

## The clone factory

Have humans been cloned? Is it possible? Immediate interest is sparked when students are asked these questions. In response to their curiosity, the clone factory activity was developed to help them understand the process of cloning. In this activity, students reenact the cloning process, in a very simplified simulation. After completing the process, they

will discover what species they have cloned. Students will then research the risks and benefits of cloning, which they summarize in a short report.

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### The clone factory teacher setup

There are several technologies for cloning. This lab will simulate *somatic cell nuclear transfer*. The egg's single set of chromosomes will be removed and replaced with the donor nucleus from a body cell containing two complete sets of chromosomes.

#### Materials (for teacher setup and 12 pairs of students)

- 2 posterboards (two different colors)
- 6 transparent plastic sheets (blank overhead transparencies work well)
- 6–10 pipe cleaners (various colors)
- glue
- tape
- 12 plastic drinking straws
- double-sided tape
- 4–6 sheets of construction paper (two contrasting colors)
- pictures of at least 12 different species

#### Procedure for creating a recipient egg cell

1. Cut out a posterboard circle, approximately 10 cm in diameter.
2. Cut out a second 10 cm diameter circle from the transparent plastic. This will represent the cell membrane. Tape the two circles together about two-thirds of the way around the edges to create a circular pocket.
3. Cut off 1 cm long pieces from a pipe cleaner. These will represent the egg's chromosomes. Bend the segments slightly so they resemble tiny sausages. (An actual egg cell would have 23 chromosomes, but you can use fewer.)
4. Insert the pieces of pipe cleaner in the cell pocket (see Figure 1). The nuclear membrane is indistinct at this time.
5. Repeat these steps to create enough egg cells for your class to work in pairs.

#### Procedure for creating a donor nucleus

1. Cut out circles 5 cm in diameter from construction paper that is a different color than the posterboard used to make

- the egg cells. These will represent the donor nuclei.
2. From a contrasting sheet of construction paper, cut out small sausage-shaped "chromosomes" similar in size to the pipe cleaner chromosomes. Glue the chromosomes to the nucleus (Figure 2).
3. Number the back of the nucleus. Write the same number on an envelope and place a picture of a specific species, such as a frog, sheep, mouse, triceratops, or human, in the envelope. This will be the species cloned when the corresponding donor nucleus is used.
4. Repeat these steps to create enough donor nuclei for your entire class. Use a variety of species. To add interest, you may wish to include famous scientists, celebrities, or athletes in your donor pool.

#### Procedure for creating a pipette

1. Roll up some double-sided tape and insert it in one end of a plastic straw, leaving a short length of the tape sticking out of the straw (Figure 3). Create enough pipettes for the entire class and a few extras.

**Figure 1** 10 cm

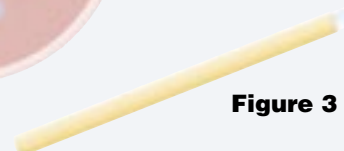


**Figure 2**

5 cm



**Figure 3**



## The clone factory student activity sheet

### Background information

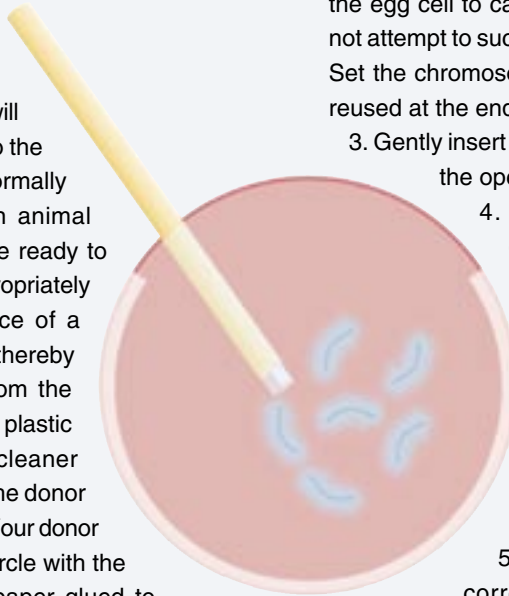
Reproductive cloning is based on nuclear transfer, the same technique scientists have used for some years to copy animals from embryonic cells. Nuclear transfer involves the use of two cells. This can be accomplished in two ways. Either the nucleus of the donor cell is implanted into the recipient egg cell, or the intact cell is fused with the egg cell. In our laboratory today, we will be implanting the donor nucleus into the egg cell. The recipient egg cell is normally an unfertilized egg taken from an animal soon after ovulation. Such eggs are ready to begin developing once they are appropriately stimulated (usually by the entrance of a sperm). The nucleus is removed, thereby eliminating the genetic material from the egg. (The circles of posterboard and plastic containing short lengths of pipe cleaner represent your recipient egg cell.) The donor nucleus has the DNA to be copied. (Your donor nucleus is the construction paper circle with the small sausage-shaped pieces of paper glued to it). A researcher working under a high power microscope holds the recipient egg cell by suction on the end of a fine pipette and uses an extremely fine micropipette (drinking straw with tape on one end in your model) to suck out the chromosomes (the segments of pipe cleaner). At this stage, the chromosomes in the egg are not enclosed in a distinct nucleus. The donor nucleus is transferred to the recipient egg. With electrical stimulation or chemical tweaking, some manipulated cells start to develop like a normal embryo and produce offspring if implanted into the uterus of a surrogate mother (Wilmut 1998). In the following activity, you will simulate the reproductive cloning process.

### Materials

- recipient egg cell
- donor nucleus
- pipette

### Procedure

1. You will be given a recipient egg cell. You will randomly choose a donor nucleus from the box labeled “Donors” that the teacher will circulate throughout the room.



Note the number on the back of the donor nucleus in your notebook.

2. Your recipient egg cell contains chromosomes that must be removed before new genetic material can be inserted. Insert the sticky end of your pipette through the opening of the egg cell to capture and remove the chromosomes. Do not attempt to suck the chromosomes out through the straw! Set the chromosomes aside so they can be collected and reused at the end of the activity.
3. Gently insert the donor nucleus into the egg cell through the opening.
4. When the fusion is successful, the chromosomes in the nucleus of the donor will begin to duplicate within the recipient egg, and a clone will be produced. We will assume that all student fusions resulted in successful duplication of the chromosomes. In actuality, the success rate is at best about 3%, or 30 of 1000 attempts—275 attempts were made before Dolly (a sheep) was cloned.
5. Collect the numbered envelope that corresponds to the number of your donor nucleus. Inside the envelope is a picture of the species you cloned.

### Questions

1. Write a short paragraph describing the risks and benefits of cloning your species. Some questions you can address include:
  - Who would benefit?
  - What could be some negative consequences?
  - What objections might be raised by the public?
  - Would you recommend that your species be cloned?
2. Why is the clone a copy of the donor nucleus and not the recipient egg cell?
3. How does the model differ from the actual cloning process?

### Reference

Wilmut, I. 1998. Cloning for medicine. *Scientific American*, Dec.

### Web resources

Genetics Science Learning Center—

<http://gslc.genetics.utah.edu/units/cloning>

Roslin Institute, Edinburgh (home of Dolly)—[www.roslin.ac.uk/public/cloning.html](http://www.roslin.ac.uk/public/cloning.html)



Explore cloning at  
[www.scilinks.org](http://www.scilinks.org).

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