WHAT IS CLAIMED IS:

1. A multi-specific antibody, comprising:

(i) a first antigen binding moiety that binds CD3, wherein the first antigen binding moiety is a first Fv fragment comprising a first heavy chain variable region (V_H) and a first light chain variable region (V_L);

(ii) a second antigen binding moiety that binds CD137, wherein the second antigen binding moiety is a second Fv fragment comprising a second V_H and a second V_L;

(iii) an Fc fragment connecting the first antigen binding moiety and the second antigen binding moiety, wherein the Fc fragment comprises a hinge domain and a CH2 domain, and wherein the Fc fragment comprises a deletion at position 237 and an amino acid substitution at position P329, optionally P329G, following the EU numbering system; and

(iv) a third antigen binding moiety that binds a first tumor associated antigen; wherein the third antigen binding moiety is connected to the first antigen binding moiety, optionally via a first peptide linker, wherein the first tumor associated antigen is CEA.

2. The multi-specific antibody of claim 1, which further comprise (v) a fourth antigen binding moiety that binds a second tumor associated antigen; wherein the fourth antigen binding moiety is connected to the first antigen binding moiety, optionally via a second peptide linker, wherein the second tumor associated antigen is CEA.

3. The multi-specific antibody of claim 1 or claim 2, wherein the Fc fragment of (iii) is an IgG1 Fc fragment, which optionally comprises the amino acid sequence of SEQ ID NO: 91.

4. The multi-specific antibody of any one of claims 1-3, wherein the Fc fragment further comprises a CH3 domain.

5. The multi-specific antibody of claim 4, wherein the CH3 domain comprises one or more mutations that enhance heterodimerization over homodimerization of the Fc fragments comprising such as relative to the wild-type counterpart and/or reduce protein A binding.

6. The multi-specific antibody of claim 5, wherein the CH3 domain comprises

the amino acid sequence of SEQ ID NO: 93, 94, or 95.

7. The multi-specific antibody of any one of claims 1-6, wherein the first V_H comprises the same heavy chain complementarity determining regions (CDRs) as those in SEQ ID NO: 7 and the first V_L comprises the same light chain CDRs as those in SEQ ID NO: 8.

8. The multi-specific antibody of claim 7, wherein the first V_H comprises the amino acid sequence of SEQ ID NO: 7 and the first V_L comprises the amino acid sequence of SEQ ID NO: 8.

9. The multi-specific antibody of any one of claims 1-8, wherein the second V_H comprises the same heavy chain complementarity determining regions (CDRs) as those in SEQ ID NO: 9 and the second V_L comprises the same light chain CDRs as those in SEQ ID NO: 10.

10. The multi-specific antibody of claim 9, wherein the second V_H comprises the amino acid sequence of SEQ ID NO: 9 and the second V_L comprises the amino acid sequence of SEQ ID NO: 10.

11. The multi-specific antibody of any one of claims 1-10, which comprises a first polypeptide comprising the amino acid sequence of SEQ ID NO: 3 and a second polypeptide comprising the amino acid sequence of SEQ ID NO: 4.

12. The multi-specific antibody of any one of claims 2-11, wherein the third antigen binding moiety and the fourth antigen binding moiety bind to different epitopes of the tumor associated antigen.

13. The multi-specific antibody of any one of claims 2-12, wherein the third antigen binding moiety and optionally the fourth antigen binding moiety are Fab fragments.

14. The multi-specific antibody of any one of claims 2-13, wherein the third antigen binding moiety comprises the same heavy chain CDRs as those in SEQ ID NO: 17 and the same light chain CDRs as those in SEQ ID NO: 18; and/or

the fourth antigen binding moiety comprises the same heavy chain CDRs as those in SEQ ID NO: 17 and the same light chain CDRs as those in SEQ ID NO: 18.

15. The multi-specific antibody of claim 14, wherein the third antigen binding moiety comprises the amino acid sequence of SEQ ID NO: 17 and the amino acid sequence of SEQ ID NO: 18; and/or

the fourth antigen binding moiety comprises the amino acid sequence of SEQ ID NO: 17 and the amino acid sequence of SEQ ID NO: 18.

16. The multi-specific antibody of any one of claims 13-15, which comprises:

(i) a first polypeptide comprising, from N-terminus to C-terminus, a VH-CH1 chain of the Fab fragments, a VH of the first antigen binding moiety, an Fc fragment, and a VH of the second antigen binding moiety;

(ii) a second polypeptide comprising, from N-terminus to C-terminus, the VH-CH1 chain of the Fab fragments, a VL of the first antigen binding moiety, an Fc fragment, and a VL of the second antigen binding moiety; and

(iii) a third polypeptide comprising a VL-CL of the Fab fragments.

17. The multi-specific antibody of any one of claims 1-16, wherein the peptide linker comprises the amino acid sequence of SEQ ID NO: 96, 97, 98, 99, 100 or 101.

18. The multi-specific antibody of claim 1, which comprises a first polypeptide comprising the amino acid sequence of SEQ ID NO: 39, a second polypeptide comprising the amino acid sequence of SEQ ID NO: 40, and a third polypeptide comprising the amino acid sequence of SEQ ID NO: 41.

19. A nucleic acid or a nucleic acid set, which collectively encodes the multi-specific antibody setting forth in any one of claims 1-18.

20. The nucleic acid or the nucleic acid set of claim 19, which is an expression vector or an expression vector set.

21. A host cell, comprising the nucleic acid or the nucleic acid set of claim 19 or claim 20.

22. The host cell of claim 21, which is a mammalian host cell.

23. A method for producing a multi-specific antibody, comprising:

(i) culturing the host cell of claim 21 or claim 22 under conditions allowing for expression of the antibody; and

(ii) harvesting the antibody thus produced.

24. A pharmaceutical composition comprising the multi-specific antibody set forth in any one of claims 1-18 or a nucleic acid or nucleic acid set of claim 19 or 20 encoding such, and a pharmaceutically acceptable carrier.

25. The effective amount of the multi-specific antibody of any one of claims 1-18, the nucleic acid(s) of claim 19 or 20 encoding such, or the pharmaceutical composition comprising the antibody or the encoding nucleic acid(s) of claim 24, for use in modulating immune responses in a subject.

26. The multi-specific antibody, the nucleic acid, or the pharmaceutical composition for use of claim 25, wherein the subject is a human patient having or suspected of having cancer.