody of embodiment 1, or antigen binding fragment thereof, wherein the antibody, or antigen binding fragment thereof, comprises:

(i) a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 25, 31, 37, 43, 53, 55, 56, 62, 71, 76, 80, 90, or 95; the heavy chain CDR2 has the amino acid sequence of 26, 32, 38, 44, 46, 48, 49, 54, 125, 72, 77, 81, 86, 91, 96, 101, or 102 and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 27, 33, 39, 45, 57, 61, 63, 65, 66, 67, 126, 69, 73, 82, 57, 92, or 97 or variants of any of the foregoing; and

(ii) a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence 22, 28, 34, 40, 47, 50, 58, 64, 74, 83, 87, 93, or 98; the light chain CDR2 sequence has the amino acid sequence of 23, 29, 41, 51, 59, 68, 84, 88, or 99, and the light chain CDR3 sequence has the amino acid sequence of 24, 30, 36, 42, 52, 60, 70, 75, 79, 85, 89, 94, or variants of any of the foregoing.

8. The antibody, or antigen binding fragment thereof, of embodiment 3, wherein the antibody, or antigen binding fragment thereof, comprises:

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 56; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 57; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences,

wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 58; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 59; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 60; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 56; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 61; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 58; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 59; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 60; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 63; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 64; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 59; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 60; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 65; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences,

wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 64; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 59; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 60; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 66; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 64; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 59; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 60; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 67; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 64; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 59; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 60; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 65; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences,

wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 58; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 68; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 60; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 126; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 58; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 68; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 60; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 69; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 58; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 68; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 60; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 69; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences,

wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 64; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 59; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 70; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 71; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 72; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 73; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 74; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 59; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 75; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 76; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 77; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 78; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 58; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 59; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 79; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 80; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 81; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 82; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences,

wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 83; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 84; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 85; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 86; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 57; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 87; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 88; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 89; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 90; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 91; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 92; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 93; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 88; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 94; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 95; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 96; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 97; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences,

wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 98; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 99; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 100; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 101; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 57; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 58; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 59; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 60; or variants of any of the foregoing; or

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 102; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 57; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 87; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 88; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 89; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 25; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 26; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 27; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences,

wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 22; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 23; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 24; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 31; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 32; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 33; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 28; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 29; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 30; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 37; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 28; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 29; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 34; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 29; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 26; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 43; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 44; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 45; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences,

wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 40; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 41; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 42; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 31; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 46; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 33; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 28; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 29; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 30; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 37; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 48; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 39; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 47; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 29; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 36; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 43; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 49; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 45; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences,

wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 40; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 41; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 42; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 53; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 54; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 33; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 50; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 51; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 52; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 55; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 54; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 33; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 50; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 51; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 52; or variants of any of the foregoing.

9. The antibody of any one of embodiments 1-8, wherein the antibody is a monoclonal antibody.

10. The antibody of any one of embodiments 1-9, wherein the antibody is a humanized antibody.

11. The antibody of any one of embodiments 1-8, wherein the antibody is a chicken antibody.

12. The antibody of any one of embodiments 1-11, wherein the antibody comprises a sequence as provided herein.

13. The isolated antibody of any of the preceding embodiments, wherein the antibody comprises a sequence a CDR sequence as provided herein.

14. The isolated antibody of any of the preceding embodiments, wherein the antibody comprises a V_L a sequence of SEQ ID NO: 3, SEQ ID NO: 5, SEQ ID NO: 7, SEQ ID NO: 9, SEQ ID NO: 11, SEQ ID NO: 13, SEQ ID NO: 15, SEQ ID NO: 17, SEQ ID NO: 19, SEQ ID NO: 21, SEQ ID NO: 104, SEQ ID NO: 106, SEQ ID NO: 108, SEQ ID NO: 110, SEQ ID NO: 112, SEQ ID NO: 114, SEQ ID NO: 116, SEQ ID NO: 118, SEQ ID NO: 120, SEQ ID NO: 122, or SEQ ID NO: 124, SEQ ID NO: 127, SEQ ID NO: 128, SEQ ID NO: 129, SEQ ID NO: 130, SEQ ID NO: 131, SEQ ID NO: 132, SEQ ID NO: 133, SEQ ID NO: 134, or SEQ ID NO: 135, or any variants of the foregoing.

15. The isolated antibody of any of the preceding embodiments, wherein the antibody comprises a V_L sequence of SEQ ID NO: 127, SEQ ID NO: 128, SEQ ID NO: 129, SEQ ID NO: 130, SEQ ID NO: 131, SEQ ID NO: 132, SEQ ID NO: 133, SEQ ID NO: 134, or SEQ ID NO: 135, or any variants of the foregoing.

16. The isolated antibody of any of the preceding embodiments, wherein the antibody comprises a V_L sequence of SEQ ID NO: 127, SEQ ID NO: 128, SEQ ID NO: 129, or SEQ ID NO: 130, or any variants of the foregoing.

17. The isolated antibody of any of the preceding embodiments, wherein the antibody comprises a V_L sequence of SEQ ID NO: 127 or SEQ ID NO: 128.

18. The isolated antibody of any of the preceding embodiments, wherein the antibody comprises a V_H sequence of SEQ ID NO: 2, SEQ ID NO: 4, SEQ ID NO: 6, SEQ ID NO: 8, SEQ ID NO: 10, SEQ ID NO: 12, SEQ ID NO: 14, SEQ ID NO: 16, SEQ ID NO: 18, SEQ ID NO: 20, SEQ ID NO: 103, SEQ ID NO: 105, SEQ ID NO: 107, SEQ ID NO: 109, SEQ ID NO: 111, SEQ ID NO: 113, SEQ ID NO: 115, SEQ ID NO: 117, SEQ ID NO: 119, SEQ ID NO: 121, or SEQ ID NO: 123, or any variant thereof.

19. The isolated antibody of any of the preceding embodiments, wherein the antibody comprises a V_H sequence of SEQ ID NO: 103.

20. The isolated antibody of any of the preceding embodiments, wherein the antibody comprises a V_H sequence of SEQ ID NO: 105.

21. The isolated antibody of any of the preceding embodiments, wherein the antibody comprises a V_H sequence of SEQ ID NO: 107.

22. The isolated antibody of any of the preceding embodiments, wherein the antibody comprises a V_H sequence of SEQ ID NO: 109.

23. The isolated antibody of any of the preceding embodiments, wherein the antibody comprises a V_H sequence of SEQ ID NO: 111.

24. The isolated antibody of any of the preceding embodiments, wherein the antibody comprises a V_H sequence of SEQ ID NO: 113.

25. The isolated antibody of any of the preceding embodiments, wherein the antibody comprises a V_H sequence of SEQ ID NO: 115.

26. The isolated antibody of any of the preceding embodiments, wherein the antibody comprises a V_H sequence of SEQ ID NO: 117.

27. The isolated antibody of any of the preceding embodiments, wherein the antibody comprises a V_H sequence of SEQ ID NO: 119.

28. The isolated antibody of any of the preceding embodiments, wherein the antibody comprises a V_H sequence of SEQ ID NO: 121.

29. The isolated antibody of any of the preceding embodiments, wherein the antibody comprises a V_H sequence of SEQ ID NO: 123.

30. The isolated antibody of any of the preceding embodiments, wherein the antibody comprises a CDR of GFSFSSY (SEQ ID NO: 139); YSSASSTY (SEQ ID NO: 140); AAGRTYRGWATYIADSIDA (SEQ ID NO: 82); GFDFSSY (SEQ ID NO: 141); GSTGSS (SEQ ID NO: 142); SVGNGNSWSGYIATSIDA (SEQ ID NO: 57); GFSISSY (SEQ ID NO: 143); YSGSR (SEQ ID NO: 144); SSYCTAWTGCDVYAGGSIDA (SEQ ID NO: 92); GFTFSSY (SEQ ID NO: 145); DSGST (SEQ ID NO: 146); DAYGYCGWSGCSADSIDA (SEQ ID NO: 97), SGDSSWYGYG (SEQ ID NO: 83); ESGKRPS (SEQ ID NO: 84);

GSADSNSIGI (SEQ ID NO: 85); SGGSSGYG (SEQ ID NO: 87); SNDKRPS (SEQ ID NO: 88); GSTDNSYVGI (SEQ ID NO: 89); SGDSSDDGSYYYG (SEQ ID NO: 93); SNDKRPS (SEQ ID NO: 88); GSYDSSTGI (SEQ ID NO: 94); SGGNNYYG (SEQ ID NO: 98); YNDKRPS (SEQ ID NO: 99); GGWDSSGGI (SEQ ID NO: 100), or as otherwise described herein.

31. The isolated antibody of any of the preceding embodiments, wherein the antibody comprises a V_H CDR of GFSFSSY (SEQ ID NO: 139); YSSASSTY (SEQ ID NO: 140); AAGRTYRGWATYIADSIDA (SEQ ID NO: 82); GFDFSSY (SEQ ID NO: 141); GSTGSS (SEQ ID NO: 142); SVGNGNSWSGYIATSIDA (SEQ ID NO: 57); GFSISSY (SEQ ID NO: 143); YSGSR (SEQ ID NO: 144); SSYCTAWTGCDVYAGGSIDA (SEQ ID NO: 92); GFTFSSY (SEQ ID NO: 145); DSGST (SEQ ID NO: 146); DAYGYCGWSGCSADSIDA (SEQ ID NO: 97); CSGDSSWYGYG (SEQ ID NO: 22); IYESGKRP (SEQ ID NO: 23); CGSADSNSIGIF (SEQ ID NO: 24); GFSFSSYDMGWV (SEQ ID NO: 25); VASIYSSASSTYYA (SEQ ID NO: 26); CAKAAGRTYRGWATYIADSIDA (SEQ ID NO: 27); CSGGSSGYG (SEQ ID NO: 28); IYSNDKRP (SEQ ID NO: 29); CGSTDNSYVGIF (SEQ ID NO: 30); GFDFSSYAMNWV (SEQ ID NO: 31); VAGIGSTGSSTGYG (SEQ ID NO: 32); CAKSVGNGNSWSGYIATSIDA (SEQ ID NO: 33); CSGDSSDDGSYYYG (SEQ ID NO: 34); IYSNDKRP (SEQ ID NO: 29); CGSYDSSTGIF (SEQ ID NO: 36); GFSISSYTMQWV (SEQ ID NO: 37); VAGIYSGSRTYYG (SEQ ID NO: 38); CAKSSYCTAWTGCDVYAGGSIDA (SEQ ID NO: 39); CSGGNNYYG (SEQ ID NO: 40); IYYNDKRP (SEQ ID NO: 41); CGGWDSSGGIF (SEQ ID NO: 42); GFTFSSYSMFWV (SEQ ID NO: 43); VAGIDSGSTTFYG (SEQ ID NO: 44); CAKDAYGYCGWSGCSADSIDA (SEQ ID NO: 45); CSGDSSWYGYG (SEQ ID NO: 22); IYESGKRP (SEQ ID NO: 23); CGSADSNSIGIF (SEQ ID NO: 24); GFSFSSYDMGWV (SEQ ID NO: 25); VASIYSSASSTYYA (SEQ ID NO: 26); CAKAAGRTYRGWATYIADSIDA (SEQ ID NO: 27); CSGGSSGYG (SEQ ID NO: 28); IYSNDKRP (SEQ ID NO: 29); CGSTDNSYVGIF (SEQ ID NO: 30); GFDFSSYAMNWV (SEQ ID NO:

31); VAGIGSTGSSTGYA (SEQ ID NO: 46); CAKSVGNGNSWSGYIATSIDA (SEQ ID NO: 33); CSGDDGSYYYG (SEQ ID NO: 47); IYSNDKRP (SEQ ID NO: 29); CGSYDSSTGIF (SEQ ID NO: 36); GFSISSYTMQWV (SEQ ID NO: 37); VAGIYSGSRTYYA (SEQ ID NO: 48); CAKSSYCTAWTGCDVYAGGSIDA (SEQ ID NO: 39); CSGGNNYYG (SEQ ID NO: 40); IYYNDKRP (SEQ ID NO: 41); CGGWDSSGGIF (SEQ ID NO: 42); GFTFSSYSMFWV (SEQ ID NO: 43); VAGIDSGSTTFYA (SEQ ID NO: 49); CAKDAYGYCGWSGCSADSIDA (SEQ ID NO: 45); CSGGSGSYG (SEQ ID NO: 50); IYGTNKRP (SEQ ID NO: 51); CGSADSSTNAGIF (SEQ ID NO: 52); GFTFSSYAMSWV (SEQ ID NO: 53); VAGISSSGRYTGYA (SEQ ID NO: 54); CAKSVGNGNSWSGYIATSIDA (SEQ ID NO: 33); CSGGSGSYG (SEQ ID NO: 50); IYGTNKRP (SEQ ID NO: 51); CGSADSSTNAGIF (SEQ ID NO: 52); GFTFSSYAMNWV (SEQ ID NO: 55); or VAGISSSGRYTGYA (SEQ ID NO: 54); CAKSVGNGNSWSGYIATSIDA (SEQ ID NO: 33), or as otherwise described herein.

32. The isolated antibody of any of the preceding embodiments, wherein the antibody comprises a V_L CDR of SGDSSWYGYG (SEQ ID NO: 83); ESGKRPS (SEQ ID NO: 84); GSADSNSIGI (SEQ ID NO: 85); SGGSSGYG (SEQ ID NO: 87); SNDKRPS (SEQ ID NO: 88); GSTDNSYVGI (SEQ ID NO: 89); SGDSSDDGSYYYG (SEQ ID NO: 93); SNDKRPS (SEQ ID NO: 88); GSYDSSTGI (SEQ ID NO: 94); SGGNNYYG (SEQ ID NO: 98); YNDKRPS (SEQ ID NO: 99); GGWDSSGGI (SEQ ID NO: 100), CSGDSSWYGYG (SEQ ID NO: 22); IYESGKRP (SEQ ID NO: 23); CGSADSNSIGIF (SEQ ID NO: 24); CSGGSSGYG (SEQ ID NO: 28); IYSNDKRP (SEQ ID NO: 29); CGSTDNSYVGIF (SEQ ID NO: 30); CSGDSSDDGSYYYG (SEQ ID NO: 34); IYSNDKRP (SEQ ID NO: 29); CGSYDSSTGIF (SEQ ID NO: 36); CSGGNNYYG (SEQ ID NO: 40); IYYNDKRP (SEQ ID NO: 41); CGGWDSSGGIF (SEQ ID NO: 42); IYESGKRP (SEQ ID NO: 23); CGSADSNSIGIF (SEQ ID NO: 24); CSGGSSGYG (SEQ ID NO: 28); IYSNDKRP (SEQ ID NO: 29); CGSTDNSYVGIF (SEQ ID NO: 30);

CSGDDGSYYYG (SEQ ID NO: 47); IYSNDKRP (SEQ ID NO: 29); CGSYDSSTGIF (SEQ ID NO: 36); CSGGNNYYG (SEQ ID NO: 40); IYYNDKRP (SEQ ID NO: 41); CGGWDSSGGIF (SEQ ID NO: 42); CSGGSGSYG (SEQ ID NO: 50); IYGTNKRP (SEQ ID NO: 51); CGSADSSTNAGIF (SEQ ID NO: 52); CSGGSGSYG (SEQ ID NO: 50); IYGTNKRP (SEQ ID NO: 51); or CGSADSSTNAGIF (SEQ ID NO: 52), or as otherwise described herein.

33. The isolated antibody of any one of the preceding embodiments, wherein the CDRs of the V_H chain comprises:

1H. GFSFSSY (SEQ ID NO: 139); YSSASSTY (SEQ ID NO: 140); and AAGRTYRGWATYIADSIDA (SEQ ID NO: 82); or

2H. GFDFSSY (SEQ ID NO: 141); GSTGSS (SEQ ID NO: 142); and SVGNGNSWSGYIATSIDA (SEQ ID NO: 57); or

3H. GFSISSY (SEQ ID NO: 143); YSGSR (SEQ ID NO: 144); and SSYCTAWTGCDVYAGGSIDA (SEQ ID NO: 92); or

4H. GFTFSSY (SEQ ID NO: 145); DSGST (SEQ ID NO: 146); and DAYGYCGWSGCSADSIDA (SEQ ID NO: 97); or

5H. GFSFSSYDMGWV (SEQ ID NO: 25); VASIYSSASSTYYA (SEQ ID NO: 26); and CAKAAGRTYRGWATYIADSIDA (SEQ ID NO: 27); or

6H. GFDFSSYAMNWV (SEQ ID NO: 31); VAGIGSTGSSTGYG (SEQ ID NO: 32); and CAKSVGNGNSWSGYIATSIDA (SEQ ID NO: 33); or

7H. GFSISSYTMQWV (SEQ ID NO: 37); VAGIYSGSRTYYG (SEQ ID NO: 38); and CAKSSYCTAWTGCDVYAGGSIDA (SEQ ID NO: 39); or

8H. GFTFSSYSMFWV (SEQ ID NO: 43); VAGIDSGSTTFYG (SEQ ID NO: 44); and CAKDAYGYCGWSGCSADSIDA (SEQ ID NO: 45); or

9H. GFSFSSYDMGWV (SEQ ID NO: 25); VASIYSSASSTYYA (SEQ ID NO: 26); and CAKAAGRTYRGWATYIADSIDA (SEQ ID NO: 27); or

10H. GFDFSSYAMNWV (SEQ ID NO: 31); VAGIGSTGSSTGYA (SEQ ID NO: 46); and CAKSVGNGNSWSGYIATSIDA (SEQ ID NO: 33); or

11H. GFSISSYTMQWV (SEQ ID NO: 37); VAGIYSGSRTYYA (SEQ ID NO: 48); and CAKSSYCTAWTGCDVYAGGSIDA (SEQ ID NO: 39); or

12H. GFTFSSYSMFWV (SEQ ID NO: 43); VAGIDSGSTTFYA (SEQ ID NO: 49); and CAKDAYGYCGWSGCSADSIDA (SEQ ID NO: 45); or

13H. GFTFSSYAMSWV (SEQ ID NO: 53); VAGISSSGRYTGYA (SEQ ID NO: 54); and CAKSVGNGNSWSGYIATSIDA (SEQ ID NO: 33); or

14H. GFTFSSYAMNWV (SEQ ID NO: 55); VAGISSSGRYTGYA (SEQ ID NO: 54); and CAKSVGNGNSWSGYIATSIDA (SEQ ID NO: 33); or

15H. SYAMS (SEQ ID NO: 56); GISSSGRYTGYADSVKG (SEQ ID NO: 101); and SVGNGNSWSGYIATSIDA (SEQ ID NO: 57); or

16H. SYAMS (SEQ ID NO: 56); GISSSGRYTGYADSVKG (SEQ ID NO: 101); and SVGNGNSWSGYVATSIDA (SEQ ID NO: 61); or

17H. SYAMN (SEQ ID NO: 62); GISSSGRYTGYADSVKG (SEQ ID NO: 101); and SVGSGVSWSGYVATSIDA (SEQ ID NO: 63); or

18H. SYAMN (SEQ ID NO: 62); GISSSGRYTGYADSVKG (SEQ ID NO: 101); and SMGSGVSWSGYVATSIDA (SEQ ID NO: 65); or

19H. SYAMN (SEQ ID NO: 62); GISSSGRYTGYADSVKG (SEQ ID NO: 101); and SMGSGVSWSGYVATSIDV (SEQ ID NO: 66); or

20H. SYAMN (SEQ ID NO: 62); GISSSGRYTGYADSVKG (SEQ ID NO: 101); and SVGSGVSWSGYVATSLDA (SEQ ID NO: 67); or

21H. SYAMN (SEQ ID NO: 62); GISSSGRYTGYADSVKG (SEQ ID NO: 101); and SMGSGVSWSGYVATSIDA (SEQ ID NO: 65); or

22H. SYAMN (SEQ ID NO: 62); GISSSGRYTGYADSVKG (SEQ ID NO: 101); and SMGSGVSWSGYVATSLDV (SEQ ID NO: 126); or

23H. SYAMN (SEQ ID NO: 62); GISSSGRYTGYADSVKG (SEQ ID NO: 101); and SVGSGVSWSGYVATSLDV (SEQ ID NO: 69); or

24H. SYAMN (SEQ ID NO: 62); GISSSGRYTGYADSVKG (SEQ ID NO: 101); and SVGSGVSWSGYVATSLDV (SEQ ID NO: 69); or

25H. SYGMS (SEQ ID NO: 71); GIGSSGIYTHYADSVKG (SEQ ID NO: 72); and SPGDSDWCGWAGYGIYSCRVAGFIDA (SEQ ID NO: 73); or

26H. GYAMS (SEQ ID NO: 76); GIYSSGSYTFYADSVKG (SEQ ID NO: 77); and GTGYCDWSGWCYSGAANIDA (SEQ ID NO: 78); or

27H. SYDMG (SEQ ID NO: 80); SIYSSASSTYYAPAVKG (SEQ ID NO: 81); and AAGRTYRGWATYIADSIDA (SEQ ID NO: 82); or

28H. SYAMN (SEQ ID NO: 62); GIGSTGSSTGYGPAVKG (SEQ ID NO: 86); and SVGNGNSWSGYIATSIDA (SEQ ID NO: 57); or

29H. SYTMQ (SEQ ID NO: 90); GIYSGSRTYYGAAVQG (SEQ ID NO: 91); and SSYCTAWTGCDVYAGGSIDA (SEQ ID NO: 92); or

30H. SYSMF (SEQ ID NO: 95); GIDSGSTTFYGSAVKG (SEQ ID NO: 96); and DAYGYCGWSGCSADSIDA (SEQ ID NO: 97); or

31H. SYAMN (SEQ ID NO: 62); GISSSGRYTGYADSVKG (SEQ ID NO: 101); and SVGNGNSWSGYIATSIDA (SEQ ID NO: 57); or

32H. SYAMN (SEQ ID NO: 62); GIGSTGSSTGYADSVKG (SEQ ID NO: 102); and SVGNGNSWSGYIATSIDA (SEQ ID NO: 57).

34. The isolated antibody of any one of the preceding embodiments, wherein the V_L chain comprises the CDRs of:

1L. SGDSSWYGYG (SEQ ID NO: 83); ESGKRPS (SEQ ID NO: 84); and GSADSNSIGI (SEQ ID NO: 85); or

2L. SGGSSGYG (SEQ ID NO: 87); SNDKRPS (SEQ ID NO: 88); and GSTDNSYVGI (SEQ ID NO: 89); or

3L. SGDSSDDGSYYYG (SEQ ID NO: 93); SNDKRPS (SEQ ID NO: 88); and GSYDSSTGI (SEQ ID NO: 94); or

4L. SGGNNYYG (SEQ ID NO: 98); YNDKRPS (SEQ ID NO: 99); and GGWDSSGGI (SEQ ID NO: 100); or

5L. CSGDSSWYGYG (SEQ ID NO: 22); IYESGKRP (SEQ ID NO: 23); and CGSADSNSIGIF (SEQ ID NO: 24); or

6L. CSGGSSGYG (SEQ ID NO: 28); IYSNDKRP (SEQ ID NO: 29); and CGSTDNSYVGIF (SEQ ID NO: 30); or

7L. CSGDSSDDGSYYYG (SEQ ID NO: 34); IYSNDKRP (SEQ ID NO: 29); and CGSYDSSTGIF (SEQ ID NO: 36); or

8L. CSGGNNYYG (SEQ ID NO: 40); IYYNDKRP (SEQ ID NO: 41); and CGGWDSSGGIF (SEQ ID NO: 42); or

9L. CSGDSSWYGYG (SEQ ID NO: 22); IYESGKRP (SEQ ID NO: 23); and CGSADSNSIGIF (SEQ ID NO: 24); or

10L. CSGGSSGYG (SEQ ID NO: 28); IYSNDKRP (SEQ ID NO: 29); and CGSTDNSYVGIF (SEQ ID NO: 30); or

11L. CSGDDGSYYYG (SEQ ID NO: 47); IYSNDKRP (SEQ ID NO: 29); and CGSYDSSTGIF (SEQ ID NO: 36); or

12L. CSGGNNYYG (SEQ ID NO: 40); IYYNDKRP (SEQ ID NO: 41); and CGGWDSSGGIF (SEQ ID NO: 42); or

13L. CSGGSGSYG (SEQ ID NO: 50); IYGTNKRP (SEQ ID NO: 51); and CGSADSSTNAGIF (SEQ ID NO: 52); or

14L. CSGGSGSYG (SEQ ID NO: 50); IYGTNKRP (SEQ ID NO: 51); and CGSADSSTNAGIF (SEQ ID NO: 52); or

15L. SGGSGSYG (SEQ ID NO: 58); GTNKRPS (SEQ ID NO: 59); and GSADSSTNAGI (SEQ ID NO: 60); or

16L. SGGSGSYG (SEQ ID NO: 58); GTNKRPS (SEQ ID NO: 59); and GSADSSTNAGI (SEQ ID NO: 60); or

17L. SAGSGLYG (SEQ ID NO: 64); GTNKRPS (SEQ ID NO: 59); and GSADSSTNAGI (SEQ ID NO: 60); or

18L. SAGSGLYG (SEQ ID NO: 64); GTNKRPS (SEQ ID NO: 59); and GSADSSTNAGI (SEQ ID NO: 60); or

19L. SAGSGLYG (SEQ ID NO: 64); GTNKRPS (SEQ ID NO: 59); and GSADSSTNAGI (SEQ ID NO: 60); or

20L. SAGSGLYG (SEQ ID NO: 64); GTNKRPS (SEQ ID NO: 59); and GSADSSTNAGI (SEQ ID NO: 60); or

21L. SGGSGSYG (SEQ ID NO: 58); GTYKRPS (SEQ ID NO: 68); and GSADSSTNAGI (SEQ ID NO: 60); or

22L. SGGSGSYG (SEQ ID NO: 58); GTYKRPS (SEQ ID NO: 68); and GSADSSTNAGI (SEQ ID NO: 60); or

23L. SGGSGSYG (SEQ ID NO: 58); GTYKRPS (SEQ ID NO: 68); and GSADSSTNAGI (SEQ ID NO: 60); or

24L. SAGSGLYG (SEQ ID NO: 64); GTNKRPS (SEQ ID NO: 59); and GSNDASTNAGI (SEQ ID NO: 70); or

25L. SGGYNGHYG (SEQ ID NO: 74); GTNKRPS (SEQ ID NO: 59); and GGYDSSAGI (SEQ ID NO: 75); or

26L. SGGSGSYGYYG; GTNKRPS (SEQ ID NO: 59); and GSEDSSSGAGI (SEQ ID NO: 79); or

27L. SGDSSWYGYG (SEQ ID NO: 83); ESGKRPS (SEQ ID NO: 84); and GSADSNSIGI (SEQ ID NO: 85); or

28L. SGGSSGYG (SEQ ID NO: 87); SNDKRPS (SEQ ID NO: 88); and GSTDNSYVGI (SEQ ID NO: 89); or

29L. SGDSSDDGSYYYG (SEQ ID NO: 93); SNDKRPS (SEQ ID NO: 88); and GSYDSSTGI (SEQ ID NO: 94); or

30L. SGGNNYYG (SEQ ID NO: 98); YNDKRPS (SEQ ID NO: 99); and GGWDSSGGI (SEQ ID NO: 100); or

31L. SGGSGSYG (SEQ ID NO: 58); GTNKRPS (SEQ ID NO: 59); and GSADSSTNAGI (SEQ ID NO: 60); or

32L. SGGSSGYG (SEQ ID NO: 87); SNDKRPS (SEQ ID NO: 88); and GSTDNSYVGI (SEQ ID NO: 89).

35. The antibody of any one of the preceding embodiments, wherein the antibody comprises the CDRs of 1H and 1L, 1H and 2L, 1H and 3L, 1H and 4L, 1H and 5L, 1H and 6L, 1H and 7L, 1H and 8L, 1H and 9L, 1H and 10L, 1H and 11L, 1H and 12L, 1H and 13L, 1H and 14L, 1H and 15L, 1H and 16L, 1H and 17L, 1H and 18L, 1H and 19L, 1H and 20L, 1H and 21L, 1H and 22L, 1H and 23L, 1H and 24L, 1H and 25L, 1H and 26L, 1H and 27L, 1H and 28L, 1H and 29L, 1H and 30L, 1H and 31L, 1H and 32L, 2H and 1L, 2H and 2L, 2H and 3L,

2H and 4L, 2H and 5L, 2H and 6L, 2H and 7L, 2H and 8L, 2H and 9L, 2H and 10L, 2H and 11L, 2H and 12L, 2H and 13L, 2H and 14L, 2H and 15L, 2H and 16L, 2H and 17L, 2H and 18L, 2H and 19L, 2H and 20L, 2H and 21L, 2H and 22L, 2H and 23L, 2H and 24L, 2H and 25L, 2H and 26L, 2H and 27L, 2H and 28L, 2H and 29L, 2H and 30L, 2H and 31L, 2H and 32L, 3H and 1L, 3H and 2L, 3H and 3L, 3H and 4L, 3H and 5L, 3H and 6L, 3H and 7L, 3H and 8L, 3H and 9L, 3H and 10L, 3H and 11L, 3H and 12L, 3H and 13L, 3H and 14L, 3H and 15L, 3H and 16L, 3H and 17L, 3H and 18L, 3H and 19L, 3H and 20L, 3H and 21L, 3H and 22L, 3H and 23L, 3H and 24L, 3H and 25L, 3H and 26L, 3H and 27L, 3H and 28L, 3H and 29L, 3H and 30L, 3H and 31L, 3H and 32L, 4H and 1L, 4H and 2L, 4H and 3L, 4H and 4L, 4H and 5L, 4H and 6L, 4H and 7L, 4H and 8L, 4H and 9L, 4H and 10L, 4H and 11L, 4H and 12L, 4H and 13L, 4H and 14L, 4H and 15L, 4H and 16L, 4H and 17L, 4H and 18L, 4H and 19L, 4H and 20L, 4H and 21L, 4H and 22L, 4H and 23L, 4H and 24L, 4H and 25L, 4H and 26L, 4H and 27L, 4H and 28L, 4H and 29L, 4H and 30L, 4H and 31L, 4H and 32L, 5H and 1L, 5H and 2L, 5H and 3L, 5H and 4L, 5H and 5L, 5H and 6L, 5H and 7L, 5H and 8L, 5H and 9L, 5H and 10L, 5H and 11L, 5H and 12L, 5H and 13L, 5H and 14L, 5H and 15L, 5H and 16L, 5H and 17L, 5H and 18L, 5H and 19L, 5H and 20L, 5H and 21L, 5H and 22L, 5H and 23L, 5H and 24L, 5H and 25L, 5H and 26L, 5H and 27L, 5H and 28L, 5H and 29L, 5H and 30L, 5H and 31L, 5H and 32L, 6H and 1L, 6H and 2L, 6H and 3L, 6H and 4L, 6H and 5L, 6H and 6L, 6H and 7L, 6H and 8L, 6H and 9L, 6H and 10L, 6H and 11L, 6H and 12L, 6H and 13L, 6H and 14L, 6H and 15L, 6H and 16L, 6H and 17L, 6H and 18L, 6H and 19L, 6H and 20L, 6H and 21L, 6H and 22L, 6H and 23L, 6H and 24L, 6H and 25L, 6H and 26L, 6H and 27L, 6H and 28L, 6H and 29L, 6H and 30L, 6H and 31L, 6H and 32L, 7H and 1L, 7H and 2L, 7H and 3L, 7H and 4L, 7H and 5L, 7H and 6L, 7H and 7L, 7H and 8L, 7H and 9L, 7H and 10L, 7H and 11L, 7H and 12L, 7H and 13L, 7H and 14L, 7H and 15L, 7H and 16L, 7H and 17L, 7H and 18L, 7H and 19L, 7H and 20L, 7H and 21L, 7H and 22L, 7H and 23L, 7H and 24L, 7H and 25L, 7H and 26L, 7H and 27L, 7H and 28L, 7H and 29L, 7H

and 30L, 7H and 31L, 7H and 32L, 8H and 1L, 8H and 2L, 8H and 3L, 8H and 4L, 8H and 5L, 8H and 6L, 8H and 7L, 8H and 8L, 8H and 9L, 8H and 10L, 8H and 11L, 8H and 12L, 8H and 13L, 8H and 14L, 8H and 15L, 8H and 16L, 8H and 17L, 8H and 18L, 8H and 19L, 8H and 20L, 8H and 21L, 8H and 22L, 8H and 23L, 8H and 24L, 8H and 25L, 8H and 26L, 8H and 27L, 8H and 28L, 8H and 29L, 8H and 30L, 8H and 31L, 8H and 32L, 9H and 1L, 9H and 2L, 9H and 3L, 9H and 4L, 9H and 5L, 9H and 6L, 9H and 7L, 9H and 8L, 9H and 9L, 9H and 10L, 9H and 11L, 9H and 12L, 9H and 13L, 9H and 14L, 9H and 15L, 9H and 16L, 9H and 17L, 9H and 18L, 9H and 19L, 9H and 20L, 9H and 21L, 9H and 22L, 9H and 23L, 9H and 24L, 9H and 25L, 9H and 26L, 9H and 27L, 9H and 28L, 9H and 29L, 9H and 30L, 9H and 31L, 9H and 32L, 10H and 1L, 10H and 2L, 10H and 3L, 10H and 4L, 10H and 5L, 10H and 6L, 10H and 7L, 10H and 8L, 10H and 9L, 10H and 10L, 10H and 11L, 10H and 12L, 10H and 13L, 10H and 14L, 10H and 15L, 10H and 16L, 10H and 17L, 10H and 18L, 10H and 19L, 10H and 20L, 10H and 21L, 10H and 22L, 10H and 23L, 10H and 24L, 10H and 25L, 10H and 26L, 10H and 27L, 10H and 28L, 10H and 29L, 10H and 30L, 10H and 31L, 10H and 32L, 11H and 1L, 11H and 2L, 11H and 3L, 11H and 4L, 11H and 5L, 11H and 6L, 11H and 7L, 11H and 8L, 11H and 9L, 11H and 10L, 11H and 11L, 11H and 12L, 11H and 13L, 11H and 14L, 11H and 15L, 11H and 16L, 11H and 17L, 11H and 18L, 11H and 19L, 11H and 20L, 11H and 21L, 11H and 22L, 11H and 23L, 11H and 24L, 11H and 25L, 11H and 26L, 11H and 27L, 11H and 28L, 11H and 29L, 11H and 30L, 11H and 31L, 11H and 32L, 12H and 1L, 12H and 2L, 12H and 3L, 12H and 4L, 12H and 5L, 12H and 6L, 12H and 7L, 12H and 8L, 12H and 9L, 12H and 10L, 12H and 11L, 12H and 12L, 12H and 13L, 12H and 14L, 12H and 15L, 12H and 16L, 12H and 17L, 12H and 18L, 12H and 19L, 12H and 20L, 12H and 21L, 12H and 22L, 12H and 23L, 12H and 24L, 12H and 25L, 12H and 26L, 12H and 27L, 12H and 28L, 12H and 29L, 12H and 30L, 12H and 31L, 12H and 32L, 13H and 1L, 13H and 2L, 13H and 3L, 13H and 4L, 13H and 5L, 13H and 6L, 13H and 7L, 13H and 8L, 13H and 9L, 13H and 10L, 13H and 11L, 13H and 12L, 13H and 13L, 13H and 14L, 13H and 15L, 13H

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10L, 24H and 11L, 24H and 12L, 24H and 13L, 24H and 14L, 24H and 15L, 24H and 16L, 24H and 17L, 24H and 18L, 24H and 19L, 24H and 20L, 24H and 21L, 24H and 22L, 24H and 23L, 24H and 24L, 24H and 25L, 24H and 26L, 24H and 27L, 24H and 28L, 24H and 29L, 24H and 30L, 24H and 31L, 24H and 32L, 25H and 1L, 25H and 2L, 25H and 3L, 25H and 4L, 25H and 5L, 25H and 6L, 25H and 7L, 25H and 8L, 25H and 9L, 25H and 10L, 25H and 11L, 25H and 12L, 25H and 13L, 25H and 14L, 25H and 15L, 25H and 16L, 25H and 17L, 25H and 18L, 25H and 19L, 25H and 20L, 25H and 21L, 25H and 22L, 25H and 23L, 25H and 24L, 25H and 25L, 25H and 26L, 25H and 27L, 25H and 28L, 25H and 29L, 25H and 30L, 25H and 31L, 25H and 32L, 26H and 1L, 26H and 2L, 26H and 3L, 26H and 4L, 26H and 5L, 26H and 6L, 26H and 7L, 26H and 8L, 26H and 9L, 26H and 10L, 26H and 11L, 26H and 12L, 26H and 13L, 26H and 14L, 26H and 15L, 26H and 16L, 26H and 17L, 26H and 18L, 26H and 19L, 26H and 20L, 26H and 21L, 26H and 22L, 26H and 23L, 26H and 24L, 26H and 25L, 26H and 26L, 26H and 27L, 26H and 28L, 26H and 29L, 26H and 30L, 26H and 31L, 26H and 32L, 27H and 1L, 27H and 2L, 27H and 3L, 27H and 4L, 27H and 5L, 27H and 6L, 27H and 7L, 27H and 8L, 27H and 9L, 27H and 10L, 27H and 11L, 27H and 12L, 27H and 13L, 27H and 14L, 27H and 15L, 27H and 16L, 27H and 17L, 27H and 18L, 27H and 19L, 27H and 20L, 27H and 21L, 27H and 22L, 27H and 23L, 27H and 24L, 27H and 25L, 27H and 26L, 27H and 27L, 27H and 28L, 27H and 29L, 27H and 30L, 27H and 31L, 27H and 32L, 28H and 1L, 28H and 2L, 28H and 3L, 28H and 4L, 28H and 5L, 28H and 6L, 28H and 7L, 28H and 8L, 28H and 9L, 28H and 10L, 28H and 11L, 28H and 12L, 28H and 13L, 28H and 14L, 28H and 15L, 28H and 16L, 28H and 17L, 28H and 18L, 28H and 19L, 28H and 20L, 28H and 21L, 28H and 22L, 28H and 23L, 28H and 24L, 28H and 25L, 28H and 26L, 28H and 27L, 28H and 28L, 28H and 29L, 28H and 30L, 28H and 31L, 28H and 32L, 29H and 1L, 29H and 2L, 29H and 3L, 29H and 4L, 29H and 5L, 29H and 6L, 29H and 7L, 29H and 8L, 29H and 9L, 29H and 10L, 29H and 11L, 29H and 12L, 29H and 13L, 29H and 14L, 29H and 15L, 29H and 16L, 29H and 17L, 29H and 18L, 29H and 19L, 29H and 20L, 29H and 21L, 29H and 22L, 29H and 23L,

29H and 24L, 29H and 25L, 29H and 26L, 29H and 27L, 29H and 28L, 29H and 29L, 29H and 30L, 29H and 31L, 29H and 32L, 30H and 1L, 30H and 2L, 30H and 3L, 30H and 4L, 30H and 5L, 30H and 6L, 30H and 7L, 30H and 8L, 30H and 9L, 30H and 10L, 30H and 11L, 30H and 12L, 30H and 13L, 30H and 14L, 30H and 15L, 30H and 16L, 30H and 17L, 30H and 18L, 30H and 19L, 30H and 20L, 30H and 21L, 30H and 22L, 30H and 23L, 30H and 24L, 30H and 25L, 30H and 26L, 30H and 27L, 30H and 28L, 30H and 29L, 30H and 30L, 30H and 31L, 30H and 32L, 31H and 1L, 31H and 2L, 31H and 3L, 31H and 4L, 31H and 5L, 31H and 6L, 31H and 7L, 31H and 8L, 31H and 9L, 31H and 10L, 31H and 11L, 31H and 12L, 31H and 13L, 31H and 14L, 31H and 15L, 31H and 16L, 31H and 17L, 31H and 18L, 31H and 19L, 31H and 20L, 31H and 21L, 31H and 22L, 31H and 23L, 31H and 24L, 31H and 25L, 31H and 26L, 31H and 27L, 31H and 28L, 31H and 29L, 31H and 30L, 31H and 31L, 31H and 32L, 32H and 1L, 32H and 2L, 32H and 3L, 32H and 4L, 32H and 5L, 32H and 6L, 32H and 7L, 32H and 8L, 32H and 9L, 32H and 10L, 32H and 11L, 32H and 12L, 32H and 13L, 32H and 14L, 32H and 15L, 32H and 16L, 32H and 17L, 32H and 18L, 32H and 19L, 32H and 20L, 32H and 21L, 32H and 22L, 32H and 23L, 32H and 24L, 32H and 25L, 32H and 26L, 32H and 27L, 32H and 28L, 32H and 29L, 32H and 30L, 32H and 31L, or 32H and 32L.

