

Assignment Discovery Online Curriculum

Lesson title:

In Vitro Fertilization

Grade level:

9-12, with adaptation for younger students

Subject area:

Life Science

Duration:

Two class periods

Objectives:

Students will

1. understand that in vitro fertilization is the union of an egg and sperm in a laboratory followed by implantation of the zygote, or fertilized egg, into the uterus; and
2. learn that in vitro fertilization is an option for some infertile couples but that it raises many physiological, ethical, and legal questions.

Materials:

- Science textbooks, encyclopedias, and other resources on the menstrual cycle, reproduction, infertility, and fertility treatments
- Computer with Internet access (optional but very helpful)
- Copies of Classroom Activity Sheet: In Vitro Fertilization: Background
- Copies of Take-Home Activity Sheet: Case Study: In Vitro Fertilization

Procedures:

1. Begin the lesson with a review of the menstrual cycle and fertilization (a brief summary follows). Key vocabulary words are in *italics*. You may share this summary with your students.

An adult woman's body releases certain levels of *hormones* at specific times throughout the month. As a result of these hormones, an egg in one of the woman's *ovaries* matures each month. The egg is contained within a *follicle*, or a group of cells that surrounds and protects it. When *ovulation* occurs, the follicle ruptures, causing the release of the egg and the secretion of hormones that make the lining of the uterus thicken and develop more blood vessels. The changes in the uterus take place as part of the body's preparation for pregnancy. Ovulation usually occurs in the middle of the *menstrual cycle*. After ovulation, the released egg is swept into the *fallopian tube*, where it begins to travel toward the *uterus*. *Fertilization*, or the union of egg and sperm, usually takes place in the fallopian tube. If no sperm are

present in the woman's reproductive tract, the egg and the uterine lining are released as part of the menstrual cycle. But if fertilization does take place, the *zygote*, or fertilized egg, continues to move toward the uterus. There it may *implant* and develop into a fetus. In this case, menstruation does not occur. Instead, the uterine lining continues to thicken to provide nutrients for the developing *zygote*.

The process of fertilization relies on numerous hormones. Constant monitoring of hormone levels by the body provides chemical signals that ensure the proper production of eggs and the preparation of the uterus.

2. After reviewing the process of fertilization, explain that not all couples are able to have a baby. A couple that has been trying to have a baby for a year unsuccessfully is considered infertile. Doctors perform many tests to discover the cause of a couple's infertility, including monitoring ovulation, hormone production, and hormone levels of the egg and the sperm donors (the woman and the man). Doctors usually look for physical reasons for the infertility by performing a physical examination and a sonogram. They also determine sperm count, or the number of sperm secreted by a male, as well as sperm motility, or the way the sperm move. Infertility may be caused by inadequate hormone function of the man, the woman, or both; blocked fallopian tubes; low sperm count; scars in the uterus caused by a condition called endometriosis; or age. Sometimes doctors cannot determine the cause of the infertility.
3. Discuss the options an infertile couple has. Explain that over the last 25 years, physicians have developed *in vitro fertilization*, or IVF, a procedure to help fertilization. IVF involves stimulating the growth of multiple eggs through daily injections of fertility drugs. Once the ovaries have been stimulated, the eggs are removed by laparoscopic surgery, which involves making a small incision in the abdomen. A laparoscope is inserted through the incision and, with the help of ultrasound, guided to the ovary. Eggs are removed and placed in a petri dish with sperm, and they are incubated for about 24 hours. The fertilized eggs are then placed in a growth medium that allows them to divide. If the eggs develop normally, some of them (usually four) will be inserted into the woman's fallopian tube or implanted into the uterus. Excess embryos may be frozen for later use. It takes around two weeks to determine whether a pregnancy has occurred.
4. Distribute copies of the Classroom Activity Sheet: In Vitro Fertilization: Background. In this activity, students may work individually or in pairs to answer the questions. For further research, they may wish to use the following Web sites:
<http://www.urmc.rochester.edu/stronghealth/ivf>
<http://www.ccivf.com>
<http://my.webmd.com/content/article/1680.51210>
5. When students have completed the assignment, give them the Take-Home Activity Sheet: Case Study: In Vitro Fertilization. They will read a case study in which a doctor tells an infertile couple about in vitro fertilization. Students will use the information gathered in class to write a script for a possible dialogue between the couple and the doctor.

Adaptation for younger students:

Review with middle school students the menstrual cycle and fertilization. Then discuss the issues facing infertile couples. Ask students whether they know what options infertile couples have. Are they familiar with any forms of assisted reproduction? Do not move forward with this discussion if students appear uncomfortable. You may use this session as an opportunity to review the physiology of reproduction.

Discussion Questions:

1. According to national statistics, one of every six couples will experience difficulty achieving pregnancy. What are some reasons such couples might choose in vitro fertilization? What are some reasons that they might not?
2. Embryos created by in vitro fertilization can be frozen for later implantation. What should be done with embryos if the donor mother decides she cannot use them or prefers not to use them? Do you think it is ethical to sell them? Why or why not? Who has the right to decide what to do with the frozen embryos?
3. When embryos are created in a laboratory, who owns them? What if the donor parents divorce? Do the embryos become the property of the laboratory? How could such a dilemma be resolved?
4. In vitro fertilization often produces multiple embryos that are implanted in the uterus. If more than one embryo “takes,” is selective abortion acceptable for the purpose of reducing the number of embryos so that the remaining embryos have an increased chance of survival?
5. Louise, the first “test-tube baby,” was born in 1978. How do you think it would feel to be the first baby conceived by IVF? Do you think it has had an effect on her life?
6. Do you think a child should be told that he or she was conceived through IVF? What are the reasons to reveal this information? What are the reasons to withhold it?

Evaluation:

Use the following three-point rubric to evaluate students' work:

- **Three points:** full understanding of in vitro fertilization; complete, accurate, and well-written script that includes much of the background information, several specialized terms, and key details and that reflects the perspectives of both sides participating in the conversation
- **Two points:** good understanding of in vitro fertilization; mostly accurate script that includes most of the background information, a few specialized terms, and some key details and that reflects some of the perspectives of both sides participating in the conversation

- **One point:** some understanding of in vitro fertilization; somewhat accurate script that includes little background information, one or two specialized terms, and one or two key details and that reflects the perspective of at least one of the sides participating in the conversation

Extensions:

Success Rates

IVF is one of many types of assisted reproductive technology. Have students research others. Students can make a graph to compare the success rates of different technologies in a given year (e.g., 1999), or they can graph the success rate of one technology over a period of time.

In Vitro in the Lab

Using sea urchins, students can perform in vitro fertilization at school. Purchase the Sea Urchin Embryology Kit, available through Carolina Biological Supply Company (#CE-16-2505); it includes all the materials necessary to induce ovulation and perform fertilization in a petri dish. Refer to the online catalog at www.carolina.com. (*Note:* If you order online, use #WW-16-2505.)

Suggested Reading:

Cloning (Lucent Overview series)

Jeanne DuPrau. Lucent, 2000.

Once the subject of science fiction, cloning is the next reproductive frontier, already in use in agriculture. While cloning sheep makes the news now, will it be human cloning in the future? This informative introduction to the topic explains today's technology and possible future applications as well as the ethical issues that surround cloning. Occasional illustrations and photographs are included.

Conquering Infertility: Medical Challenges and Moral Dilemmas

Elizabeth L. Marshall. Franklin Watts, 1997.

Beginning with a brief history of the causes and diagnoses of infertility, the author describes current treatments and reproductive choices potential parents must make. The need for laws regulating these new methods is discussed as well. An extensive glossary and list of resources follow the text.

Vocabulary:

egg

Definition: The female reproductive cell produced in the ovary.

Context: Girls are born with all the **eggs** they will ever have during their lives.

fertility drug

Definition: A medication that helps increase the likelihood of conception by increasing the number of eggs that mature each month.

Context: **Fertility drugs** have helped thousands of women become pregnant.

fertilization

Definition: The fusion of a sperm and egg, which usually takes place in the fallopian tube.

Context: After **fertilization** takes place, the fertilized egg moves toward the uterus.

hormone

Definition: A chemical secreted by the body that has a specific effect on activities occurring in other parts of the body.

Context: **Hormones** are responsible for the successful functioning of the reproductive system.

implantation

Definition: The process by which a fertilized egg attaches to the lining of the uterus.

Context: After **implantation** occurs, the fertilized egg begins to develop into a fetus.

menstrual cycle

Definition: The monthly cycle, usually about 28 days, during which the egg matures in the ovary (at about the 14th day), followed by the discharge of tissue and blood from the uterus at the 28th day if no pregnancy has occurred.

Context: Girls usually begin their **menstrual cycles** between the ages of 10 and 16.

ovary

Definition: The female reproductive organ in which eggs are formed.

Context: Every month an egg in one of the **ovaries** matures in preparation for fertilization.

ovulation

Definition: The process of releasing an egg from the ovary.

Context: **Ovulation** usually takes place about 14 days before a woman begins menstruation.

sperm

Definition: The male reproductive cell.

Context: It takes just one **sperm** to fertilize an egg.

zygote

Definition: A fertilized egg.

Context: After the egg and the sperm have fused, the **zygote** may begin to develop in the uterus.

Academic standard:

Grade level:

9-12

Subject area:

Life Science

Standard:

Understands the structure and function of cells and organisms.

Benchmark:

Knows how cell functions are regulated through changes in activity of the functions performed by proteins and through selective expression of genes and how this regulation allows cells to respond to their environment and to control and coordinate cell growth and division.

Credit

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In Vitro Fertilization: Background

Answer the questions below regarding in vitro fertilization. If you need to do additional research, go to the following Web sites:

<http://www.urmc.rochester.edu/stronghealth/ivf>

<http://www.ccivf.com>

<http://my.webmd.com/content/article/1680.51210>

1. How is in vitro fertilization performed?
2. What tests are necessary before a doctor performs in vitro fertilization?
3. Should a doctor consider a woman's age before deciding to recommend IVF? Does the woman's age help determine whether the procedure will be successful?
4. Why are medications given in preparation for IVF?
5. How much time is required for the entire procedure?
6. What risks to the woman are associated with the procedure?
7. If a procedure is unsuccessful, can a doctor perform it again on the same woman? How long would a woman have to wait before repeating the procedure?
8. