CLAIMS

1. A method of growing and/or maintaining eukaryotic cells in suspension, the method comprising:

(a) culturing at least one eukaryotic cell in a culture media in suspension, wherein the at least one eukaryotic cell has been genetically engineered to express a fusion protein comprising a signaling protein receptor, or a functional portion thereof, and a light-activatable domain;

(b) exposing the at least one eukaryotic cell to light to activate the light-activatable domain resulting in activation of a downstream signaling pathway of the signaling protein receptor, such that the at least one eukaryotic cell is grown and/or maintained in suspension.

2. The method of claim 1, wherein the signaling protein receptor or functional portion thereof is a growth factor receptor.

3. The method of claim 1 or 2, wherein the culture media is deficient in at least one factor required for growing and/or maintaining the at least one eukaryotic cell.

4. The method of claim 3, wherein the at least one factor is a ligand for the signaling protein receptor or functional portion thereof.

5. The method of claim 4, wherein the at least one factor comprises at least one growth factor.

6. The method of claim 4 or 5, wherein the at least one growth factor is a fibroblast growth factor (FGF).

7. The method of any one of the preceding claims, wherein the signaling protein receptor or functional portion thereof is a fibroblast growth factor receptor (FGFR).

8. The method of claim 7, wherein the FGFR is selected from the group consisting of: FGFR1, FGFR2, and both.

9. The method of any one of the preceding claims, wherein the at least one eukaryotic cell is a mammalian cell.

10. The method of any one of the preceding claims, wherein the at least one eukaryotic cell is a bovine cell or a chicken cell.

11. The method of any one of the preceding claims, wherein the at least one eukaryotic cell is grown and/or maintained, or is capable of being grown and/or maintained, in suspension for at least 7 days.

12. The method of any one of the preceding claims, wherein, at 7 days or greater in suspension culture, the at least one eukaryotic cell expresses at least one marker of stemness.

13. The method of any one of the preceding claims, wherein the at least one eukaryotic cell is a stem cell.

14. The method of claim 13, wherein the stem cell is a pluripotent stem cell or a multipotent stem cell.

15. The method of claim 14, wherein the pluripotent stem cell is maintained, or is capable of being maintained, in a pluripotent state for at least 7 days; or wherein the multipotent stem cell is maintained, or is capable of being maintained, in a multipotent state for at least 7 days.

16. The method of any one of claims 13-15, wherein the stem cell remains, or is capable of remaining, in an undifferentiated state for at least 7 days.

17. The method of any one of claims 13-16, wherein the stem cell is an embryonic stem cell or a mesenchymal stem cell.

18. The method of any one of claims 13-16, wherein the stem cell is a satellite cell, a muscle stem cell, or a fat stem cell.

19. The method of any one of the preceding claims, wherein the suspension culture has a volume of at least 100 milliliters (mL).

20. The method of any one of the preceding claims, wherein the suspension culture is contained within a bioreactor vessel.

21. The method of claim 20, wherein the bioreactor vessel has a total volume of at least 100 milliliters (mL).

22. The method of any one of the preceding claims, wherein the light-activatable domain is selected from the group consisting of: a Light-Oxygen-Voltage (LOV) photoreceptor domain, a Cryptochrome (CRY) photoreceptor domain, Blue-light-using FAD (BLUF) photoreceptor domain, a Phytochrome (PHY) photoreceptor domain, a cryptochrome-interacting basic-helix-loop-helix protein 1 (CIB1) domain, a phytochrome interacting factor (PIF) domain, a Dronpa domain, a UVR8 photoreceptor domain, a COP1 domain, a BphP1 domain, a QPAS-1 domain, a cobalamin-binding domain (CBD), and any combination thereof.

23. The method of any one of the preceding claims, wherein the exposing of (b) comprises exposing the at least one eukaryotic cell to light having at least one illumination parameter.

24. The method of claim 23, wherein the at least one illumination parameter comprises light intensity, a temporal pattern of illumination, or both.

25. The method of claim 24, wherein the light intensity is between 1 - 10 $\mu W/mm^2$.

26. The method of claim 25, wherein the temporal pattern comprises a light stimulus duration of at least about 5 minutes, an interstimulus duration of from about 20 minutes to about 250 minutes, or both.

27. The method of any one of the preceding claims, wherein the fusion protein, after the exposing to light of (b), dimerizes or oligomerizes.

28. The method of any one of the preceding claims, wherein the downstream signaling pathway is an ERK signaling pathway.