CLAIMS

What is claimed is:

1. A protein comprising a D Domain target binding domain that specifically binds CS1 and comprises the amino acid sequence of any one of SEQ ID NOs: 41-106.
2. The protein of claim 1, wherein the D domain comprises the amino acid sequence of SEQ ID NO: 46.
3. The protein of claim 1, wherein the D domain comprises the amino acid sequence of SEQ ID NO: 60.
4. The protein of any one of claims 1 to 3, wherein the D domain is fused to a heterologous polypeptide.
5. The protein of claim 4, wherein the heterologous polypeptide comprises a member selected from the group consisting of.
    (a) a transmembrane domain;
    (b) a membrane associating domain;
    (c) human serum albumin or a fragment thereof;
    (d) AFP or a fragment thereof;
    (e) AFP p26 or a fragment thereof; and
    (f) the extracellular domain of a receptor or a fragment thereof.
6. The protein of any one of claims 1-5, which is labeled.
7. The protein of claim 6, wherein the label is selected from the group consisting of an enzymatic label, a fluorescent label, a luminescent label, a bioluminescent label and a biotin moiety.
8. The protein of any one of claims 1 to 7, which is conjugated to a therapeutic or cytotoxic agent.
9. The protein of any one of claims 1-3, wherein the protein is a chimeric antigen receptor (CAR), wherein the CAR further comprises (i) a transmembrane domain and (ii) an intracellular signaling domain.
10. The protein of claim 9, wherein transmembrane domain comprises a CD8a, 41BB, or CD28 transmembrane domain.
11. The protein of claim 9, wherein the intracellular signaling domain is selected from the group consisting of a domain of a human T cell receptor alpha, beta, or zeta chain; a human 41BB domain; a human CD28 domain; and any combination thereof.
12. The protein of claim 9, wherein the intracellular signaling domain comprises the intracellular domain of a costimulatory molecule selected from the group consisting of CD27, CD28, 4lBB, OX40, CD30, CD40, PD1, lymphocyte function-associated antigen- 1 (LFA-1), CD2, CD7, LIGHT, NKG2C, NKG2D, B7-H3, a ligand that specifically binds with CD83, and any combination thereof.
13. The protein of claim 9 comprising the amino acid sequence of SEQ ID NO: 107.

14. The protein of claim 9 comprising the amino acid sequence of SEQ ID NO: 108.
15. The protein of claim 4, wherein the heterologous polypeptide comprises an antigenic determinant (AD).
16. The protein of claim 15, wherein the AD comprises AFP p26 or a fragment thereof.
17. The protein of claim 16, wherein AFP p26 comprises an amino acid sequence selected from the group consisting of SEQ ID NOs: 8-15.
18. The protein of claim 16, wherein AFP p26 comprises the amino acid sequence of SEQ ID NO: 8.
19. The protein of claim 16, wherein AFP p26 comprises the amino acid sequence of SEQ ID NO: 10.
20. The protein of claim 15, wherein the AD comprises BCMA (SEQ ID NO: 2) or a fragment thereof.
21. The protein of any one of claims 15 to 20, wherein the protein comprises a single D domain that specifically binds CS1.
22. The protein of claim 21, which comprises the amino acid sequence of SEQ ID NO: 109.
23. The protein of claim 21, which comprises the amino acid sequence of SEQ ID NO: 110.
24. The protein of any one of claims 15 to 20, wherein the protein comprises two D domains that specifically bind CS1.
25. The protein of claim 24, which comprises the amino acid sequence of SEQ ID NO: 111.
26. The protein of claim 24, which comprises the amino acid sequence of SEQ ID NO: 112.
27. The protein of any one of claims 1-26, which further comprises a second target binding domain having the same or a different target than the D domain target binding domain.
28. An isolated polynucleotide encoding the protein of any one of claims 1 to 27.
29. A vector comprising the polynucleotide of claim 28.
30. A host cell comprising the polynucleotide of claim 28 or the vector of claim 29.
31. The host cell of claim 30, wherein the host cell is a T cell or a natural killer (NK) cell.
32. A method of delivering an immune response to or killing one or more target cells comprising contacting a composition comprising the target cell with a cell expressing the CAR of any one of claims 9-14.
33. A method of delivering an immune response to or killing one or more target cells comprising contacting a composition comprising the target cell with the protein of any one of claims 15-26, wherein (a) the composition comprising the target cell further comprises a cell expressing a CAR, wherein the CAR comprises (i) an antigenic determinant binding domain (ADBD) that binds to an antigenic determinant (AD) other than CS1, (ii) a transmembrane domain, and (iii) an intracellular domain; and (b) the protein of any one of claims 15-26 comprises (i) a D domain that binds to CS1 and (ii) the AD bound by the CAR.
34. The method of claim 32 or claim 33, where the target cell is a cancer cell.

35. The method of claim 32 or claim 33, where the cancer cell is a myeloma cell, optionally a multiple myeloma cell.
36. Use of a composition comprising a cell expressing the CAR of any one of claims 9-14 in the manufacture of a medicament for treating cancer.
37. Use of a composition comprising the protein of any one of claims 15-26 in the manufacture of a medicament for treating cancer, wherein (a) the composition further comprises a cell expressing a CAR, wherein the CAR comprises (i) an antigenic determinant binding domain (ADBD) that binds to an antigenic determinant (AD) other than CS1, (ii) a transmembrane domain, and (iii) an intracellular domain; and (b) the protein of any one of claims 15-26 comprises (i) a D domain that binds to CS1 and (ii) the AD bound by the CAR.
38. The use of claims 32, 33, 36, or 37, wherein the cell expressing the CAR is a T cell or a natural killer (NK) cell.
39. The use of claims 36 or 37, wherein the cancer is hematological cancer.
40. The use of claim 39, wherein the hematological cancer is myeloma, optionally multiple myeloma.
41. A composition comprising a cell expressing the CAR of any one of claims 9-14 or a composition comprising the protein of any one of claims 15-26 for use in therapy.