

Teacher Guide: Color-Label-Learn: Creating Stem Cells for Research

ACTIVITY OVERVIEW

Abstract:

Students color and label images on a worksheet and answer questions about the on-line content featured in *Creating Stem Cells for Research*.

Module:

Stem Cells in the Spotlight

Prior Knowledge Needed:

Stem cells are undifferentiated cells

Key Concepts:

Embryonic stem cells, adult stem cells, cell line, fertilization, embryo, differentiation, therapeutic cloning

Materials:

Student pages, Internet access, crayons or colored pencils (optional)

Appropriate For:

Ages: 12 - 18

USA grades: 7 - 12

Prep Time:

10 minutes to make copies

Class Time:

30 minutes

Activity Overview Web Address:

<http://gslc.genetics.utah.edu/teachers/tindex/overview.cfm?id=>

Other activities in the *Stem Cells in the Spotlight* module can be found at:

<http://gslc.genetics.utah.edu/teachers/tindex/>

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I. PEDAGOGY

A. Learning Objectives

- Students will learn that the development of stem cell therapies begins with experimentation on “cell lines” that reflect the biology of human stem cells.
- Students will be able to describe how stem cell lines currently in use are created from both embryonic and adult stem cells.
- Students will understand that therapeutic cloning is a possible medical application of this technology.

B. Background Information

A cell line is a genetically identical population of cells derived from a single cell or small group of uniform founder cells. The cells are maintained or “cultured” in a dish and bathed in a liquid medium that contains nutrients and important growth factors. Each time the cells divide, the new cells can be used to seed other dishes of cells—creating a “line” of progeny. Cell lines are useful because they allow a whole series of experiments to be done with a uniform population of cells.

The first success at culturing human embryonic stem cells was reported in 1998. Stem cell lines require special growth conditions that encourage cell division and discourage cell differentiation. Each human stem cell line currently in use is slightly different from another in their genetic make-up because each originated from a different embryo donor. Experiments done with these stem cell lines serve as a model for the biology of human stem cells *in vivo* and are an important first step toward developing new medical treatments for disease or injury (called stem cell therapies).

C. Teaching Strategies

1. Classroom Implementation

- Begin class with a discussion about the usefulness of model systems for testing new drugs and therapies.
 - Before a drug or therapy can be safely given to humans, it is often tested in animal models or in human cells grown in a dish. The hope is that these models will provide an accurate representation of how human cells inside the body will respond to the same treatment.
 - The development of stem cell therapies will require the establishment of these same model systems. How might scientists grow stem cells in dishes, and where would the stem cells come from?
 - Explain that a “cell line” is a genetically identical population of cells

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originally derived from a single cell. The cells are grown in dishes and bathed in medium that encourages them to divide continuously. Each time they divide, the new cells can be used to seed other dishes of cells. This allows a whole series of experiments to be done with a uniform population of cells.

- Invite students to explore *Creating Stem Cells for Research* to learn how these stem cell lines are generated.
 - See <http://gslc.genetics.utah.edu/units/stemcells/screate/>
- Instruct students to label the diagrams and answer the questions found on the student pages as they go through the on-line material. Coloring the images is optional.
- Review as a class the possible medical applications for therapeutic cloning.
- Optional: End class with a discussion of political and ethical issues related to the creation of stem cell lines for research.

2. Common Misconceptions

- Many students think that embryonic stem cell research is performed on embryos at a much later stage in development. Emphasize that stem cell lines are generated from embryos just hours after fertilization when the embryo consists of only a few cells.

II. STANDARDS

A. U.S. National Science Education Standards

Grades 5-8:

- Content Standard C: Life Science - Structure and Function in Living Systems; All organisms are composed of cells—the fundamental unit of life; Cells carry on the many functions needed to sustain life. They grow and divide, thereby producing more cells. This requires that they take in nutrients, which they use to provide energy for the work that cells do and to make the materials that a cell or an organism needs; Specialized cells perform specialized functions in multicellular organisms.
- Content Standard C: Life Science - Reproduction and Heredity; Some organisms reproduce asexually. Other organisms reproduce sexually; In many species, including humans, females produce eggs and males produce sperm. An egg and sperm unite to begin development of a new individual.
- Content Standard F: Science in Personal and Social Perspectives - Science and Technology in Society; Technology influences the quality of

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life. Technological changes are often accompanied by social, political, and economic changes that can be beneficial or detrimental to individuals and to society. Social needs, attitudes, and values influence the direction of technological development.