36. The isolated antibody of any one of the preceding embodiments, wherein the antibody is humanized.

37. The isolated antibody of the of any one of the preceding embodiments, wherein the antibody is chimeric or fused to a non-antibody protein.

38. The isolated antibody of any one of the preceding embodiments, wherein the antibody does not significantly bind to claudin 9.

39. The isolated antibody of any one of the preceding embodiments, wherein the antibody binds to the claudin 6 with an affinity, EC_{50}, or K_D at least 100, 200, or 300 times greater than it binds to claudin 9.

40. The isolated antibody of any one of the preceding embodiments, wherein the, CDR amino acid sequence, VL or VH peptide is at least, or about 90-99%

identical to a sequence as provided herein or the sequence has 1, 2, 3, 4, or 5 substitutions.

41. A peptide comprising, consisting of, or consisting essentially of a sequence as provided herein, or a variant thereof.

42. The peptide of embodiment 41, wherein the peptide is a CDR, VL, or VH peptide.

43. The peptide of embodiment 41, wherein the peptide comprises, consists of, or consists essentially of a sequence of SEQ ID NO: 2-138, or a variant thereof or as otherwise provided for herein.

44. A peptide comprising, consisting of, or consisting essentially of a sequence that is 90-99% identical to a sequence as provided herein.

45. The peptide of embodiment 44, wherein peptide comprises a 1, 2, 3, 4, or 5 substitutions, deletions, or insertions as compared to a sequence as provided herein.

46. The peptide of embodiments 44 or 45, wherein the peptide is a CDR, VL, or VH peptide.

47. The peptide of embodiment 44 or 45, wherein the sequence provided herein comprises a sequence of SEQ ID NO: 2-135, or a variant thereof, or as otherwise provided for herein.

48. An antibody, such as a monoclonal antibody or scFv, that binds to an epitope on Claudin 6 whose residues include T33, N38, D68, P74, D76, D146, V152, A153, E154, Q156, R158, or any combination thereof.

49. An antibody, such as a monoclonal antibody or a scFv, that binds preferentially to Claudin 6 as compared to Claudin 9, wherein the antibody binds to an epitope on Claudin 6 that comprises Q156.

50. A bi-specific antibody comprising a first V_H peptide that binds to Claudin 6 and second V_H peptide that binds to a different moiety.

51. The antibody of embodiment 46, wherein the second V_H peptide binds to CD3 or 4-1BB.

52. The antibody of embodiments 50 or 51, wherein the antibody is a bi-

specific antibody or where the antibody is fusion protein.

53. The antibody of embodiments 50-52, further comprising a linker domain that links the antibody that binds to claudin 6 and the second V_H peptide.

54. The antibody of any one of embodiments 50-53, wherein the linker domain comprises 1, 2, 3, 4, or 5, or more GGGGS (SEQ ID NO: 137) repeats.

55. The antibody of any one of embodiments 50-54, wherein the antibody comprises heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 25, 31, 37, 43, 53, 55, 56, 62, 71, 76, 80, 90, or 95; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 26, 32, 38, 44, 46, 48, 49, 54, 125, 72, 77, 81, 86, 91, 96, 101, or 102 and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 27, 33, 39, 45, 57, 61, 63, 65, 66, 67, 126, 69, 73, 82, 57, 92, or 97 or variants of any of the foregoing.

56. The antibody of any one of embodiments 50-55, wherein the antibody comprises:

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 25; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 26; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 27, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 31; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 32; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 33, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 37; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 38; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 39, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 43; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 44; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 45, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 31; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 46; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 33, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 37; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 48; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 39, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 43; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 49; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 45, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 53; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 54; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 33, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 55; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 54; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 33, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 56; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 57, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 56; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 61, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 63, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 65, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 66, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 67, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 126, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 69, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 71; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 72; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 73, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 76; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 77; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 78, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 80; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 81; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 82, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 86; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 57, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 90; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 91; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 92, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 95; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 96; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 97, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 101; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 57, or variants of any of the foregoing; or

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 102; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 57, or variants of any of the foregoing.

57. The antibody of any one of embodiments 50-56, wherein the antibody comprises a light chain variable region comprising a sequence of any one of sequences as set forth in SEQ ID NOs: 127-135.

58. The antibody of any one of embodiments 50-56, wherein the antibody comprises a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 22, 28, 34, 40, 47, 50, 58, 64, 74, 83, 87, 93, or 98; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 23, 29, 41, 51, 59, 68, 84, 88, or 99, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 24, 30, 36, 42, 52, 60, 70, 75, 79, 85, 89, 94, or

variants of any of the foregoing.

59. The antibody of any one of embodiments 50-56, wherein antibody comprises:

a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 22; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 23, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 24, or variants of any of the foregoing;

a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 28; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 29, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 30, or variants of any of the foregoing;

a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 34; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 29, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 36, or variants of any of the foregoing;

a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 40; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 41, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 42, or variants of any of the foregoing;

a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 47; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 29, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 36, or variants of any of the foregoing;

a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid

sequence SEQ ID NO: 50; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 51, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 52, or variants of any of the foregoing;

a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 58; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 59, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 60, or variants of any of the foregoing;

a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 64; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 59, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 60, or variants of any of the foregoing;

a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 58; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 68, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 60, or variants of any of the foregoing;

a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 64; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 59, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 70, or variants of any of the foregoing;

a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 74; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 59, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 75, or variants of any of the foregoing;

a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid

sequence SEQ ID NO: 58; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 59, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 79, or variants of any of the foregoing;

a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 83; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 84, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 85, or variants of any of the foregoing;

a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 87; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 88, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 89, or variants of any of the foregoing;

a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 93; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 88, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 94, or variants of any of the foregoing; or

a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 98; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 99, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 100, or variants of any of the foregoing.

60. The antibody of any one of embodiments 50-56, or antigen binding fragment thereof, wherein the antibody, or antigen binding fragment thereof, comprises:

(i) a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 25, 31, 37, 43, 53, 55, 56, 62, 71, 76, 80, 90, or 95; the heavy chain CDR2 has the amino acid sequence of 26, 32, 38, 44, 46, 48, 49,

54, 125, 72, 77, 81, 86, 91, 96, 101, or 102 and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 27, 33, 39, 45, 57, 61, 63, 65, 66, 67, 126, 69, 73, 82, 57, 92, or 97 or variants of any of the foregoing; and

(ii) a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence 22, 28, 34, 40, 47, 50, 58, 64, 74, 83, 87, 93, or 98; the light chain CDR2 sequence has the amino acid sequence of 23, 29, 41, 51, 59, 68, 84, 88, or 99, and the light chain CDR3 sequence has the amino acid sequence of 24, 30, 36, 42, 52, 60, 70, 75, 79, 85, 89, 94, or variants of any of the foregoing.

61. The antibody of any one of embodiments 50-56, wherein the antibody, or antigen binding fragment thereof, comprises:

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 56; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 57; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 58; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 59; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 60; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 56; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 61; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 58; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 59; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID

NO: 60; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 63; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 64; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 59; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 60; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 65; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 64; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 59; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 60; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 66; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 64; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 59; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID

NO: 60; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 67; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 64; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 59; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 60; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 65; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 58; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 68; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 60; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 126; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 58; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 68; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID

NO: 60; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 69; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 58; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 68; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 60; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 69; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 64; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 59; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 70; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 71; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 72; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 73; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 74; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 59; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID

NO: 75; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 76; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 77; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 78; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 58; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 59; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 79; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 80; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 81; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 82; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 83; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 84; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 85; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 86; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 57; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 87; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 88; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID

NO: 89; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 90; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 91; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 92; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 93; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 88; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 94; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 95; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 96; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 97; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 98; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 99; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 100; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 101; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 57; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 58; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 59; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID

NO: 60; or variants of any of the foregoing; or

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 102; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 57; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 87; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 88; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 89; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 25; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 26; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 27; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 22; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 23; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 24; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 31; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 32; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 33; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 28; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 29; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID

NO: 30; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 37; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 28; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 29; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 34; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 29; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 26; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 43; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 44; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 45; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 40; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 41; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 42; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 31; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 46; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 33; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 28; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 29; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID

NO: 30; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 37; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 48; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 39; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 47; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 29; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 36; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 43; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 49; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 45; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 40; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 41; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 42; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 53; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 54; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 33; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 50; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 51; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID

NO: 52; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 55; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 54; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 33; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 50; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 51; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 52; or variants of any of the foregoing;

62. A nucleic acid molecule encoding an antibody or an amino acid sequence of any of the preceding embodiments.

63. A vector comprising the nucleic acid molecule of embodiment 62.

64. A cell comprising the nucleic comprising the nucleic acid molecule of embodiment 62 or the vector of embodiment 63.

65. A pharmaceutical composition comprising the isolated antibody of any one of embodiments 1-61 or a nucleic acid molecule encoding the same.

66. The pharmaceutical composition of embodiment 65, wherein the composition is an injectable pharmaceutical composition.

67. The pharmaceutical compositions of embodiments 65 or 66, wherein the composition is sterile.

68. The pharmaceutical compositions of any one of embodiments 65-67, wherein the composition is pyrogen free.

69. The pharmaceutical compositions of any one of embodiments 65-68, wherein the composition is free of antibodies that do not bind to Claudin 6.

70. A method of modulating Claudin 6 activity by contacting a cell expressing Claudin 6 with a Claudin 6 antibody or a pharmaceutical composition comprising the same that binds to Claudin 6 on the cell surface.

71. The method of embodiment 70, wherein the antibody is any of the

antibodies provided for herein or an antibody of any one of embodiments 1-61 or a nucleic acid molecule encoding the same.

72. A method for inhibiting the function of Claudin 6 by contacting a cell expressing Claudin 6 with an antibody or a pharmaceutical composition comprising the same that inhibits the function of Claudin 6 by binding to Claudin 6.

73. The method of embodiment 61, wherein the antibody is any of the antibodies provided for herein or an antibody of any one of embodiments 1-61 or a nucleic acid molecule encoding the same.

74. The method of embodiment 72, wherein the antibody is an antibody or peptide of any one of embodiments 1-61.

75. The method of any of one of embodiments 72-74, wherein the antibody is administered to a subject in need of such antibody.

76. The method of embodiment 75, wherein the function is regulation of the tight junction integrity.

77. A method of treating a subject with a Claudin 6 mediated disorder, the method comprising administering a pharmaceutical composition comprising a Claudin 6 antibody to the subject, such as any antibody provided herein or an antibody of any one of embodiments 1-61 or a nucleic acid molecule encoding the same.

78. The method of embodiment 77, wherein the disorder is benign or metastatic cancer, for example, ovarian cancer (*e.g.*, ovarian carcinoma), reproductive cancer (breast, cervical, testicular, uterine, or placental cancer), lung cancer, gastric cancer, hepatic cancer, pancreatic cancer, bile duct cancer, cancer of the urinary bladder, kidney cancer, colon cancer, small bowel cancer, skin cancer, head and neck cancer, sarcoma, or germ cell tumor.

79. The method of embodiments 77 or 78, wherein the antibody is an antibody of any of one of embodiments 1-61 or a nucleic acid molecule encoding the same or a pharmaceutical composition comprising the antibody or the nucleic acid molecule encoding the same.

80. A method of treating cancer in a subject, the method comprising administering a therapeutic that specifically binds to claudin 6 and binds to CD3 and/or 4-1BB.

81. The method of embodiment 80, wherein the therapeutic comprises an antibody of any one of embodiments 1-61 or a nucleic acid molecule encoding the same.

82. A method of treating cancer in a subject, the method comprising administering to the subject a pharmaceutical composition comprising an antibody that binds to residue Q156 of Claudin 6 or nucleic acid molecule encoding the same.

83. The method of embodiment 77, wherein the antibody comprises a CDR, VL, or VH as provided herein or a sequence of SEQ ID NO: 2-135.

84. The method of embodiments 82 or 83, wherein the antibody is a hexabody.

85. The method of embodiment 82, wherein the pharmaceutical composition comprises a chimeric receptor, such as a chimeric antigen receptor (CAR), wherein the receptor comprises an extracellular antibody domain that comprises an antibody of any one of embodiments 1-61 or an antibody that binds to residue Q156 of Claudin 6.

86. The method of embodiment 85, wherein the chimeric receptor comprises a transmembrane domain and an intracellular domain.

87. The method of embodiments 85 and 86, wherein a cell comprises the chimeric receptor.

88. The method of embodiment 87, wherein the cell is an immune cell, such as a T-cell, macrophage, dendritic cell, NK cell, and the like.

89. A multi-specific antibody, wherein the multi-specific antibody comprises an antibody domain as provided herein.

90. The multi-specific antibody of embodiment 89, wherein the antibody domain comprises an antibody, CDR, VL, or VH peptide as provided herein or according to any one of embodiments 1-61.

91. A chimeric receptor comprising an antibody domain as provided herein.

92. The chimeric receptor of embodiment 91, wherein the antibody domain comprises an antibody, CDR, VL, or VH peptide as provided herein or according to any one of embodiments 1-61.

93. A composition comprising an antibody of any one of embodiments 1-61 or an antibody domain as provided herein linked to a drug or other therapeutic.

94. The composition of embodiment 93, wherein the therapeutic is a cytokine, such as IL-2.

95. The composition of embodiment 93, wherein the composition is an antibody drug conjugate (ADC).

96. The composition of any one of embodiments 93-95, wherein the antibody domain comprises an antibody, CDR, VL, or VH peptide as provided herein or according to any one of embodiments 1-61.

97. A hexabody comprising an antibody domain as provided herein.

98. The hexabody of embodiment 97, wherein the antibody domain comprises an antibody, CDR, VL, or VH peptide as provided herein or according to any one of embodiments 1-61 or a sequence comprising one or more sequences of SEQ ID NO: 2-135.

99. A composition comprising a peptide as provided herein, such as a peptide comprising one or more sequences of SEQ ID NO: 2-135.

100. The composition of embodiment 99, wherein the peptide is an antibody, CDR, VL, or VH peptide as provided herein or is a peptide or antibody according to any one of embodiments 1-61.

101. A method of detecting the presence or absence of Claudin 6 in a sample comprising contacting a sample with an antibody as provided herein and any of the preceding embodiments and detecting the binding to a Claudin 6 antigen by the antibody, wherein the detection of the binding indicates the presence Claudin 6; or the absence of the detection of the binding to the Claudin 6 indicates the absence of the Claudin 6.

102. A method of delivering a composition to a cell expressing Claudin 6, the

method comprising contacting a cell with an antibody as provided herein or an antibody of any one of embodiments 1-61, wherein the antibody is linked to another molecule to be delivered to the cell expressing Claudin 6.

103. The method of embodiment 102, wherein the antibody is an antibody, CDR, VL, or VH peptide as provided herein or is a peptide or antibody according to any one of embodiments 1-61, or comprising one or more sequences of SEQ ID NO: 2-135.

104. The methods of embodiments 102 or 103, wherein the other molecule is a drug.

105. A method of contacting a composition to a cell expressing Claudin 6, the method comprising contacting a cell with an antibody as provided herein, wherein the antibody is linked to another molecule to contact with the cell expressing Claudin 6.

106. The method of embodiment 105, wherein the antibody is an antibody, CDR, VL, or VH peptide as provided herein or is a peptide or antibody according to any one of embodiments 1-61, or comprising one or more sequences of SEQ ID NO: 2-135.

107. The methods of embodiments 105 or 106, wherein the other molecule is a drug.

108. The method of any one of embodiments 105-107, wherein the cell expressing claudin 6 is in a subject.

109. The method of any one of embodiments 105-108, wherein the cell is a tumor cell.

110. The method of embodiment 109, wherein the tumor cell is a solid tumor cell.

111. The method of embodiment 110, wherein the tumor cell is an ovarian tumor cell, non-small cell lung tumor cell, teratoma tumor cell, a gastric tumor cell, a lung tumor cell, a breast tumor cell, or a colon tumor cell or other type of tumor or cancer cell provided for herein.

[00256] As provided for herein, the DNA (or RNA sequences) that may encode a protein may vary due to the degeneracy of the genetic code. Such variants are encompassed by the embodiments provided for herein.

[00257] The subject matter is now described with reference to the following examples. These examples are provided for the purpose of illustration only and the claims should in no way be construed as being limited to these examples, but rather should be construed to encompass any and all variations which become evident as a result of the teaching provided herein. Those of skill in the art will readily recognize a variety of non-critical parameters that could be changed or modified to yield essentially similar results.

[00258] Examples

[00259] Example 1: Claudin 6 Antibodies Bind to Claudin 6.

[00260] FIG. 1 illustrates the results of a binding assay showing that Claudin 6 MAbs bind to human Claudin 6. Human embryonic kidney 293T (HEK-293T) cells were transiently transfected with DNA for human Claudin 6 (hsCLDN6) or empty vector along with GFP (pUC) for 22 hours. Claudin 6 MAbs (IM136, IM171, IM172, and IM173) were added at serial dilutions (0.0–10 μg/mL) and incubated for 90 min with shaking. After a wash step, secondary antibody for detection (allophycocyanin-conjugated mouse anti-human IgG Fc; Southern Biotech) was added and incubated for 30–45 min. Cells were washed, and fluorescence was detected by high-throughput Intellicyt flow cytometry, with gating by graphing forward scatter against side scatter. Data were analyzed in GraphPad Prism software based on the geometric mean of fluorescence intensity for the cell population in each well.

[00261] **Example 2: Claudin 6 Antibodies Bind Preferentially to Claudin 6 over other Claudin Proteins.** FIG.2 illustrates the results of a binding assay showing that Claudin 6 MAbs bind to human Claudin 6 preferentially over other Claudin proteins. Human embryonic kidney 293T (HEK-293T) cells were transiently transfected with DNA for the indicated Claudin protein or empty vector along with GFP (pUC) for 22 hours. The results demonstrate that the antibodies can bind preferentially to Claudin 6 over other family members.

[00262] **Example 3: Flow cytometry on HEK-293T cells transfected with plasmids expressing the indicated proteins.** FIG. 3 illustrates the specificity if the antibodies tested in a flow cytometry method, as performed in Example 2.

[00263] Example 4: IM136 and IM171 binding to PA-1 cells naturally expressing Claudin-6. Detection by flow cytometry by staining PA-1 cells with the indicated antibodies. FIG.4 illustrates antibodies binding to PA-1 cells naturally expressing Claudin-6. Detection by flow cytometry.

[00264] Example 5: Antibodies bind to cells naturally expressing Claudin-6. FIG. 5 illustrates additional antibodies binding to PA-1 cells naturally expressing Claudin-6. Detection by flow cytometry, as performed in Example 4. DENV represents a negative control (anti-Dengue virus) antibody.

[00265] Example 6: FIG.6 illustrates the specificity of Claudin 6 MAb LM171 binding to a membrane proteome array (MPA), consisting of 5,300 human membrane proteins expressed in human HEK-293 cells. Cells were permeabilized with 0.1% saponin, antibody was added to the MPA at 1 ug/ml, and binding across the protein library was measured using high-throughput flow cytometry (Intellicyt HTFC) using a fluorescent secondary antibody. LM171 is highly specific for Claudin 6.

[00266] Example 7: Claudin 6 specific antibodies can function with a 'universal' common light chain. Antibodies specific to Claudin 6 were modified to swap the originally identified light chain with a common light chain. The results illustrated in the table below demonstrate that the common light chain can also support binding to Claudin 6 or expression/production of the antibody. The results demonstrate that binding to Claudin 6 is primarily determined by using any of the variable heavy chains and CDRs contained within the same, and that these heavy chains can be paired with these or other common light chains.

Table 1. Expression and Binding of claudin6 MAbs. Claudin 6 MAbs produced using their natural light chain, or produced using a different light chain. Yield represents the preparation of the purified MAb and ug of protein resulting from the preparation. Binding represents 66 nM of the indicated MAb binding to HEK-293T cells expressing the target claudin6. The Controls represents the same MAbs staining HEK-293T cells not transfected with claudin6. Staining was detected by flow cytometry (geometric mean fluorescence). N/A, not available.

Target	MAb	Yield (ug)	Binding
CLDN6	IM179	116.2	N/A
CLDN6	IM179 w/ F10h cLC	152.0	N/A
CLDN6	IM180	178.5	46,870
CLDN6	IM180 w/ F10h cLC	166.3	10,085
Control (-CLDN6)	IM180 w/ F10h cLC	166.3	288

CLDN6	IM271	112.6	62,993
CLDN6	IM271 w/ F10h cLC	124.2	160,301
Control (-CLDN6)	IM271 w/ F10h cLC	124.2	312

[00267] Example 8: Identification of critical residues for Ab binding. Shotgun Mutagenesis epitope mapping results. Mean binding reactivities (and ranges) are listed for all identified critical residues. Critical residues for Ab binding (shaded in grey) were residues whose mutations were negative for binding to test Abs (<30% of wild type reactivity), but positive for binding to control 3656 MAb. MAbs 3001-D5 and 3656 are Claudin antibodies that are cross-reactive and bind Claudin 6 and Claudin 9. Thus, the epitope for MAb IM136 includes residues E48, D68, P74, D76, and R158. The epitope for MAb IM171 includes T33, N38, E48, D76, A153, E154, Q156, and R158. The epitope for MAb IM172 includes N38, E48, Y67, P74, D76, D146, V152, E154, Q156, and R158. The epitope for MAb IM173 includes E48, Y67, Q156, and R158. For example, the data illustrates that an antibody that has preferential binding to Claudin6 over Claudin 9 preferentially includes as an epitope residue Q156. The data is illustrated in FIG. 8.

[00268] Example 9: CAR-T cells expressing claudin 6 antibody IM136 are activated by cells expressing human or murine claudin 6. CAR-T cells without the claudin antibody ('CAR-Negative T-cells') are not activated by cells expressing claudin 6. Cell activation is measured by expression of CD69 after overnight co-incubation of the cells, as detected by flow cytometry with an anti-CD69 antibody. The data is illustrated in FIG. 7. The chimeric receptor comprises an extracellular domain comprising a claudin 6 antibody described herein (IM136) as an scFv (VL-linker-VH) fused to the CD8 transmembrane domain, 4-1BB, and CD3zeta signaling domains. This construct is based on the CAR construct reported in Milone *et al.,* Molecular Therapy vol. 17 no. 8, 1453–1464 aug. 2009, which is hereby incorporated by reference in its entirety.

[00269] Example 10: Anti-Claudin 6 Antibodies Bind Specifically to Claudin 6

[00270] The table below provides binding information about various antibodies. The antibodies were tested for binding against Claudin 6 as well as demonstrating the specificity of such binding against CLDN9, CLDN4, and CLDN3.

Antibody	CLDN6 Binding (EC50)	CLDN9	CLDN4	CLDN3
IM-271	less than 4 nM	+/-	-	-
IM-271-1HAQ	less than 4 nM	+/-	+/-	-
IM-271-1HBG	less than 4 nM	-	-	-
IM-271-1HFJ	less than 4 nM	-	-	-
IM-271-1HEP	less than 4 nM	-	-	-
IM-271-1HHP	less than 4 nM	-	+/-	-
IM-35-N1F09-1HA	less than 4 nM	+	+	+
IM-271-1HBF	less than 4 nM	-	+/-	-
IM-271-1HFB	less than 4 nM	-	-	-
IM-271-1HHR	less than 4 nM	-	+/-	+/-
IM-271-1HGT	less than 4 nM	+	+	+/-
IM-35-N2H07-1HA	less than 4 nM	+	+/-	-

Affinity of various antibodies against CLDN6 as compared to CLDN9, CLDN3, and CLDN4 was measured using a biosensor. Biosensor affinity measurement of the various antibodies against the proteins was determined using a Forte Octet, which was used for biosensor measurements, using intact claudin proteins embedded in virus-like particles (lipoparticles). The K_D for different antibodies is shown below.

Antibody	CLDN6 (K_D)	CLDN9 (K_D)
IM-136	12 nM	386 nM
IM-171	3.0 nM	902 nM
IM-172	Less than 0.1 nM	81 nM
IM-173	0.32 nM	N/D
Clinical Benchmark	0.11 nM	94 nM

[00271] The data demonstrates that the antibodies can bind specifically to Claudin 6 without significant binding to CLDN9, CLDN4, and CLDN3.

[00272] In summary, the embodiments and examples demonstrate the production and specificity of Claudin 6 antibodies, which can be used for various methods as provided for herein.

[00273] The disclosures of each and every patent, patent application, publication, and accession number cited herein are hereby incorporated herein by reference in their entirety.

[00274] While present disclosure has been disclosed with reference to various embodiments, it is apparent that other embodiments and variations of these may be devised by others skilled in the art without departing from the true spirit and scope of the disclosure. The appended claims are intended to be construed to include all such embodiments and equivalent variations.

What is claimed is:

1. An antibody, or an isolated form thereof, that binds to claudin 6 with an affinity of less than 10 nM and with at least 100 fold greater EC_{50} than claudin 9, claudin 3, and/or claudin 4.

2. The antibody of claim 1, or an isolated form thereof, wherein the antibody comprises a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 25, 31, 37, 43, 53, 55, 56, 62, 71, 76, 80, 90, 95, 139, 141, 143, or 145, or a variant of any of the foregoing; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 26, 32, 38, 44, 46, 48, 49, 54, 125, 72, 77, 81, 86, 91, 96, 101, 102, 140, 142, 144, or 146, or a variant of any of the foregoing; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 27, 33, 39, 45, 57, 61, 63, 65, 66, 67, 126, 69, 73, 82, 57, 92, or 97, or a variant of any of the foregoing.

3. The antibody of claim 1, or an isolated form thereof, wherein the antibody comprises:

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 25; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 26; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 27, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 31; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 32; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 33, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 37; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 38; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 39, or variants of any of the

foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 43; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 44; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 45, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 31; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 46; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 33, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 37; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 48; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 39, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 43; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 49; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 45, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 53; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 54; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 33, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 55; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 54; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 33, or variants of any of the

foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 56; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 57, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 56; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 61, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 63, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 65, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 66, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 67, or variants of any of the

foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 126, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 69, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 71; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 72; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 73, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 76; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 77; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 78, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 80; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 81; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 82, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 86; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 57, or variants of any of the

foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 90; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 91; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 92, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 95; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 96; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 97, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 101; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 57, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 102; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 57, or variants of any of the foregoing; or

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 139; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 140; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 82, or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 141; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 142; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 57, or variants of any

of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 143; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 144; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 92, or variants of any of the foregoing; or

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 145; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 146; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 97, or variants of any of the foregoing.

4. The antibody of claim 1, or an isolated form thereof, wherein the antibody comprises a light chain variable region comprising a sequence of any one of sequences as set forth in SEQ ID NOs: 127-135.

5. The antibody of claim 1, or an isolated form thereof, wherein the antibody comprises a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 22, 28, 34, 40, 47, 50, 58, 64, 74, 83, 87, 93, or 98; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 23, 29, 41, 51, 59, 68, 84, 88, or 99, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 24, 30, 36, 42, 52, 60, 70, 75, 79, 85, 89, 94, or variants of any of the foregoing.

6. The antibody of claim 5, wherein antibody comprises:

a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 22; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 23, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 24, or variants of any of the foregoing;

a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences,

wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 28; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 29, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 30, or variants of any of the foregoing;

a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 34; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 29, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 36, or variants of any of the foregoing;

a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 40; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 41, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 42, or variants of any of the foregoing;

a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 47; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 29, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 36, or variants of any of the foregoing;

a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 50; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 51, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 52, or variants of any of the foregoing;

a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 58; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 59, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 60, or variants of any of the foregoing;

a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 64; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 59, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 60, or variants of any of the foregoing;

a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 58; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 68, and the light chain CDR3

sequence has the amino acid sequence of SEQ ID NO: 60, or variants of any of the foregoing;

a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 64; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 59, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 70, or variants of any of the foregoing;

a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 74; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 59, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 75, or variants of any of the foregoing;

a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 58; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 59, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 79, or variants of any of the foregoing;

a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 83; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 84, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 85, or variants of any of the foregoing;

a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 87; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 88, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 89, or variants of any of the foregoing;

a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 93; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 88, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 94, or variants of any of the foregoing; or

a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 98; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 99, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 100, or variants of any of the foregoing.

7. The antibody of claim 1, or an isolated form thereof, or antigen binding fragment thereof, wherein the antibody, or antigen binding fragment thereof, comprises:

(i) a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 25, 31, 37, 43, 53, 55, 56, 62, 71, 76, 80, 90, or 95; the heavy chain CDR2 has the amino acid sequence of 26, 32, 38, 44, 46, 48, 49, 54, 125, 72, 77, 81, 86, 91, 96, 101, or 102 and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 27, 33, 39, 45, 57, 61, 63, 65, 66, 67, 126, 69, 73, 82, 57, 92, or 97 or variants of any of the foregoing; and

(ii) a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence 22, 28, 34, 40, 47, 50, 58, 64, 74, 83, 87, 93, or 98; the light chain CDR2 sequence has the amino acid sequence of 23, 29, 41, 51, 59, 68, 84, 88, or 99, and the light chain CDR3 sequence has the amino acid sequence of 24, 30, 36, 42, 52, 60, 70, 75, 79, 85, 89, 94, or variants of any of the foregoing.

8. The antibody, or an isolated form thereof, or antigen binding fragment thereof, of claim 1, wherein the antibody, or antigen binding fragment thereof, comprises:

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 56; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 57; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 58; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 59; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 60; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 56; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 61; or variants of any of the foregoing; and a light chain variable region comprising light chain

CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 58; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 59; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 60; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 63; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 64; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 59; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 60; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 65; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 64; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 59; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 60; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 66; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 64; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 59; and the light chain CDR3 sequence has the amino acid

sequence of SEQ ID NO: 60; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 67; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 64; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 59; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 60; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 65; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 58; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 68; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 60; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 126; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 58; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 68; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 60; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ

ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 69; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 58; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 68; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 60; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 125; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 69; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 64; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 59; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 70; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 71; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 72; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 73; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 74; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 59; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 75; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 76; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 77; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 78; or variants of any of the foregoing; and a light chain variable region comprising light chain

CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 58; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 59; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 79; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 80; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 81; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 82; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 83; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 84; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 85; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 86; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 57; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 87; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 88; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 89; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 90; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 91; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 92; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 93; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 88; and the light chain CDR3 sequence has the amino acid

sequence of SEQ ID NO: 94; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 95; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 96; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 97; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 98; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 99; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 100; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 101; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 57; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 58; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 59; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 60; or variants of any of the foregoing; or

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 62; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 102; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 57; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 87; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 88; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 89; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ

ID NO: 25; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 26; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 27; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 22; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 23; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 24; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 31; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 32; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 33; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 28; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 29; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 30; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 37; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 28; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 29; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 34; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 29; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 26; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 43; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 44; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 45; or variants of any of the foregoing; and a light chain variable region comprising light chain

CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 40; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 41; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 42; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 31; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 46; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 33; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 28; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 29; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 30; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 37; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 48; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 39; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 47; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 29; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 36; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 43; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 49; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 45; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 40; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 41; and the light chain CDR3 sequence has the amino acid

sequence of SEQ ID NO: 42; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 53; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 54; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 33; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 50; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 51; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 52; or variants of any of the foregoing;

a heavy chain variable region comprising heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 55; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 54; and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 33; or variants of any of the foregoing; and a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence SEQ ID NO: 50; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 51; and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 52; or variants of any of the foregoing.

9. The antibody, or an isolated form thereof, of claim 1, wherein the antibody comprises a V_L a sequence of SEQ ID NO: 3, SEQ ID NO: 5, SEQ ID NO: 7, SEQ ID NO: 9, SEQ ID NO: 11, SEQ ID NO: 13, SEQ ID NO: 15, SEQ ID NO: 17, SEQ ID NO: 19, SEQ ID NO: 21, SEQ ID NO: 104, SEQ ID NO: 106, SEQ ID NO: 108, SEQ ID NO: 110, SEQ ID NO: 112, SEQ ID NO: 114, SEQ ID NO: 116, SEQ ID NO: 118, SEQ ID NO: 120, SEQ ID NO: 122, or SEQ ID NO: 124, SEQ ID NO: 127, SEQ ID NO: 128, SEQ ID NO: 129, SEQ ID NO: 130, SEQ ID NO: 131, SEQ ID NO: 132, SEQ ID NO: 133, SEQ ID NO: 134, or SEQ ID NO: 135, or any variants of the foregoing.

10. The antibody of claim 1, or an isolated form thereof, wherein the antibody comprises a V_L sequence of SEQ ID NO: 127, SEQ ID NO: 128, SEQ ID NO: 129, SEQ ID NO: 130, SEQ ID NO: 131, SEQ ID NO: 132, SEQ ID NO: 133, SEQ ID NO: 134, or SEQ ID NO: 135, or any variants of the foregoing.

11. The antibody of claim 1, or an isolated form thereof, wherein the antibody comprises a V_L sequence of SEQ ID NO: 127 or SEQ ID NO: 128.

12. The antibody of claim 1, or an isolated form thereof, wherein the antibody comprises a V_H sequence of SEQ ID NO: 2, SEQ ID NO: 4, SEQ ID NO: 6, SEQ ID NO: 8, SEQ ID NO: 10, SEQ ID NO: 12, SEQ ID NO: 14, SEQ ID NO: 16, SEQ ID NO: 18, SEQ ID NO: 20, SEQ ID NO: 103, SEQ ID NO: 105, SEQ ID NO: 107, SEQ ID NO: 109, SEQ ID NO: 111, SEQ ID NO: 113, SEQ ID NO: 115, SEQ ID NO: 117, SEQ ID NO: 119, SEQ ID NO: 121, or SEQ ID NO: 123, or any variant thereof.

13. The antibody of claim 1, or an isolated form thereof, wherein the antibody comprises a V_H chain, wherein the CDRs of the V_H chain comprises:

1H. GFSFSSY (SEQ ID NO: 139); YSSASSTY (SEQ ID NO: 140); and AAGRTYRGWATYIADSIDA (SEQ ID NO: 82); or

2H. GFDFSSY (SEQ ID NO: 141); GSTGSS (SEQ ID NO: 142); and SVGNGNSWSGYIATSIDA (SEQ ID NO: 57); or

3H. GFSISSY (SEQ ID NO: 143); YSGSR (SEQ ID NO: 144); and SSYCTAWTGCDVYAGGSIDA (SEQ ID NO: 92); or

4H. GFTFSSY (SEQ ID NO: 145); DSGST (SEQ ID NO: 146); and DAYGYCGWSGCSADSIDA (SEQ ID NO: 97); or

5H. GFSFSSYDMGWV (SEQ ID NO: 25); VASIYSSASSTYYA (SEQ ID NO: 26); and CAKAAGRTYRGWATYIADSIDA (SEQ ID NO: 27); or

6H. GFDFSSYAMNWV (SEQ ID NO: 31); VAGIGSTGSSTGYG (SEQ ID NO: 32); and CAKSVGNGNSWSGYIATSIDA (SEQ ID NO: 33); or

7H. GFSISSYTMQWV (SEQ ID NO: 37); VAGIYSGSRTYYG (SEQ ID NO: 38); and CAKSSYCTAWTGCDVYAGGSIDA (SEQ ID NO: 39); or

8H. GFTFSSYSMFWV (SEQ ID NO: 43); VAGIDSGSTTFYG (SEQ ID NO: 44); and CAKDAYGYCGWSGCSADSIDA (SEQ ID NO: 45); or

9H. GFSFSSYDMGWV (SEQ ID NO: 25); VASIYSSASSTYYA (SEQ ID NO: 26); and CAKAAGRTYRGWATYIADSIDA (SEQ ID NO: 27); or

10H. GFDFSSYAMNWV (SEQ ID NO: 31); VAGIGSTGSSTGYA (SEQ ID NO: 46); and CAKSVGNGNSWSGYIATSIDA (SEQ ID NO: 33); or

11H. GFSISSYTMQWV (SEQ ID NO: 37); VAGIYSGSRTYYA (SEQ ID NO: 48); and CAKSSYCTAWTGCDVYAGGSIDA (SEQ ID NO: 39); or

12H. GFTFSSYSMFWV (SEQ ID NO: 43); VAGIDSGSTTFYA (SEQ ID NO: 49); and CAKDAYGYCGWSGCSADSIDA (SEQ ID NO: 45); or

13H. GFTFSSYAMSWV (SEQ ID NO: 53); VAGISSSGRYTGYA (SEQ ID NO: 54); and CAKSVGNGNSWSGYIATSIDA (SEQ ID NO: 33); or

14H. GFTFSSYAMNWV (SEQ ID NO: 55); VAGISSSGRYTGYA (SEQ ID NO: 54); and CAKSVGNGNSWSGYIATSIDA (SEQ ID NO: 33); or

15H. SYAMS (SEQ ID NO: 56); GISSSGRYTGYADSVKG (SEQ ID NO: 101); and SVGNGNSWSGYIATSIDA (SEQ ID NO: 57); or

16H. SYAMS (SEQ ID NO: 56); GISSSGRYTGYADSVKG (SEQ ID NO: 101); and SVGNGNSWSGYVATSIDA (SEQ ID NO: 61); or

17H. SYAMN (SEQ ID NO: 62); GISSSGRYTGYADSVKG (SEQ ID NO: 101); and SVGSGVSWSGYVATSIDA (SEQ ID NO: 63); or

18H. SYAMN (SEQ ID NO: 62); GISSSGRYTGYADSVKG (SEQ ID NO: 101); and SMGSGVSWSGYVATSIDA (SEQ ID NO: 65); or

19H. SYAMN (SEQ ID NO: 62); GISSSGRYTGYADSVKG (SEQ ID NO: 101); and SMGSGVSWSGYVATSIDV (SEQ ID NO: 66); or

20H. SYAMN (SEQ ID NO: 62); GISSSGRYTGYADSVKG (SEQ ID NO: 101); and SVGSGVSWSGYVATSLDA (SEQ ID NO: 67); or

21H. SYAMN (SEQ ID NO: 62); GISSSGRYTGYADSVKG (SEQ ID NO: 101); and SMGSGVSWSGYVATSIDA (SEQ ID NO: 65); or

22H. SYAMN (SEQ ID NO: 62); GISSSGRYTGYADSVKG (SEQ ID NO: 101); and SMGSGVSWSGYVATSLDV (SEQ ID NO: 126); or

23H. SYAMN (SEQ ID NO: 62); GISSSGRYTGYADSVKG (SEQ ID NO: 101); and SVGSGVSWSGYVATSLDV (SEQ ID NO: 69); or

24H. SYAMN (SEQ ID NO: 62); GISSSGRYTGYADSVKG (SEQ ID NO: 101); and SVGSGVSWSGYVATSLDV (SEQ ID NO: 69); or

25H. SYGMS (SEQ ID NO: 71); GIGSSGIYTHYADSVKG (SEQ ID NO: 72); and SPGDSDWCGWAGYGIYSCRVAGFIDA (SEQ ID NO: 73); or

26H. GYAMS (SEQ ID NO: 76); GIYSSGSYTFYADSVKG (SEQ ID NO: 77); and GTGYCDWSGWCYSGAANIDA (SEQ ID NO: 78); or

27H. SYDMG (SEQ ID NO: 80); SIYSSASSTYYAPAVKG (SEQ ID NO: 81); and AAGRTYRGWATYIADSIDA (SEQ ID NO: 82); or

28H. SYAMN (SEQ ID NO: 62); GIGSTGSSTGYGPAVKG (SEQ ID NO: 86); and SVGNGNSWSGYIATSIDA (SEQ ID NO: 57); or

29H. SYTMQ (SEQ ID NO: 90); GIYSGSRTYYGAAVQG (SEQ ID NO: 91); and SSYCTAWTGCDVYAGGSIDA (SEQ ID NO: 92); or

30H. SYSMF (SEQ ID NO: 95); GIDSGSTTFYGSAVKG (SEQ ID NO: 96); and DAYGYCGWSGCSADSIDA (SEQ ID NO: 97); or

31H. SYAMN (SEQ ID NO: 62); GISSSGRYTGYADSVKG (SEQ ID NO: 101); and SVGNGNSWSGYIATSIDA (SEQ ID NO: 57); or

32H. SYAMN (SEQ ID NO: 62); GIGSTGSSTGYADSVKG (SEQ ID NO: 102); and SVGNGNSWSGYIATSIDA (SEQ ID NO: 57).

14. The antibody of claims 1 or 13, or an isolated form thereof, wherein the antibody comprises a V_L chain, the V_L chain comprises the CDRs of:

1L. SGDSSWYGYG (SEQ ID NO: 83); ESGKRPS (SEQ ID NO: 84); and GSADSNSIGI (SEQ ID NO: 85); or

2L. SGGSSGYG (SEQ ID NO: 87); SNDKRPS (SEQ ID NO: 88); and GSTDNSYVGI (SEQ ID NO: 89); or

3L. SGDSSDDGSYYYG (SEQ ID NO: 93); SNDKRPS (SEQ ID NO: 88); and GSYDSSTGI (SEQ ID NO: 94); or

4L. SGGNNYYG (SEQ ID NO: 98); YNDKRPS (SEQ ID NO: 99); and GGWDSSGGI (SEQ ID NO: 100); or

5L. CSGDSSWYGYG (SEQ ID NO: 22); IYESGKRP (SEQ ID NO: 23); and CGSADSNSIGIF (SEQ ID NO: 24); or

6L. CSGGSSGYG (SEQ ID NO: 28); IYSNDKRP (SEQ ID NO: 29); and CGSTDNSYVGIF (SEQ ID NO: 30); or

7L. CSGDSSDDGSYYYG (SEQ ID NO: 34); IYSNDKRP (SEQ ID NO: 29); and CGSYDSSTGIF (SEQ ID NO: 36); or

8L. CSGGNNYYG (SEQ ID NO: 40); IYYNDKRP (SEQ ID NO: 41); and CGGWDSSGGIF (SEQ ID NO: 42); or

9L. CSGDSSWYGYG (SEQ ID NO: 22); IYESGKRP (SEQ ID NO: 23); and CGSADSNSIGIF (SEQ ID NO: 24); or

10L. CSGGSSGYG (SEQ ID NO: 28); IYSNDKRP (SEQ ID NO: 29); and CGSTDNSYVGIF (SEQ ID NO: 30); or

11L. CSGDDGSYYYG (SEQ ID NO: 47); IYSNDKRP (SEQ ID NO: 29); and CGSYDSSTGIF (SEQ ID NO: 36); or

12L. CSGGNNYYG (SEQ ID NO: 40); IYYNDKRP (SEQ ID NO: 41); and CGGWDSSGGIF (SEQ ID NO: 42); or

13L. CSGGSGSYG (SEQ ID NO: 50); IYGTNKRP (SEQ ID NO: 51); and CGSADSSTNAGIF (SEQ ID NO: 52); or

14L. CSGGSGSYG (SEQ ID NO: 50); IYGTNKRP (SEQ ID NO: 51); and CGSADSSTNAGIF (SEQ ID NO: 52); or

15L. SGGSGSYG (SEQ ID NO: 58); GTNKRPS (SEQ ID NO: 59); and GSADSSTNAGI (SEQ ID NO: 60); or

16L. SGGSGSYG (SEQ ID NO: 58); GTNKRPS (SEQ ID NO: 59); and GSADSSTNAGI (SEQ ID NO: 60); or

17L. SAGSGLYG (SEQ ID NO: 64); GTNKRPS (SEQ ID NO: 59); and GSADSSTNAGI (SEQ ID NO: 60); or

18L. SAGSGLYG (SEQ ID NO: 64); GTNKRPS (SEQ ID NO: 59); and GSADSSTNAGI (SEQ ID NO: 60); or

19L. SAGSGLYG (SEQ ID NO: 64); GTNKRPS (SEQ ID NO: 59); and GSADSSTNAGI (SEQ ID NO: 60); or

20L. SAGSGLYG (SEQ ID NO: 64); GTNKRPS (SEQ ID NO: 59); and GSADSSTNAGI (SEQ ID NO: 60); or

21L. SGGSGSYG (SEQ ID NO: 58); GTYKRPS (SEQ ID NO: 68); and GSADSSTNAGI (SEQ ID NO: 60); or

22L. SGGSGSYG (SEQ ID NO: 58); GTYKRPS (SEQ ID NO: 68); and GSADSSTNAGI (SEQ ID NO: 60); or

23L. SGGSGSYG (SEQ ID NO: 58); GTYKRPS (SEQ ID NO: 68); and GSADSSTNAGI (SEQ ID NO: 60); or

24L. SAGSGLYG (SEQ ID NO: 64); GTNKRPS (SEQ ID NO: 59); and GSNDASTNAGI (SEQ ID NO: 70); or

25L. SGGYNGHYG (SEQ ID NO: 74); GTNKRPS (SEQ ID NO: 59); and GGYDSSAGI (SEQ ID NO: 75); or

26L. SGGSGSYGYYG; GTNKRPS (SEQ ID NO: 59); and GSEDSSSGAGI (SEQ ID NO: 79); or

27L. SGDSSWYGYG (SEQ ID NO: 83); ESGKRPS (SEQ ID NO: 84); and GSADSNSIGI (SEQ ID NO: 85); or

28L. SGGSSGYG (SEQ ID NO: 87); SNDKRPS (SEQ ID NO: 88); and GSTDNSYVGI (SEQ ID NO: 89); or

29L. SGDSSDDGSYYYG (SEQ ID NO: 93); SNDKRPS (SEQ ID NO: 88); and GSYDSSTGI (SEQ ID NO: 94); or

30L. SGGNNYYG (SEQ ID NO: 98); YNDKRPS (SEQ ID NO: 99); and GGWDSSGGI (SEQ ID NO: 100); or

31L. SGGSGSYG (SEQ ID NO: 58); GTNKRPS (SEQ ID NO: 59); and GSADSSTNAGI (SEQ ID NO: 60); or

32L. SGGSSGYG (SEQ ID NO: 87); SNDKRPS (SEQ ID NO: 88); and GSTDNSYVGI (SEQ ID NO: 89).

15. The antibody of claim 1, or an isolated form thereof, wherein the antibody comprises the CDRs of: 1H and 1L, 1H and 2L, 1H and 3L, 1H and 4L, 1H and 5L, 1H and 6L, 1H and 7L, 1H and 8L, 1H and 9L, 1H and 10L, 1H and 11L, 1H and 12L, 1H and 13L, 1H and 14L, 1H and 15L, 1H and 16L, 1H and 17L, 1H and 18L, 1H and 19L, 1H and 20L, 1H and 21L, 1H and 22L, 1H and 23L, 1H and 24L, 1H and 25L, 1H and 26L, 1H and 27L, 1H and 28L, 1H and 29L, 1H and 30L, 1H and 31L, 1H and 32L, 2H and 1L, 2H and 2L, 2H and 3L, 2H and 4L, 2H and 5L, 2H and 6L, 2H and 7L, 2H and 8L, 2H and 9L, 2H and 10L, 2H and 11L, 2H and 12L, 2H and 13L, 2H and 14L, 2H and 15L, 2H and 16L, 2H and 17L, 2H and 18L, 2H and 19L, 2H and 20L, 2H and 21L, 2H and 22L, 2H and 23L, 2H and 24L, 2H and 25L, 2H and 26L, 2H and 27L, 2H and 28L, 2H and 29L, 2H and 30L, 2H and 31L, 2H and 32L, 3H and 1L, 3H and 2L, 3H and 3L, 3H and 4L, 3H and 5L, 3H and 6L, 3H and 7L, 3H and 8L, 3H and 9L, 3H and 10L, 3H and 11L, 3H and 12L, 3H and 13L, 3H and 14L, 3H and 15L, 3H and 16L, 3H and 17L, 3H and 18L, 3H and 19L, 3H and 20L, 3H and 21L, 3H and 22L, 3H and 23L, 3H and 24L, 3H and 25L, 3H and 26L, 3H and 27L, 3H and 28L, 3H and 29L, 3H and 30L, 3H and 31L, 3H and 32L, 4H and 1L, 4H and 2L, 4H and 3L, 4H and 4L, 4H and 5L, 4H and 6L, 4H and 7L, 4H and 8L, 4H and 9L, 4H and 10L, 4H and 11L, 4H and 12L, 4H and 13L, 4H and 14L, 4H and 15L, 4H and 16L, 4H and 17L, 4H and 18L, 4H and 19L, 4H and 20L, 4H and 21L, 4H and 22L, 4H and 23L, 4H and 24L, 4H and 25L, 4H and 26L, 4H and 27L, 4H and 28L, 4H and 29L, 4H and 30L, 4H and 31L, 4H and 32L, 5H and 1L, 5H and 2L, 5H and 3L, 5H and 4L, 5H and 5L, 5H and 6L, 5H and 7L, 5H and 8L, 5H and 9L, 5H and 10L, 5H and 11L, 5H and 12L, 5H and 13L, 5H and 14L, 5H and 15L, 5H and 16L, 5H and 17L, 5H and 18L, 5H and 19L, 5H and 20L, 5H and 21L, 5H and 22L, 5H and 23L, 5H and 24L, 5H and 25L, 5H and 26L, 5H and 27L, 5H and 28L, 5H and 29L, 5H and 30L, 5H and 31L, 5H and 32L, 6H and 1L, 6H and 2L, 6H and 3L, 6H and 4L, 6H and 5L, 6H and 6L, 6H and 7L, 6H and 8L, 6H and 9L, 6H and 10L, 6H and 11L, 6H and 12L, 6H and 13L, 6H and 14L, 6H and 15L, 6H and 16L, 6H and 17L, 6H and 18L, 6H and 19L, 6H and 20L, 6H and 21L, 6H and 22L, 6H and 23L, 6H and 24L, 6H and 25L, 6H and 26L, 6H and 27L, 6H and 28L, 6H and 29L, 6H and 30L, 6H and 31L, 6H and 32L, 7H and 1L, 7H and 2L, 7H and 3L, 7H and 4L, 7H and 5L, 7H and 6L, 7H and 7L, 7H and 8L, 7H and 9L, 7H and 10L, 7H and 11L, 7H and 12L, 7H and 13L, 7H and 14L, 7H and 15L, 7H and 16L, 7H and 17L, 7H and 18L, 7H

and 19L, 7H and 20L, 7H and 21L, 7H and 22L, 7H and 23L, 7H and 24L, 7H and 25L, 7H and 26L, 7H and 27L, 7H and 28L, 7H and 29L, 7H and 30L, 7H and 31L, 7H and 32L, 8H and 1L, 8H and 2L, 8H and 3L, 8H and 4L, 8H and 5L, 8H and 6L, 8H and 7L, 8H and 8L, 8H and 9L, 8H and 10L, 8H and 11L, 8H and 12L, 8H and 13L, 8H and 14L, 8H and 15L, 8H and 16L, 8H and 17L, 8H and 18L, 8H and 19L, 8H and 20L, 8H and 21L, 8H and 22L, 8H and 23L, 8H and 24L, 8H and 25L, 8H and 26L, 8H and 27L, 8H and 28L, 8H and 29L, 8H and 30L, 8H and 31L, 8H and 32L, 9H and 1L, 9H and 2L, 9H and 3L, 9H and 4L, 9H and 5L, 9H and 6L, 9H and 7L, 9H and 8L, 9H and 9L, 9H and 10L, 9H and 11L, 9H and 12L, 9H and 13L, 9H and 14L, 9H and 15L, 9H and 16L, 9H and 17L, 9H and 18L, 9H and 19L, 9H and 20L, 9H and 21L, 9H and 22L, 9H and 23L, 9H and 24L, 9H and 25L, 9H and 26L, 9H and 27L, 9H and 28L, 9H and 29L, 9H and 30L, 9H and 31L, 9H and 32L, 10H and 1L, 10H and 2L, 10H and 3L, 10H and 4L, 10H and 5L, 10H and 6L, 10H and 7L, 10H and 8L, 10H and 9L, 10H and 10L, 10H and 11L, 10H and 12L, 10H and 13L, 10H and 14L, 10H and 15L, 10H and 16L, 10H and 17L, 10H and 18L, 10H and 19L, 10H and 20L, 10H and 21L, 10H and 22L, 10H and 23L, 10H and 24L, 10H and 25L, 10H and 26L, 10H and 27L, 10H and 28L, 10H and 29L, 10H and 30L, 10H and 31L, 10H and 32L, 11H and 1L, 11H and 2L, 11H and 3L, 11H and 4L, 11H and 5L, 11H and 6L, 11H and 7L, 11H and 8L, 11H and 9L, 11H and 10L, 11H and 11L, 11H and 12L, 11H and 13L, 11H and 14L, 11H and 15L, 11H and 16L, 11H and 17L, 11H and 18L, 11H and 19L, 11H and 20L, 11H and 21L, 11H and 22L, 11H and 23L, 11H and 24L, 11H and 25L, 11H and 26L, 11H and 27L, 11H and 28L, 11H and 29L, 11H and 30L, 11H and 31L, 11H and 32L, 12H and 1L, 12H and 2L, 12H and 3L, 12H and 4L, 12H and 5L, 12H and 6L, 12H and 7L, 12H and 8L, 12H and 9L, 12H and 10L, 12H and 11L, 12H and 12L, 12H and 13L, 12H and 14L, 12H and 15L, 12H and 16L, 12H and 17L, 12H and 18L, 12H and 19L, 12H and 20L, 12H and 21L, 12H and 22L, 12H and 23L, 12H and 24L, 12H and 25L, 12H and 26L, 12H and 27L, 12H and 28L, 12H and 29L, 12H and 30L, 12H and 31L, 12H and 32L, 13H and 1L, 13H and 2L, 13H and 3L, 13H and 4L, 13H and 5L, 13H and 6L, 13H and 7L, 13H and 8L, 13H and 9L, 13H and 10L, 13H and 11L, 13H and 12L, 13H and 13L, 13H and 14L, 13H and 15L, 13H and 16L, 13H and 17L, 13H and 18L, 13H and 19L, 13H and 20L, 13H and 21L, 13H and 22L, 13H and 23L, 13H and 24L, 13H and 25L, 13H and 26L, 13H and 27L, 13H and 28L, 13H and 29L, 13H and 30L, 13H and 31L, 13H and 32L, 14H and 1L, 14H and 2L, 14H and 3L, 14H and 4L, 14H and 5L, 14H and 6L,

14H and 7L, 14H and 8L, 14H and 9L, 14H and 10L, 14H and 11L, 14H and 12L, 14H and 13L, 14H and 14L, 14H and 15L, 14H and 16L, 14H and 17L, 14H and 18L, 14H and 19L, 14H and 20L, 14H and 21L, 14H and 22L, 14H and 23L, 14H and 24L, 14H and 25L, 14H and 26L, 14H and 27L, 14H and 28L, 14H and 29L, 14H and 30L, 14H and 31L, 14H and 32L, 15H and 1L, 15H and 2L, 15H and 3L, 15H and 4L, 15H and 5L, 15H and 6L, 15H and 7L, 15H and 8L, 15H and 9L, 15H and 10L, 15H and 11L, 15H and 12L, 15H and 13L, 15H and 14L, 15H and 15L, 15H and 16L, 15H and 17L, 15H and 18L, 15H and 19L, 15H and 20L, 15H and 21L, 15H and 22L, 15H and 23L, 15H and 24L, 15H and 25L, 15H and 26L, 15H and 27L, 15H and 28L, 15H and 29L, 15H and 30L, 15H and 31L, 15H and 32L, 16H and 1L, 16H and 2L, 16H and 3L, 16H and 4L, 16H and 5L, 16H and 6L, 16H and 7L, 16H and 8L, 16H and 9L, 16H and 10L, 16H and 11L, 16H and 12L, 16H and 13L, 16H and 14L, 16H and 15L, 16H and 16L, 16H and 17L, 16H and 18L, 16H and 19L, 16H and 20L, 16H and 21L, 16H and 22L, 16H and 23L, 16H and 24L, 16H and 25L, 16H and 26L, 16H and 27L, 16H and 28L, 16H and 29L, 16H and 30L, 16H and 31L, 16H and 32L, 17H and 1L, 17H and 2L, 17H and 3L, 17H and 4L, 17H and 5L, 17H and 6L, 17H and 7L, 17H and 8L, 17H and 9L, 17H and 10L, 17H and 11L, 17H and 12L, 17H and 13L, 17H and 14L, 17H and 15L, 17H and 16L, 17H and 17L, 17H and 18L, 17H and 19L, 17H and 20L, 17H and 21L, 17H and 22L, 17H and 23L, 17H and 24L, 17H and 25L, 17H and 26L, 17H and 27L, 17H and 28L, 17H and 29L, 17H and 30L, 17H and 31L, 17H and 32L, 18H and 1L, 18H and 2L, 18H and 3L, 18H and 4L, 18H and 5L, 18H and 6L, 18H and 7L, 18H and 8L, 18H and 9L, 18H and 10L, 18H and 11L, 18H and 12L, 18H and 13L, 18H and 14L, 18H and 15L, 18H and 16L, 18H and 17L, 18H and 18L, 18H and 19L, 18H and 20L, 18H and 21L, 18H and 22L, 18H and 23L, 18H and 24L, 18H and 25L, 18H and 26L, 18H and 27L, 18H and 28L, 18H and 29L, 18H and 30L, 18H and 31L, 18H and 32L, 19H and 1L, 19H and 2L, 19H and 3L, 19H and 4L, 19H and 5L, 19H and 6L, 19H and 7L, 19H and 8L, 19H and 9L, 19H and 10L, 19H and 11L, 19H and 12L, 19H and 13L, 19H and 14L, 19H and 15L, 19H and 16L, 19H and 17L, 19H and 18L, 19H and 19L, 19H and 20L, 19H and 21L, 19H and 22L, 19H and 23L, 19H and 24L, 19H and 25L, 19H and 26L, 19H and 27L, 19H and 28L, 19H and 29L, 19H and 30L, 19H and 31L, 19H and 32L, 20H and 1L, 20H and 2L, 20H and 3L, 20H and 4L, 20H and 5L, 20H and 6L, 20H and 7L, 20H and 8L, 20H and 9L, 20H and 10L, 20H and 11L, 20H and 12L, 20H and 13L, 20H and 14L, 20H and 15L, 20H and 16L, 20H and 17L, 20H and 18L, 20H and

19L, 20H and 20L, 20H and 21L, 20H and 22L, 20H and 23L, 20H and 24L, 20H and 25L, 20H and 26L, 20H and 27L, 20H and 28L, 20H and 29L, 20H and 30L, 20H and 31L, 20H and 32L, 21H and 1L, 21H and 2L, 21H and 3L, 21H and 4L, 21H and 5L, 21H and 6L, 21H and 7L, 21H and 8L, 21H and 9L, 21H and 10L, 21H and 11L, 21H and 12L, 21H and 13L, 21H and 14L, 21H and 15L, 21H and 16L, 21H and 17L, 21H and 18L, 21H and 19L, 21H and 20L, 21H and 21L, 21H and 22L, 21H and 23L, 21H and 24L, 21H and 25L, 21H and 26L, 21H and 27L, 21H and 28L, 21H and 29L, 21H and 30L, 21H and 31L, 21H and 32L, 22H and 1L, 22H and 2L, 22H and 3L, 22H and 4L, 22H and 5L, 22H and 6L, 22H and 7L, 22H and 8L, 22H and 9L, 22H and 10L, 22H and 11L, 22H and 12L, 22H and 13L, 22H and 14L, 22H and 15L, 22H and 16L, 22H and 17L, 22H and 18L, 22H and 19L, 22H and 20L, 22H and 21L, 22H and 22L, 22H and 23L, 22H and 24L, 22H and 25L, 22H and 26L, 22H and 27L, 22H and 28L, 22H and 29L, 22H and 30L, 22H and 31L, 22H and 32L, 23H and 1L, 23H and 2L, 23H and 3L, 23H and 4L, 23H and 5L, 23H and 6L, 23H and 7L, 23H and 8L, 23H and 9L, 23H and 10L, 23H and 11L, 23H and 12L, 23H and 13L, 23H and 14L, 23H and 15L, 23H and 16L, 23H and 17L, 23H and 18L, 23H and 19L, 23H and 20L, 23H and 21L, 23H and 22L, 23H and 23L, 23H and 24L, 23H and 25L, 23H and 26L, 23H and 27L, 23H and 28L, 23H and 29L, 23H and 30L, 23H and 31L, 23H and 32L, 24H and 1L, 24H and 2L, 24H and 3L, 24H and 4L, 24H and 5L, 24H and 6L, 24H and 7L, 24H and 8L, 24H and 9L, 24H and 10L, 24H and 11L, 24H and 12L, 24H and 13L, 24H and 14L, 24H and 15L, 24H and 16L, 24H and 17L, 24H and 18L, 24H and 19L, 24H and 20L, 24H and 21L, 24H and 22L, 24H and 23L, 24H and 24L, 24H and 25L, 24H and 26L, 24H and 27L, 24H and 28L, 24H and 29L, 24H and 30L, 24H and 31L, 24H and 32L, 25H and 1L, 25H and 2L, 25H and 3L, 25H and 4L, 25H and 5L, 25H and 6L, 25H and 7L, 25H and 8L, 25H and 9L, 25H and 10L, 25H and 11L, 25H and 12L, 25H and 13L, 25H and 14L, 25H and 15L, 25H and 16L, 25H and 17L, 25H and 18L, 25H and 19L, 25H and 20L, 25H and 21L, 25H and 22L, 25H and 23L, 25H and 24L, 25H and 25L, 25H and 26L, 25H and 27L, 25H and 28L, 25H and 29L, 25H and 30L, 25H and 31L, 25H and 32L, 26H and 1L, 26H and 2L, 26H and 3L, 26H and 4L, 26H and 5L, 26H and 6L, 26H and 7L, 26H and 8L, 26H and 9L, 26H and 10L, 26H and 11L, 26H and 12L, 26H and 13L, 26H and 14L, 26H and 15L, 26H and 16L, 26H and 17L, 26H and 18L, 26H and 19L, 26H and 20L, 26H and 21L, 26H and 22L, 26H and 23L, 26H and 24L, 26H and 25L, 26H and 26L, 26H and 27L, 26H and 28L, 26H and 29L, 26H and 30L, 26H and 31L,

26H and 32L, 27H and 1L, 27H and 2L, 27H and 3L, 27H and 4L, 27H and 5L, 27H and 6L, 27H and 7L, 27H and 8L, 27H and 9L, 27H and 10L, 27H and 11L, 27H and 12L, 27H and 13L, 27H and 14L, 27H and 15L, 27H and 16L, 27H and 17L, 27H and 18L, 27H and 19L, 27H and 20L, 27H and 21L, 27H and 22L, 27H and 23L, 27H and 24L, 27H and 25L, 27H and 26L, 27H and 27L, 27H and 28L, 27H and 29L, 27H and 30L, 27H and 31L, 27H and 32L, 28H and 1L, 28H and 2L, 28H and 3L, 28H and 4L, 28H and 5L, 28H and 6L, 28H and 7L, 28H and 8L, 28H and 9L, 28H and 10L, 28H and 11L, 28H and 12L, 28H and 13L, 28H and 14L, 28H and 15L, 28H and 16L, 28H and 17L, 28H and 18L, 28H and 19L, 28H and 20L, 28H and 21L, 28H and 22L, 28H and 23L, 28H and 24L, 28H and 25L, 28H and 26L, 28H and 27L, 28H and 28L, 28H and 29L, 28H and 30L, 28H and 31L, 28H and 32L, 29H and 1L, 29H and 2L, 29H and 3L, 29H and 4L, 29H and 5L, 29H and 6L, 29H and 7L, 29H and 8L, 29H and 9L, 29H and 10L, 29H and 11L, 29H and 12L, 29H and 13L, 29H and 14L, 29H and 15L, 29H and 16L, 29H and 17L, 29H and 18L, 29H and 19L, 29H and 20L, 29H and 21L, 29H and 22L, 29H and 23L, 29H and 24L, 29H and 25L, 29H and 26L, 29H and 27L, 29H and 28L, 29H and 29L, 29H and 30L, 29H and 31L, 29H and 32L, 30H and 1L, 30H and 2L, 30H and 3L, 30H and 4L, 30H and 5L, 30H and 6L, 30H and 7L, 30H and 8L, 30H and 9L, 30H and 10L, 30H and 11L, 30H and 12L, 30H and 13L, 30H and 14L, 30H and 15L, 30H and 16L, 30H and 17L, 30H and 18L, 30H and 19L, 30H and 20L, 30H and 21L, 30H and 22L, 30H and 23L, 30H and 24L, 30H and 25L, 30H and 26L, 30H and 27L, 30H and 28L, 30H and 29L, 30H and 30L, 30H and 31L, 30H and 32L, 31H and 1L, 31H and 2L, 31H and 3L, 31H and 4L, 31H and 5L, 31H and 6L, 31H and 7L, 31H and 8L, 31H and 9L, 31H and 10L, 31H and 11L, 31H and 12L, 31H and 13L, 31H and 14L, 31H and 15L, 31H and 16L, 31H and 17L, 31H and 18L, 31H and 19L, 31H and 20L, 31H and 21L, 31H and 22L, 31H and 23L, 31H and 24L, 31H and 25L, 31H and 26L, 31H and 27L, 31H and 28L, 31H and 29L, 31H and 30L, 31H and 31L, 31H and 32L, 32H and 1L, 32H and 2L, 32H and 3L, 32H and 4L, 32H and 5L, 32H and 6L, 32H and 7L, 32H and 8L, 32H and 9L, 32H and 10L, 32H and 11L, 32H and 12L, 32H and 13L, 32H and 14L, 32H and 15L, 32H and 16L, 32H and 17L, 32H and 18L, 32H and 19L, 32H and 20L, 32H and 21L, 32H and 22L, 32H and 23L, 32H and 24L, 32H and 25L, 32H and 26L, 32H and 27L, 32H and 28L, 32H and 29L, 32H and 30L, 32H and 31L, or 32H and 32L.

16. The antibody of any one of claims 1-15, or an isolated form thereof, wherein the antibody is a monoclonal antibody, humanized antibody, or a chicken antibody.

17. A peptide, wherein the peptide comprises, consists of, or consists essentially of a sequence of SEQ ID NO: 2-135, or a variant thereof.

18. A peptide comprising, consisting of, or consisting essentially of a sequence that is 90-99% identical to a protein comprising a sequence of SEQ ID NO: 2-135.

19. The peptide of claim 18, wherein peptide comprises a 1, 2, 3, 4, or 5 substitutions, deletions, or insertions as compared to a sequence of SEQ ID NO: 2-135.

20. An antibody, such as a monoclonal antibody or scFv, that binds to an epitope on Claudin 6 whose residues include T33, N38, D68, P74, D76, D146, V152, A153, E154, Q156, R158, or any combination thereof.

21. An antibody, such as a monoclonal antibody or a scFv, that binds preferentially to Claudin 6 as compared to Claudin 9, wherein the antibody binds to an epitope on Claudin 6 that comprises Q156.

22. A bi-specific antibody comprising a first V_H peptide that binds to Claudin 6 and second V_H peptide that binds to a different moiety.

23. The bi-specific antibody of claim 22, wherein the antibody comprises heavy chain CDRl, CDR2, and CDR3 sequences, wherein the heavy chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 25, 31, 37, 43, 53, 55, 56, 62, 71, 76, 80, 90, or 95; the heavy chain CDR2 has the amino acid sequence of SEQ ID NO: 26, 32, 38, 44, 46, 48, 49, 54, 125, 72, 77, 81, 86, 91, 96, 101, or 102 and the heavy chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 27, 33, 39, 45, 57, 61, 63, 65, 66, 67, 126, 69, 73, 82, 57, 92, or 97 or variants of any of the foregoing.

24. The bi-specific antibody of claims 22 or 23, wherein the antibody comprises a light chain variable region comprising a sequence of any one of sequences as set forth in SEQ ID NOs: 127-135.

25. The bi-specific antibody of claims 22 or 23, wherein the antibody comprises a light chain variable region comprising light chain CDR1, CDR2, and CDR3 sequences, wherein the light chain CDR1 sequence has the amino acid sequence of SEQ ID NO: 22, 28, 34, 40, 47, 50, 58, 64, 74, 83, 87, 93, or 98; the light chain CDR2 sequence has the amino acid sequence of SEQ ID NO: 23, 29, 41, 51, 59, 68, 84, 88, or 99, and the light chain CDR3 sequence has the amino acid sequence of SEQ ID NO: 24, 30, 36, 42, 52, 60, 70, 75, 79, 85, 89, 94, or variants of any of the foregoing.

26. A nucleic acid molecule encoding an antibody of any one of claims 1-16 or an amino acid sequence of claims 17-25.

27. A vector comprising the nucleic acid molecule of claim 26.

28. A cell comprising the nucleic comprising the nucleic acid molecule of claim 26 or the vector of claim 27.

29. A pharmaceutical composition comprising the antibody, peptide, or protein, of any one of claims 1-25 or a nucleic acid molecule encoding the same.

30. A method of modulating Claudin 6 activity by contacting a cell expressing Claudin 6 with a Claudin 6 antibody or a pharmaceutical composition comprising the same that binds to Claudin 6 on the cell surface, wherein the the antibody is an antibody or protein of any one of claims 1-25 or a nucleic acid molecule encoding the same.

31. A method for inhibiting the function of Claudin 6 by contacting a cell expressing Claudin

6 with an antibody or a pharmaceutical composition comprising the same that inhibits the function of Claudin 6 by binding to Claudin 6, wherein the the antibody is an antibody or protein of any one of claims 1-25 or a nucleic acid molecule encoding the same.

32. A method of treating a subject with a Claudin 6 mediated disorder, the method comprising administering a pharmaceutical composition comprising a Claudin 6 antibody to the subject, wherein the the antibody is an antibody or protein of any one of claims 1-25 or a nucleic acid molecule encoding the same.

33. The method of claim 32, wherein the disorder is benign or metastatic cancer, for example, ovarian cancer, ovarian carcinoma, reproductive cancer, breast cancer, cervical cancer, testicular cancer, uterine cancer, placental cancer, lung cancer, gastric cancer, hepatic cancer, pancreatic cancer, bile duct cancer, cancer of the urinary bladder, kidney cancer, colon cancer, small bowel cancer, skin cancer, head and neck cancer, sarcoma, or germ cell tumor.

34. A method of treating cancer in a subject, the method comprising administering a therapeutic that specifically binds to claudin 6 and binds to CD3 and/or 4-1BB, wherein the the antibody is an antibody or protein of any one of claims 1-25 or a nucleic acid molecule encoding the same.

35. A method of treating cancer in a subject, the method comprising administering to the subject a pharmaceutical composition comprising an antibody that binds to residue Q156 of Claudin 6 or nucleic acid molecule encoding the same.

36. The method of claim 35, wherein the antibody comprises a CDR, VL, or VH comprising one or more protein sequences of SEQ ID NO: 2-135.

37. The method of claim 35, wherein the pharmaceutical composition comprises a chimeric receptor, wherein the receptor comprises an extracellular antibody domain that comprises an antibody of any one of claims 1-25.

38. A composition comprising an antibody or protein of any one of claims 1-25 linked to a drug or other therapeutic.

39. The composition of claim 38, wherein the therapeutic is a cytokine, such as IL-2.

40. The composition of claim 38, wherein the composition is an antibody drug conjugate (ADC).

41. A method of contacting a composition to a cell expressing Claudin 6, the method comprising contacting a cell with an antibody as provided herein, wherein the antibody is linked to another molecule to contact with the cell expressing Claudin 6, wherein the the antibody is an antibody or protein of any one of claims 1-25 or a nucleic acid molecule encoding the same.

FIG. 1

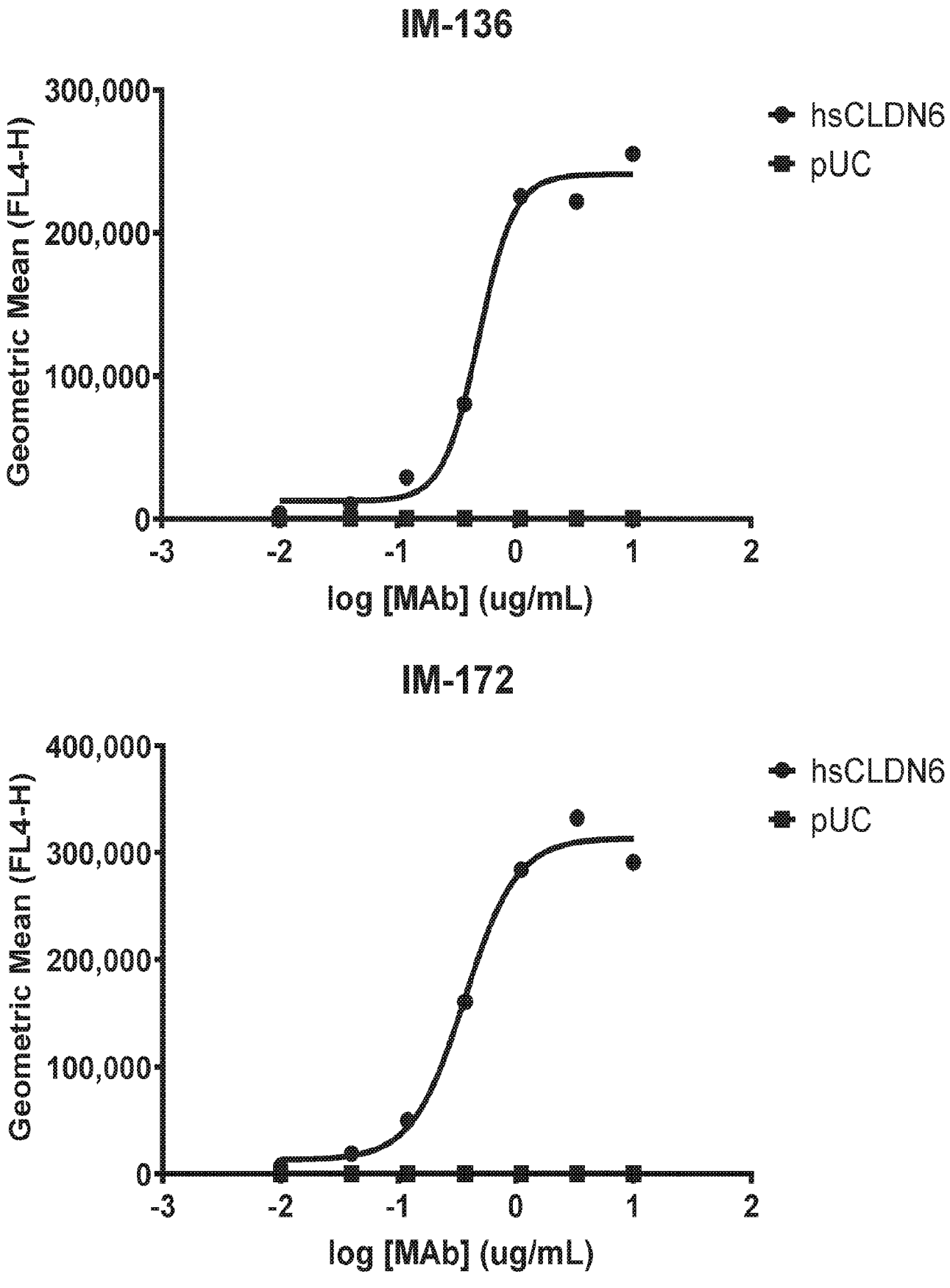

IM-136
300,000
200,000
100,000
0
Geometric Mean (FL4-H)
-3
-2
-1
0
1
2
log [MAb] (ug/mL)
hsCLDN6
pUC
IM-172
400,000
300,000
200,000
100,000
0
Geometric Mean (FL4-H)
-3
-2
-1
0
1
2
log [MAb] (ug/mL)
hsCLDN6
pUC

FIG. 1 CONT.

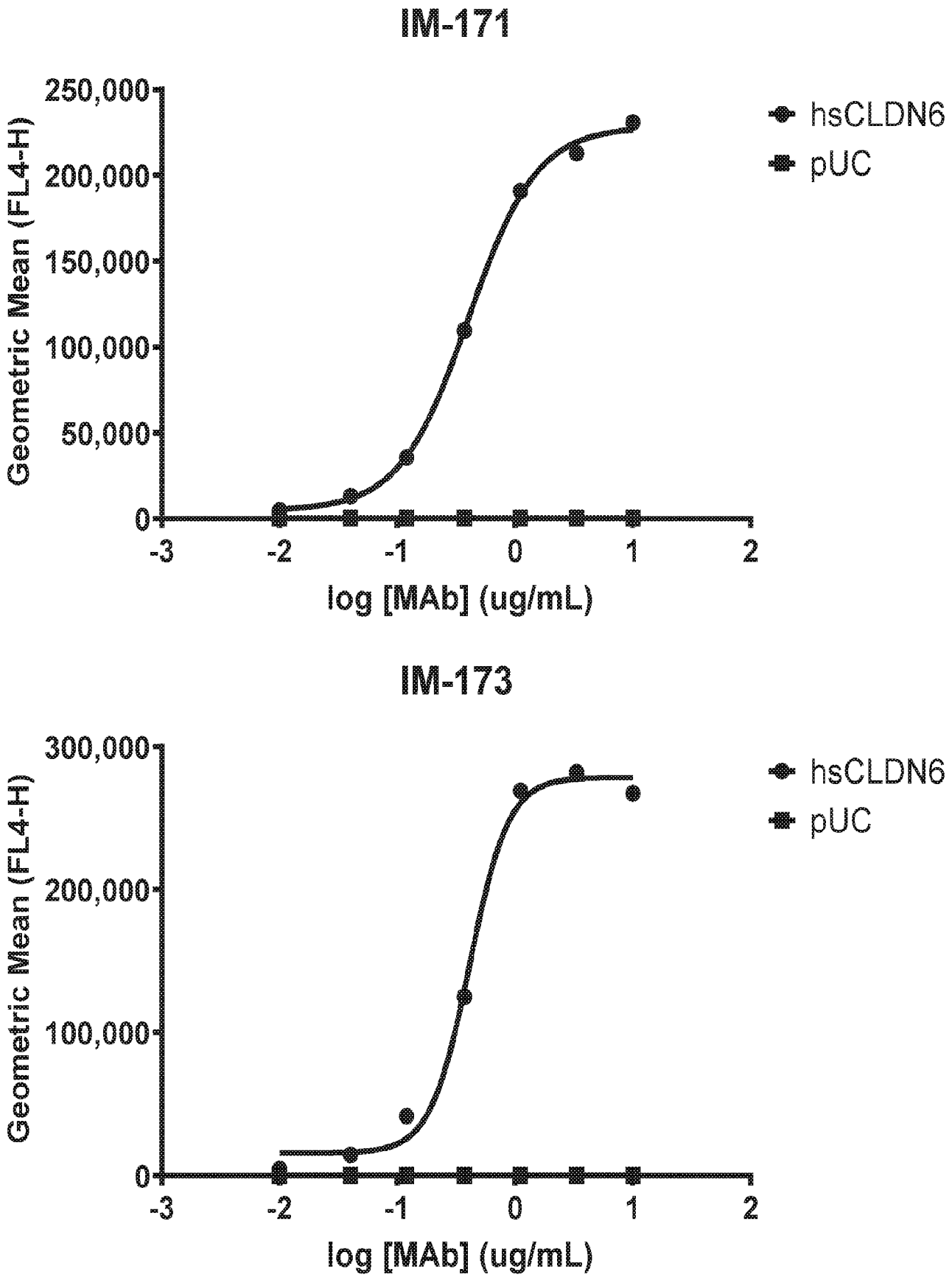

IM-171
Geometric Mean (FL4-H)
250,000
200,000
150,000
100,000
50,000
0
-3
-2
-1
0
1
2
log [MAb] (ug/mL)
hsCLDN6
pUC
IM-173
Geometric Mean (FL4-H)
300,000
200,000
100,000
0
-3
-2
-1
0
1
2
log [MAb] (ug/mL)
hsCLDN6
pUC

FIG. 2

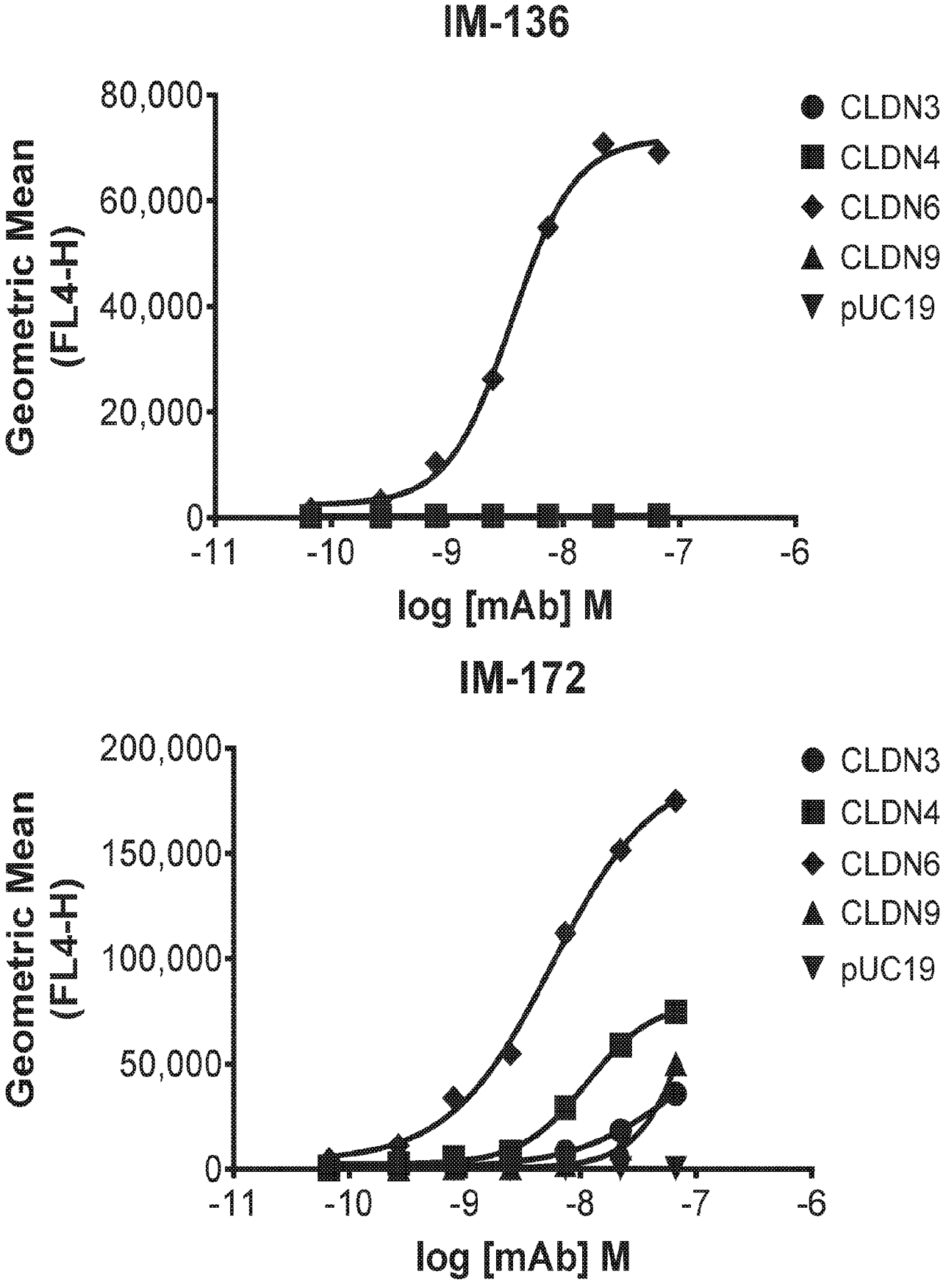

IM-136
Geometric Mean (FL4-H)
80,000
60,000
40,000
20,000
0
-11
-10
-9
-8
-7
-6
log [mAb] M
CLDN3
CLDN4
CLDN6
CLDN9
pUC19
IM-172
Geometric Mean (FL4-H)
200,000
150,000
100,000
50,000
0
-11
-10
-9
-8
-7
-6
log [mAb] M
CLDN3
CLDN4
CLDN6
CLDN9
pUC19

FIG. 2 CONT.

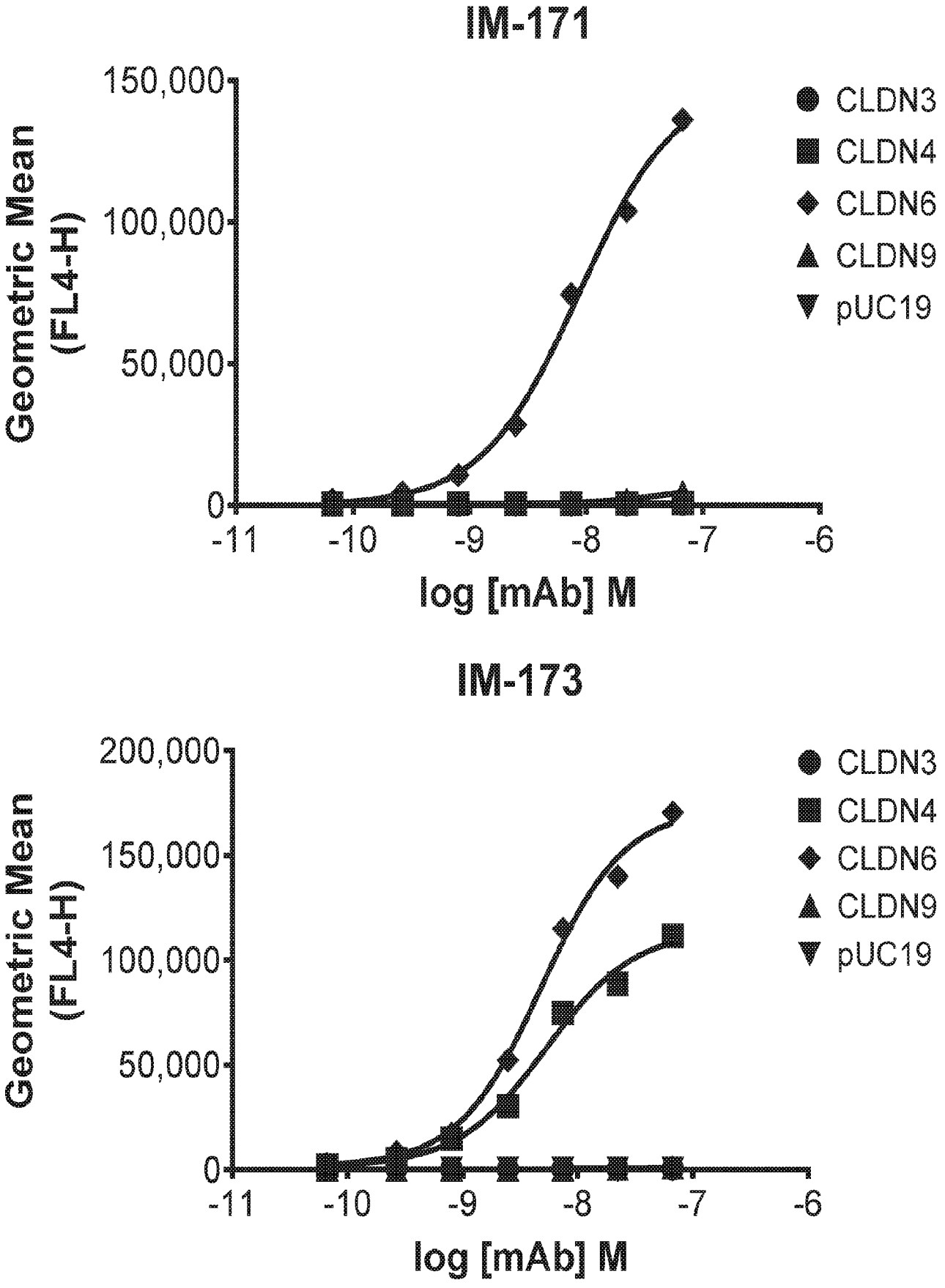

IM-171
Geometric Mean (FL4-H)
150,000
100,000
50,000
0
-11
-10
-9
-8
-7
-6
log [mAb] M
CLDN3
CLDN4
CLDN6
CLDN9
pUC19
IM-173
Geometric Mean (FL4-H)
200,000
150,000
100,000
50,000
0
-11
-10
-9
-8
-7
-6
log [mAb] M
CLDN3
CLDN4
CLDN6
CLDN9
pUC19

FIG. 3

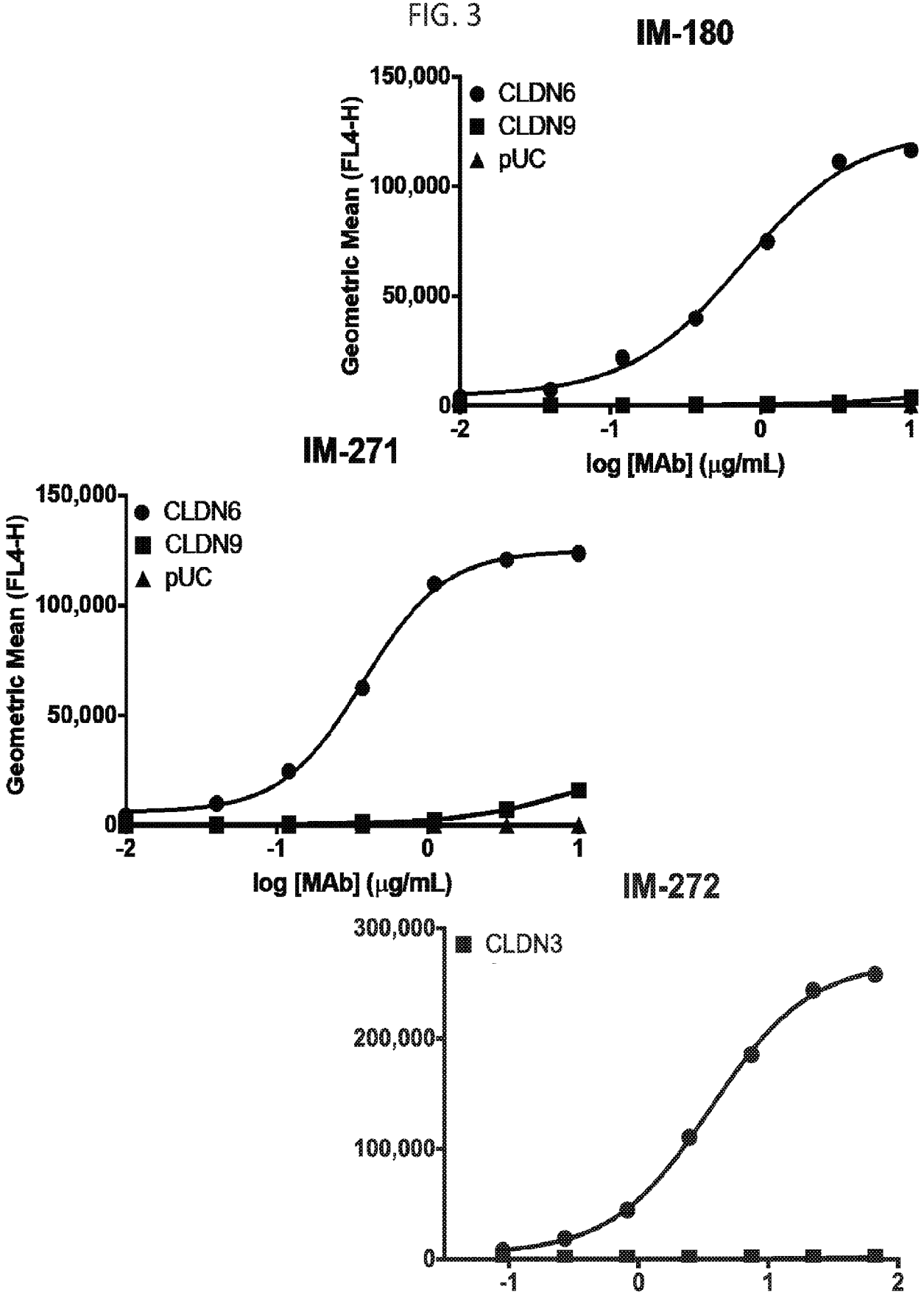

IM-180
150,000
100,000
50,000
0
Geometric Mean (FL4-H)
CLDN6
CLDN9
pUC
-2
-1
0
1
log [MAb] (μg/mL)
IM-271
150,000
100,000
50,000
0
Geometric Mean (FL4-H)
CLDN6
CLDN9
pUC
-2
-1
0
1
log [MAb] (μg/mL)
IM-272
300,000
200,000
100,000
0
CLDN3
-1
0
1
2

FIG. 4

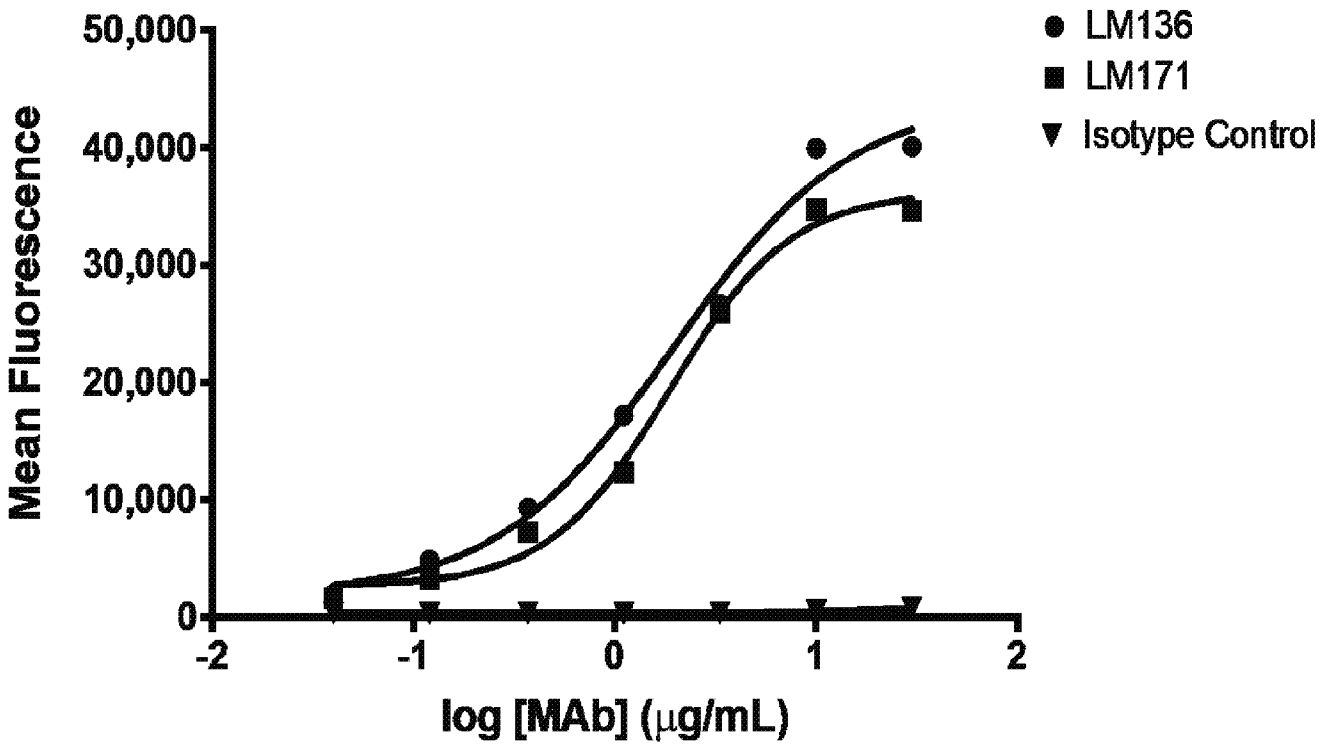
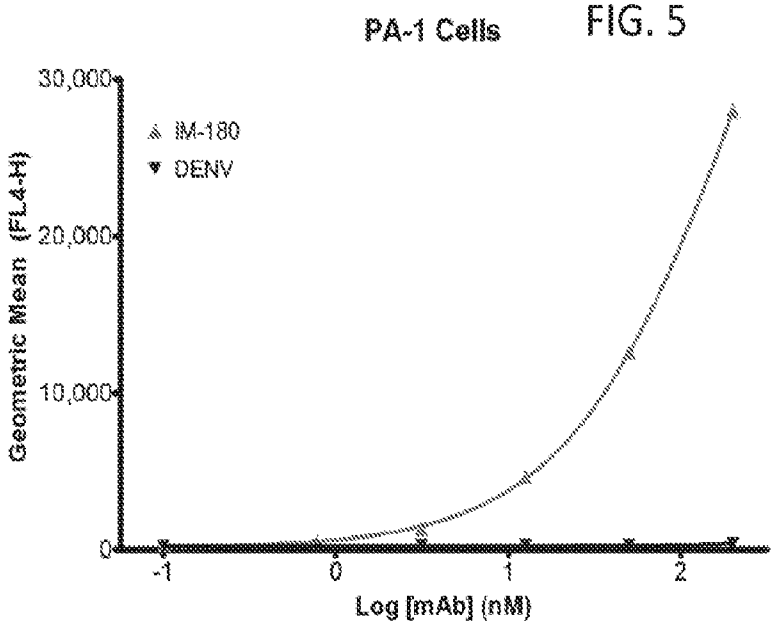
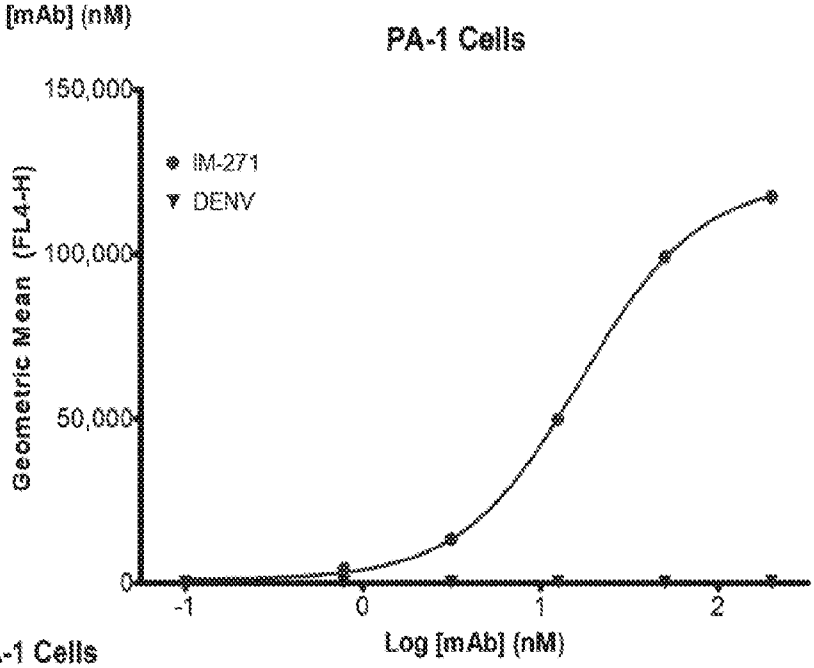

50,000
40,000
30,000
20,000
10,000
0
Mean Fluorescence
-2
-1
0
1
2
log [MAb] (μg/mL)
LM136
LM171
Isotype Control

FIG. 5


PA-1 Cells
IM-180
DENV
Geometric Mean (FL4-H)
30,000
20,000
10,000
0
-1
0
1
2
Log [mAb] (nM)


PA-1 Cells
IM-271
DENV
Geometric Mean (FL4-H)
150,000
100,000
50,000
0
-1
0
1
2
Log [mAb] (nM)

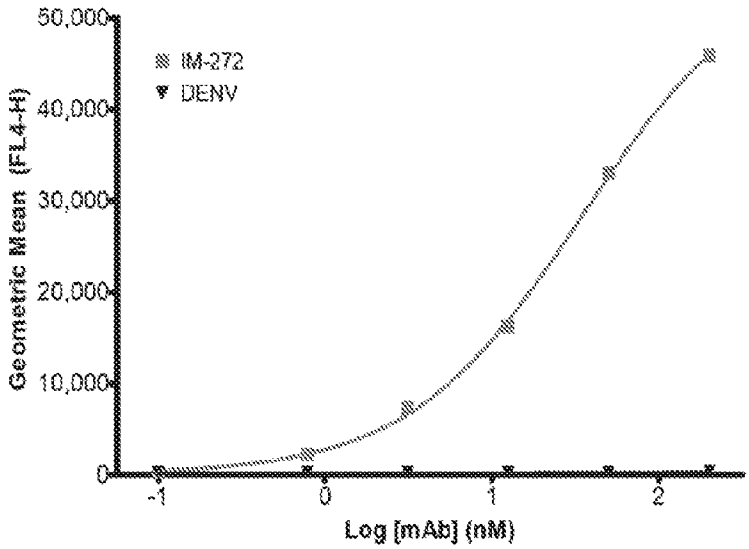

PA-1 Cells
IM-272
DENV
Geometric Mean (FL4-H)
50,000
40,000
30,000
20,000
10,000
0
-1
0
1
2
Log [mAb] (nM)

FIG. 6

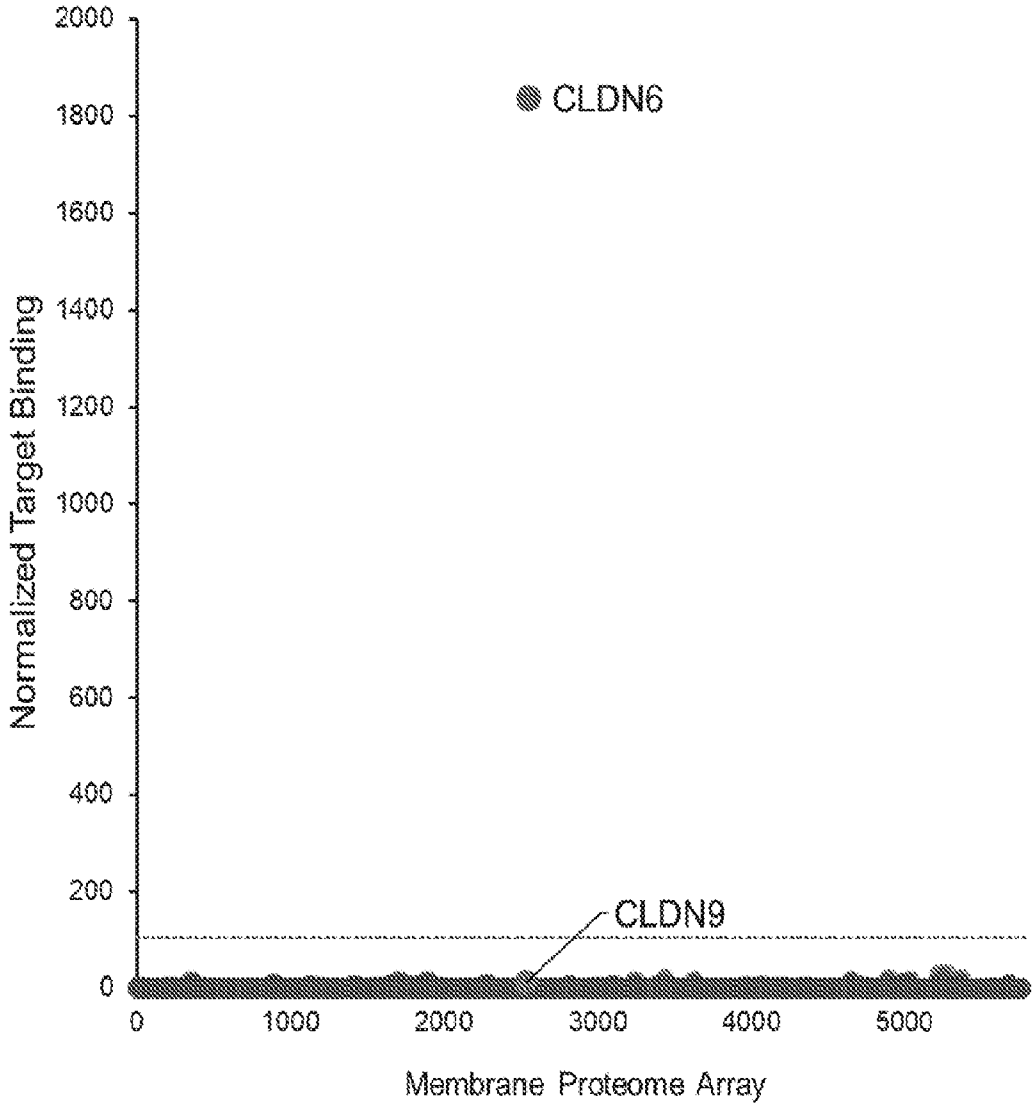

2000
1800
1600
1400
1200
1000
800
600
400
200
0
Normalized Target Binding
CLDN6
CLDN9
0
1000
2000
3000
4000
5000
Membrane Proteome Array

FIG. 7

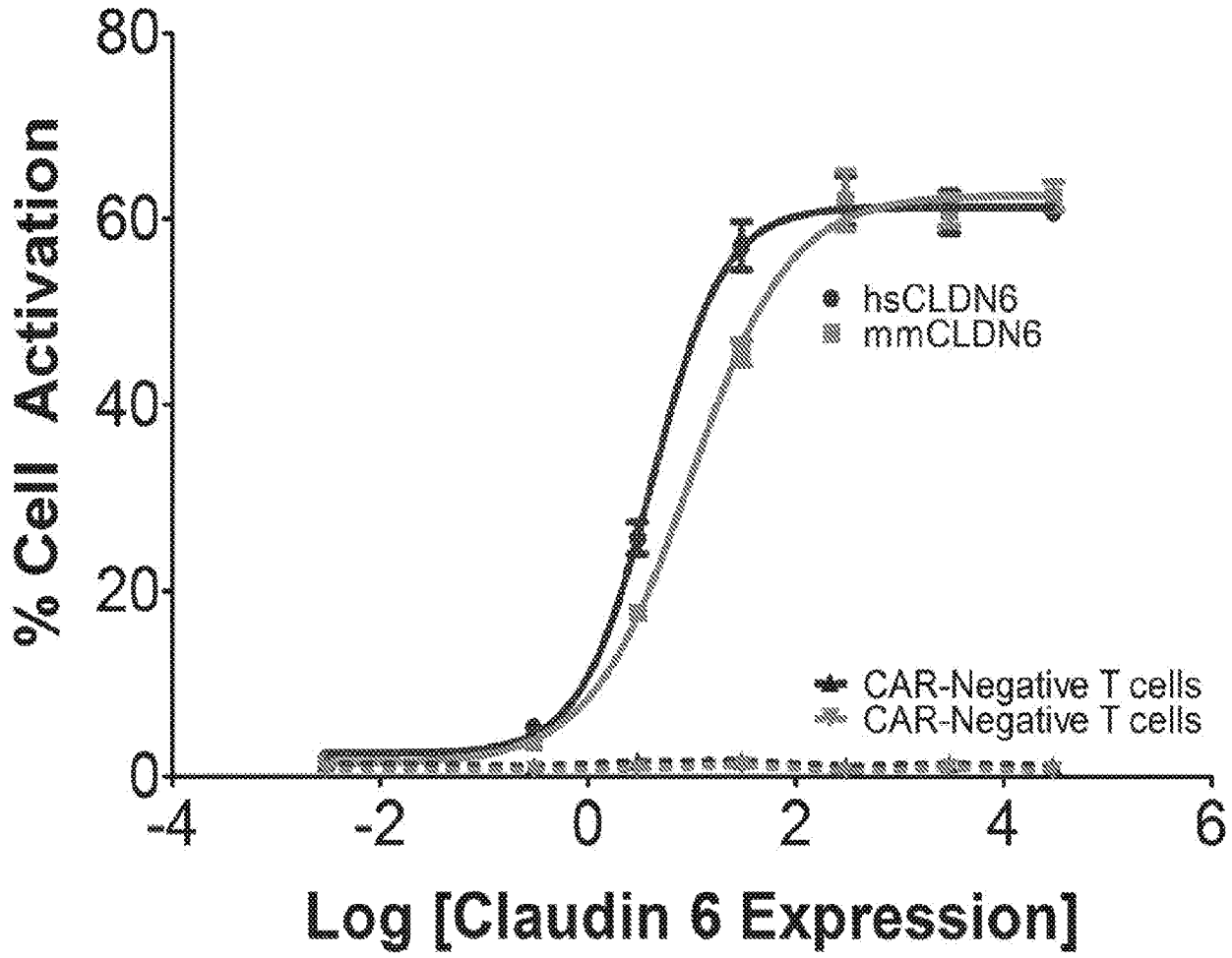

% Cell Activation
80
60
40
20
0
-4
-2
0
2
4
6
Log [Claudin 6 Expression]
hsCLDN6
mmCLDN6
CAR-Negative T cells
CAR-Negative T cells

FIG. 8

Binding Reactivity (% WT)						
Mutation	**3001-D5 MAb**	**LM136 MAb**	**LM171 MAb**	**LM172 Fab**	**LM173 MAb**	**3656 MAb**
T33A	356.9 (20)	202.4 (128)	22.8 (4)	71.3 (38)	116.2 (12)	130.6 (2)
N38A	57.2 (7)	78.4 (37)	22.4 (12)	3.1 (30)	86.0 (6)	90.3 (8)
V45A	12.3 (1)	85.0 (35)	88.4 (36)	250.0 (101)	76.1 (10)	108.7 (2)
E48A	11.1 (1)	5.3 (7)	0.9 (1)	-10.7 (34)	-0.5 (2)	151.3 (9)
Y67A	5.9 (2)	44.2 (14)	97.2 (11)	-4.0 (26)	28.8 (5)	167.6 (39)
D68A	235.2 (74)	10.2 (6)	93.7	563.4 (482)	89.6 (4)	120.1 (33)
P74A	27.7 (4)	26.5 (11)	37.5 (16)	-0.1 (16)	147.1 (32)	164.0 (12)
D76A	49.2 (17)	17.9 (1)	6.0 (1)	2.2 (19)	76.8 (11)	64.3 (0)
Q78A	22.0 (0)	170.0 (42)	150.7 (106)	69.2 (52)	143.9 (20)	130.6 (36)
D146A	61.4 (21)	91.0 (7)	57.6 (1)	10.3 (13)	119.2 (23)	113.0 (6)
V152A	121.1 (41)	134.7 (86)	128.7 (46)	17.5 (36)	58.2 (10)	106.9 (22)
A153S	151.4	134.6 (58)	24.0 (16)	107.6 (80)	113.3 (11)	105.2 (1)
E154A	45.1 (20)	142.6 (51)	4.0 (0)	18.7 (22)	133.8 (27)	101.6 (36)
Q156A	179.2 (52)	190.5 (85)	102.5 (11)	2.0 (44)	0.9 (6)	150.9 (24)
Q156L	126.0 (64)	41.7 (26)	10.0 (3)	-11.8 (35)	10.7 (8)	72.5 (4)
R158A	82.0 (14)	1.3 (1)	1.3 (0)	1.3 (29)	3.6 (1)	167.4 (10)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 20/18087

A. CLASSIFICATION OF SUBJECT MATTER

IPC - C07K 16/44, A61K 45/06, C07K 16/18 (2020.01)

CPC - C07K 16/4266, A61K 2039/505, C07K 2317/76, C07K 16/2839

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
See Search History document

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
See Search History document

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
See Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- A	US 2014/0127219 A1 (SAHIN et al.) 8 May 2014 (08.05.2014) para [0010], [0016], [0019], [0047], [0145]-[0148]	1 --- 2, 3, 5-9, 12-15
A	WO 2014/016737 A1 (PFIZER INC.) 30 January 2014 (30.01.2014) Abstract; pg 3, ln 10-19; SEQ ID NO:16	5, 7, 8, 14/1, 15
A	A0A2V9M896_9BACT, UniProtKB Accession No. A0A2V9M896_9BACT, Sialidase domain-containing protein, 12 September 2018 [Online]. [Retrieved On 22 May 2020]. Retrieved from the Internet: < URL: Https://Www.Uniprot.Org/Uniprot/A0a2v9m896 >) Entire document	5, 7, 8, 14/1, 15
A	US 2004/0141980 A1 (IGNJATOVIC et al.) 22 July 2004 (22.07.2004) Abstract, para [0002], [0024], [0221], Figure 4F, SEQ ID Nos:96, 118	2, 3, 5, 7, 8, 13-15
A	WO 2017/192567 A1 (TETRAGENETICS, INC.) 9 November 2017 (09.11.2017) para [0041], SEQ ID NO:402	2, 3, 7, 8, 13, 14, 15

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"D" document cited by the applicant in the international application
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
22 May 2020	15 JUL 2020
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Authorized officer Lee Young Telephone No. PCT Helpdesk: 571-272-4300

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 20/18087

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2018/067198 A1 (THE REGENTS OF THE UNIVERSITY OF CALIFORNIA) 12 April 2018 (12.04.2018) Table 3, SEQ ID NO:83	2, 3, 7, 8, 13, 14, 15
A	US 9,074,002 B2 (TONKS et al.) 7 July 2015 (07.07.2015) Abstract; col 11, ln 52-col 12, ln 29; SEQ ID NO:138	9
A	CN 103483449 A (LI et al.) 1 January 2014 (01.01.2014) Abstract; pg 4, para 4; SEQ ID NO:3	12
A	WO 2009/025759 A1 (PROGENICS PHARMACEUTICALS (NEVADA), INC.) 26 February 2009 (26.02.2009) Abstract, para [0040], [0071], [0078], Figure 1	20

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 20/18087

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☒ Claims Nos.: 16, 26-34, 37-41
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:
This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be searched, the appropriate additional search fees must be paid.

----please see continuation in extra sheet------

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
1-3, 5-9, 12-15 and 20, limited to SEQ ID NOs: 2-3 and 22-27

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/US 20/18087

Continuation of Box No. III Observations where unity of invention is lacking

Group I+: Claims 1-15, 20-25, and 35-36 directed to an antibody, or an isolated form thereof, that binds to claudin 6 with an affinity of less than 10 nM and with at least 100 fold greater EC50 than claudin 9, claudin 3, and/or claudin 4, comprising variable heavy chain (VH) and light chain (VL) domains, each comprising CDR1-3, and a method of use for treating cancer. The anti-claudin 6 antibody (applicant #136, see para [00128], [00135], for VH, VL, and CDRs, and para [00267] for epitope residues, instant application) will be searched to the extent that the VH domain comprises SEQ ID NO: 2, with CDR1-3 comprising SEQ ID NOs: 25-27, and the VL comprises SEQ ID NO: 3, with CDR1-3 comprising SEQ ID NOs: 22-24, wherein the antibody binding epitope includes claudin 6 residues E48, D68, P74, D76, and R158. It is believed that claims 1-3, 5-9, 12-15 and 20 encompass this first named invention, and thus these claims will be searched without fee to the extent that they encompass applicant antibody 136, comprising VH and VL of SEQ ID NOs: 2 and 3, SEQ ID NOs 25-27 (VH CDRs1-3), SEQ ID NOs: 22-24 (VL CDRs1-3) wherein the antibody binding epitope binds E48, D68, P74, D76, and R158. Additional anti-claudin 6 antibodies will be searched upon the payment of additional fees. Applicants must specify the claims that encompass any additionally elected anti-claudin 6 antibodies. Applicants must further indicate, if applicable, the claims which encompass the first named invention, if different than what was indicated above for this group. Failure to clearly identify how any paid additional invention fees are to be applied to the "+" group(s) will result in only the first claimed invention to be searched. An exemplary election would be the applicant's antibody #172 comprising VH and VL of SEQ ID NOs: 6 and 7, with SEQ ID NOs: 37-39 (VH CDRs1-3), SEQ ID NOs: 34, 29, 36 (VL CDRs1-3) wherein the antibody binding epitope binds N38, E48, Y67, P74, D76, D146, VI52, E154, Q156, and R158 (claims 1-3, 5-9 12-15, 20-21 and 35-36). Another exemplary election would be abi-specific antibody comprising a first VH peptide that binds to Claudin 6 and second VH peptide that binds to a different moiety, wherein the Claudin 6 VH antibody is applicant antibody 136, comprising VH and VL of SEQ ID NOs: 2 and 3, SEQ ID NOs 25-27 (VH CDRs1-3), SEQ ID NOs: 22 -24 (VL CDRs1-3) wherein the antibody binding epitope binds E48, D68, P74, D76, and R158 (claims 1-3, 5-9, 12-15, 20-21 and 35-36).

Group II+: Claims 17-19, directed to an isolated peptide, wherein the peptide comprises, consists of, or consists essentially of a sequence of SEQ ID NO: 2-135, or a variant thereof. Group II+ will be searched upon payment of additional fees. The peptide may be searched, for example, to the extent that the peptide encompasses SEQ ID NO: 2. It is believed that claims 17-18 limited to a peptide comprising SEQ ID NO: 2, read on this exemplary invention. Additional peptides will be searched upon the payment of additional fees. Applicants must specify the claims that encompass any additionally elected . Failure to clearly identify how any paid additional invention fees are to be applied to the "+" group(s) will result in only the first claimed invention to be searched. An exemplary election would be a peptide consisting of SEQ ID NO: 3 (Claims 17-18).

The inventions listed as Groups I+ and II+ do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

Special Technical Features

The technical feature of each of the inventions listed as Group I+ is the amino acid sequence and binding characteristics of antibodies recited therein. Each invention of Group I+ requires said sequences and binding characteristics not required by any of the other inventions.

The technical feature of each of the inventions listed as Group II+ is the amino acid sequence of the peptides recited therein. Each invention of Group I+ requires said sequences and binding characteristics not required by any of the other inventions.

Group I+ requires anti-claudin 6 antibodies having defined binding characteriscs, useful for cancer treatments, not required by Group II+.

Group II+ requires isolated single peptides, not required by Group I+.

Common Technical Features

The inventions of Group I+ share the technical feature of an antibody, or an isolated form thereof, that binds to claudin 6 with an affinity of less than 10 nM and with at least 100 fold greater ECso than claudin 9, claudin 3, and/or claudin 4.

However, this shared technical feature does not represent a contribution over prior art, because the shared technical feature is made obvious by US 2014/0127219 A1 to Sahin et al. (hereinafter 'Sahin'). Sahin teaches an antibody, or an isolated form thereof, that binds to claudin 6 (para [0010] - "In one aspect the invention relates to an antibody which is capable of binding to CLDN6 associated with the surface of a cell that expresses CLDN6") with an affinity of less than 10 nM (para [0047] - "In preferred embodiments, antibodies of the present invention can be characterized by one or more of the following properties: a) specificity for CLDN6; b) a binding affinity to CLDN6 of about 100 nM or less, preferably, about 5-10 nM or less and, more preferably, about 1-3 nM or less"), but does not expressly teach the antibody binds to claudin 6 with at least 100 fold greater EC50 than claudin 9, claudin 3, and/or claudin 4. However, Sahin does teach the CLDN6-specific antibody does not substantially bind to claudin 9, claudin 3, or claudin 4 (para [0010] - "In one aspect the invention relates to an antibody which is capable of binding to CLDN6 associated with the surface of a cell that expresses CLDN6. Preferably, the antibody is not substantially capable of binding to CLDN9 associated with the surface of a cell that expresses CLDN9. Preferably, the antibody is not substantially capable of binding to CLDN4 associated with the surface of a cell that expresses CLDN4 and/or is not substantially capable of binding to CLDN3 associated with the surface of a cell that expresses CLDN3"). It would have been obvious to one of ordinary skill in the art the antibody may bind to claudin 6 with at least 100 fold greater EC50 than claudin 9, claudin 3, and/or claudin 4 because said antibody of Sahin binds with 1-3 nM or less affinity to claudin 6 but is not substantially capable of binding to claudin 9, claudin 3, or claudin 4, and said artisan would expect a difference of at least 100 fold binding, because it is known in the art that antibodies having 100-300 nm affinity would be readily detected.

The common technical feature shared by Groups I+ and II+ (and within the inventions of GrII+), is a peptide or protein sequence that comprises a VH, VL, or a CDR comprised in an anti-claudin 6 antibody (i.e., SEQ ID NOs: 2-135 of the applicant).

----please see continuation in next extra sheet------

Continuation of previous extra sheet

However, this shared technical feature does not represent a contribution over prior art, because the shared technical feature is anticipated by Sahin. Sahin discloses anti-claudin 6 antibodies and peptide sequences comrpising VH, VL, and CDR1-3 of said VH and VL (para [0008] "CLDN6-specific antibodies capable of binding to the surface of intact cells that express CLDN6" para [0224] ""antibody" refers to a glycoprotein comprising at least two heavy (H) chains and two light (L) chains inter-connected by disulfide bonds ... Each heavy chain is comprised of a heavy chain variable region (abbreviated herein as VH) and a heavy chain constant region. Each light chain is comprised of a light chain variable region (abbreviated herein as VL) and a light chain constant region. The VH and VL regions can be further subdivided into regions of hypervariability, termed complementarity determining regions (CDR)", para [0145] - [0148] "FIG. 25. Alignment of heavy chain variable region amino acid sequences of CLDN6 specific antibodies of the invention. [0146] The CDR sequences (HCDR1, HCDR2, and HCDR3) are outlined by a box. [0147] FIG. 26. Alignment of light chain variable region amino acid sequences of CLDN6 specific antibodies of the invention.[0148] The CDR sequences (LCDR1, LCDR2, and LCDR3) are outlined by a box.").

As the technical features were known in the art at the time of the invention, they cannot be considered special technical features that would otherwise unify the groups.

Groups I+ and II+ therefore lack unity under PCT Rule 13 because they do not share a same or corresponding special technical feature.

Item 4, continued: claims 16, 26-34 and 37-41 are not not drafted in accordance with the second and third sentences of Rule 6.4(a) regarding multiply dependent claims.