Grades 9-12:

- Content Standard C: Life Science - The Cell; Cells can differentiate, and complex multicellular organisms are formed as a highly organized arrangement of differentiated cells. In the development of these multicellular organisms, the progeny from a single cell form an embryo in which the cells multiply and differentiate to form the many specialized cells, tissues and organs that comprise the final organism. This differentiation is regulated through the expression of different genes.
- Content Standard C: Life Science - Molecular Basis of Heredity; Transmission of genetic information to offspring occurs through egg and sperm cells that contain only one representative from each chromosome pair. An egg and a sperm unite to form a new individual.
- Content Standard E: Science and Technology - Understandings About Science and Technology; Technological design is driven by the need to meet human needs and solve human problems. Technological solutions may create new problems. Sometimes scientific advances challenge people's beliefs and practical explanations concerning various aspects of the world.
- Content Standard F: Science in Personal and Social Perspectives - Science and Technology in Local, National, and Global Challenges; Understanding basic concepts and principles of science and technology should precede active debate about the economics, policies, politics, and ethics of various science- and technology-related challenges; Individuals and society must decide on proposals involving new research and the introduction of new technologies into society. Decisions involve assessment of alternatives, risks, costs, and benefits and consideration of who benefits and who suffers, who pays and gains, and what the risks are and who bears them.

B. AAAS Benchmarks for Science Literacy

Grades 6-8:

- The Living Environment: Cells - Cells repeatedly divide to make more cells for growth and repair.
- The Living Environment: Heredity - In sexual reproduction, a single specialized cell from a female merges with a specialized cell from a male. As the fertilized egg, carrying genetic information from each parent, multiplies to form the complete organism with about a trillion cells, the same genetic information

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is copied in each cell.

- The Human Organism: Human Development - Following fertilization, cell division produces a small cluster of cells that then differentiate by appearance and function to form the basic tissues of an embryo.
- The Nature of Technology: Issues in Technology - Societies influence what aspects of technology are developed and how these are used. People control technology (as well as science) and are responsible for its effects.

Grades 9-12:

- The Living Environment: Heredity - The many body cells in an individual can be very different from one another, even though they are all descended from a single cell and thus have essentially identical genetic instructions. Different parts of the instructions are used in different types of cells, influenced by the cell's environment and past history.
- The Human Organism: Human Development - As successive generations of an embryo's cells form by division, small differences in their immediate environments cause them to develop slightly differently, by activating or inactivating different parts of the DNA information; The development and use of technologies to maintain, prolong, sustain, or terminate life raise social, moral, ethical, and legal issues.
- The Nature of Technology: Technology and Science - New technologies make it possible for scientists to extend their research in new ways or to undertake entirely new lines of research. The very availability of new technology itself often sparks scientific advances.
- The Nature of Technology: Issues in Technology - Social and economic forces strongly influence which technologies will be developed and used. Which will prevail is affected by many factors, such as personal values, the federal budget, local and national regulations, media attention, etc.

Activity created by:

Tanya Vickers, April Mitchell, and Harmony Starr (illustrations), Genetic Science Learning Center

Funding:

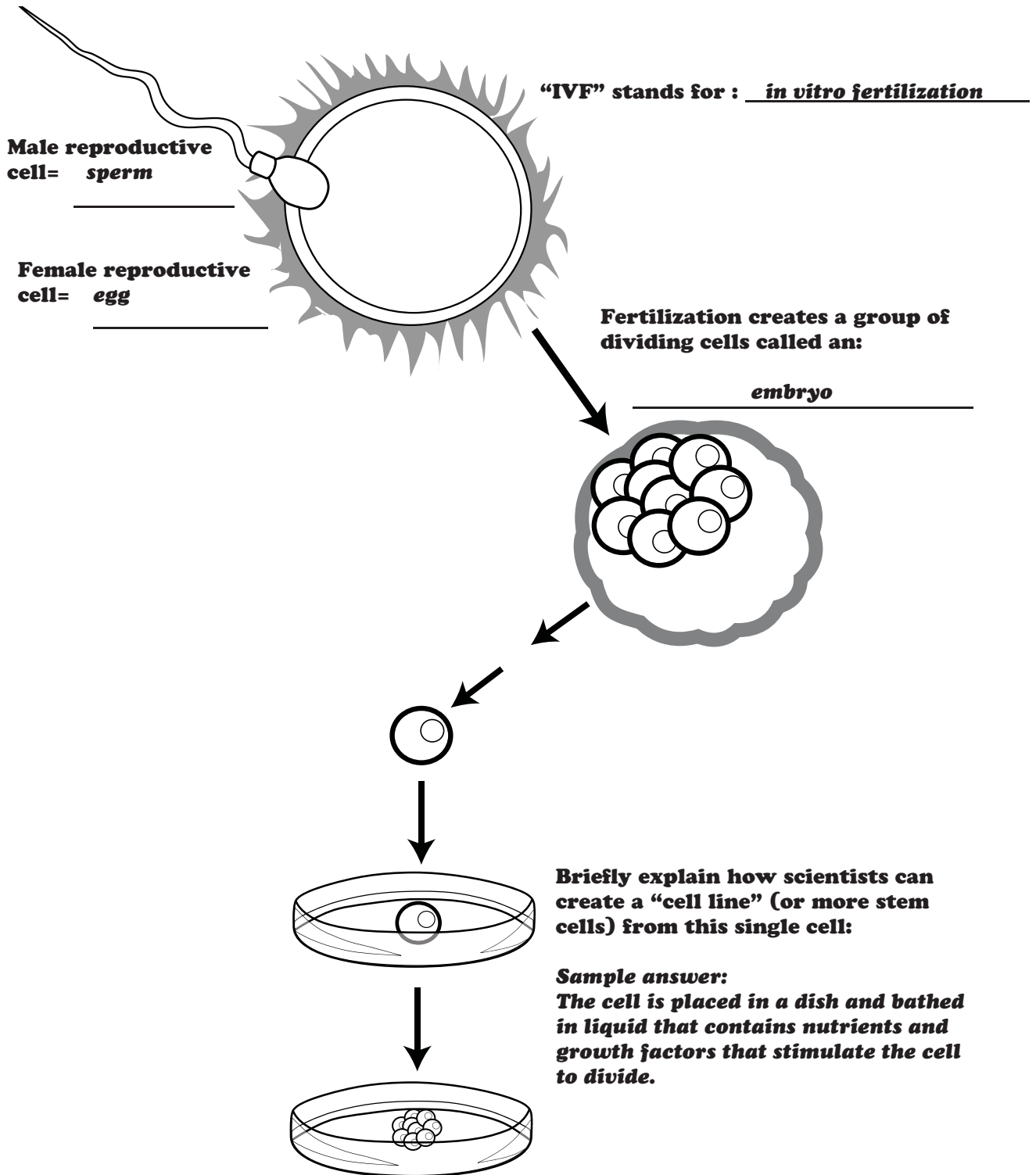


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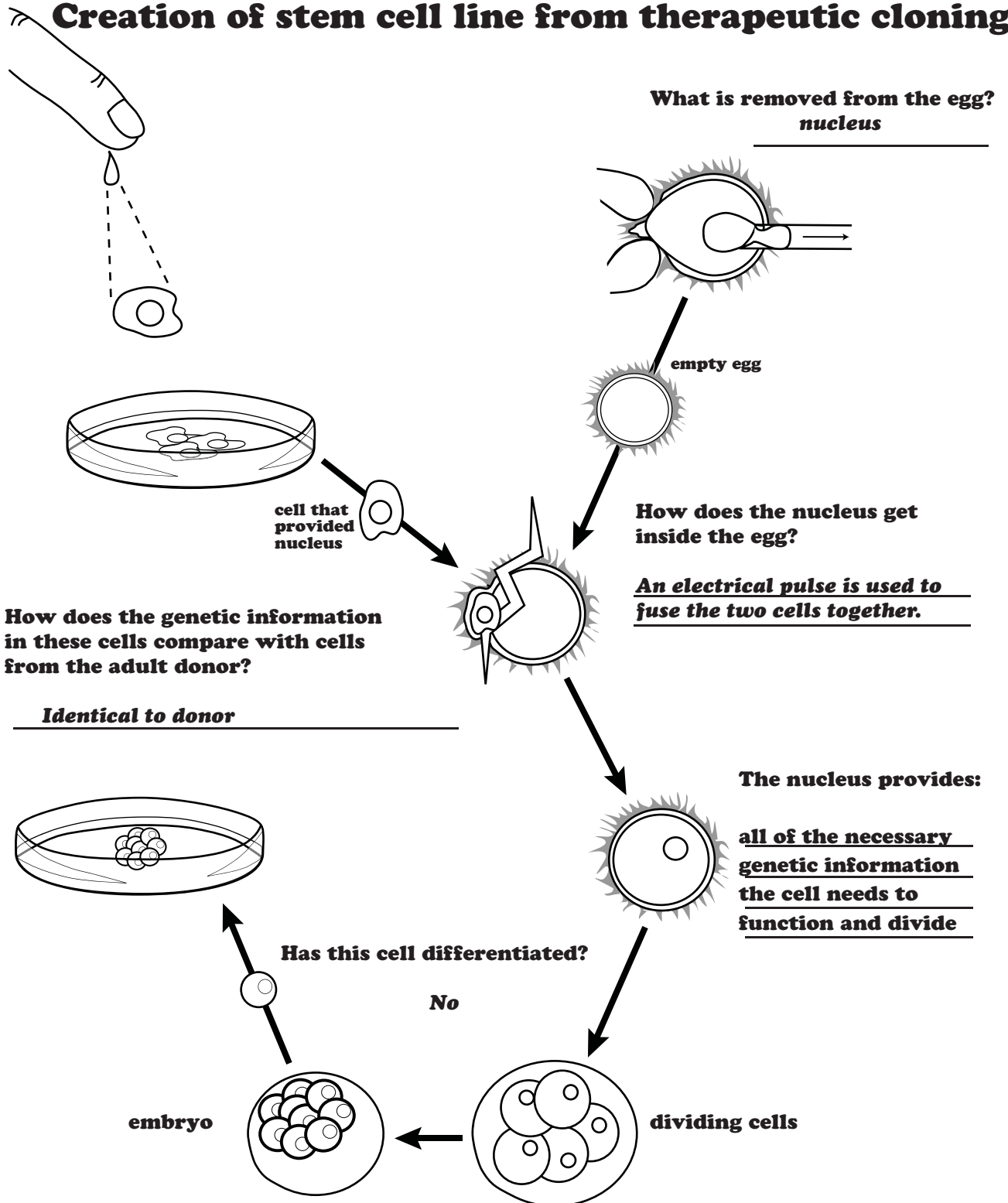
Teacher References: Answer Key

Creation of stem cell line from an embryo



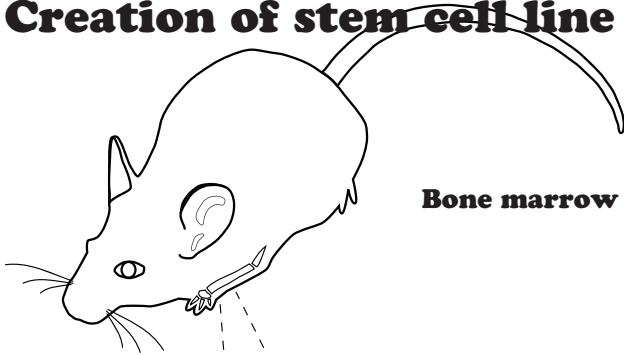
Teacher References: Answer Key

Creation of stem cell line from therapeutic cloning



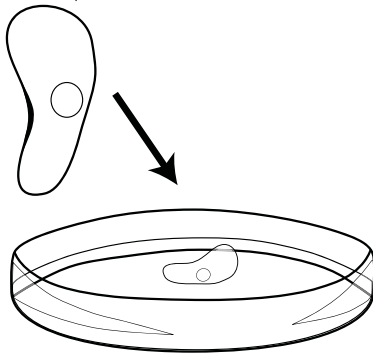
Teacher References: Answer Key

Creation of stem cell line from adult tissue



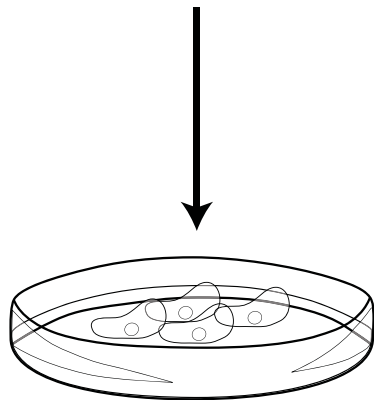
Bone marrow is a source of:

stem cells



Why is most research involving adult stem cells performed using model organisms?

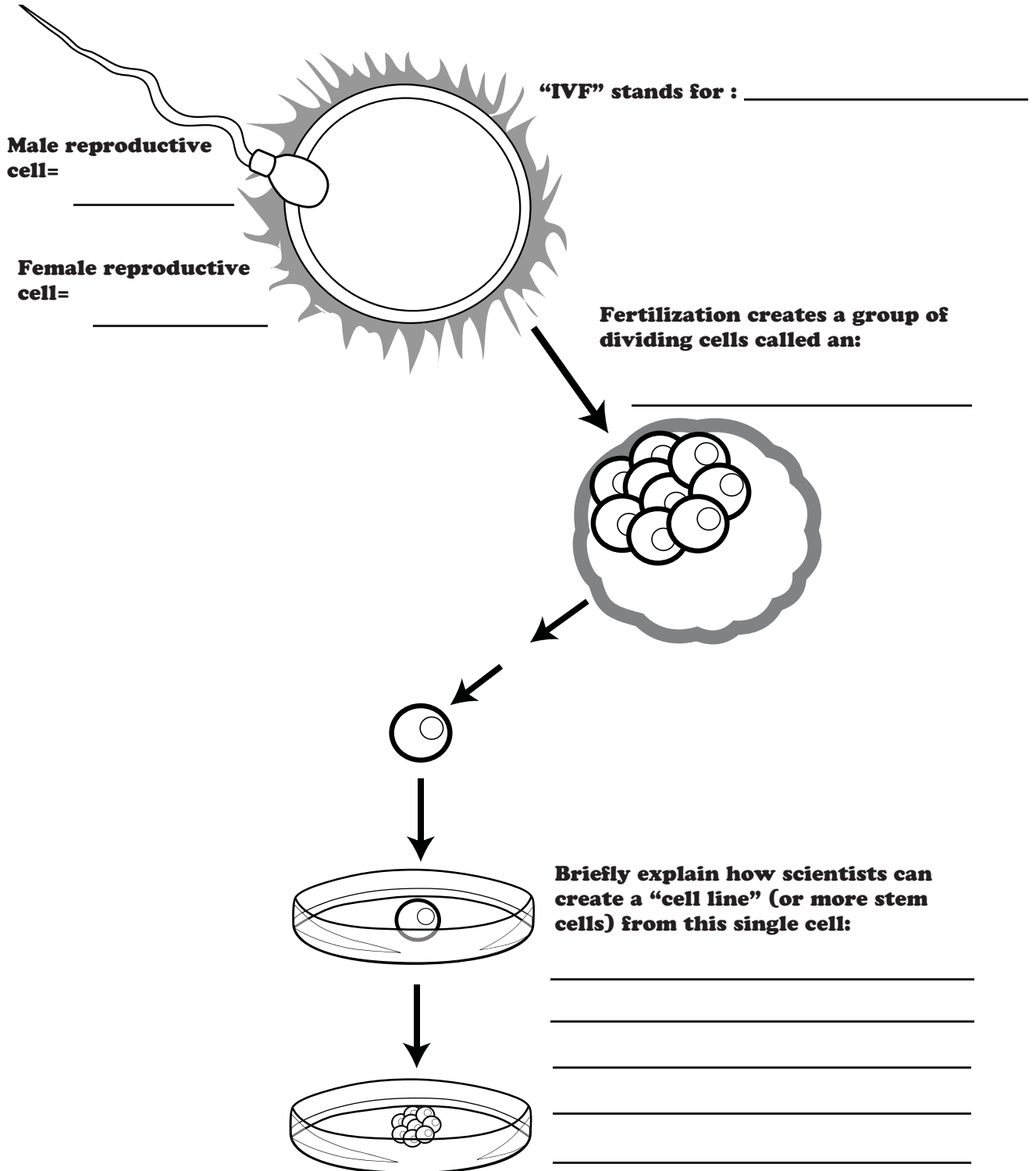
obtaining adult stem cells from humans can involve invasive surgical procedures.



Stem cells can then be bathed in special growth medium that promotes “differentiation” into blood cells.

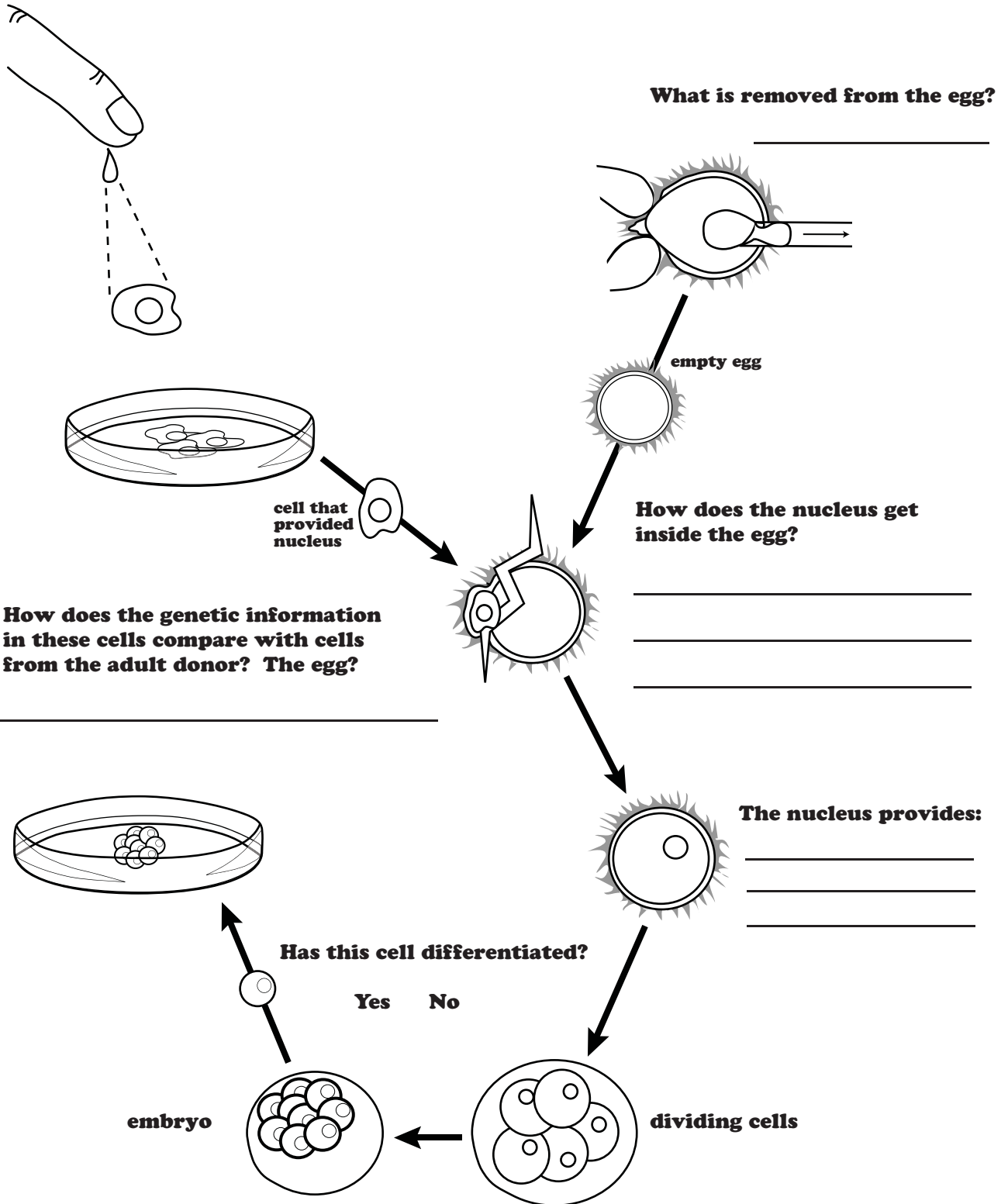
Color - Label - Learn:

Creation of stem cell line from an embryo



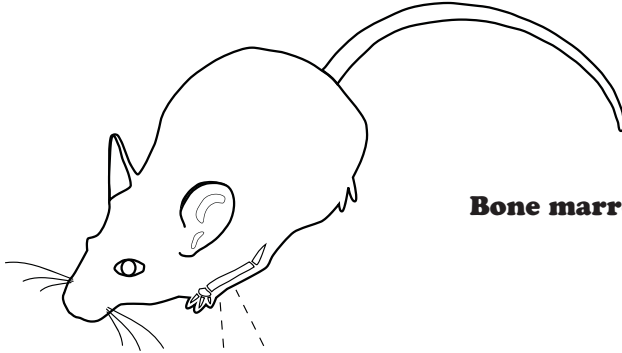
Color - Label - Learn:

Creation of stem cell line from therapeutic cloning

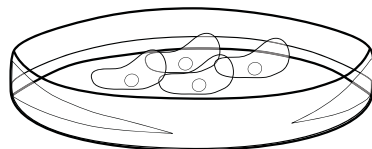
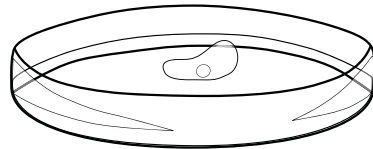


Color - Label - Learn:

Creation of stem cell line from adult tissue



Bone marrow is a source of: _____



Why is most research involving adult stem cells performed using model organisms?

Stem cells can then be bathed in special growth medium that promotes differentiation into blood cells.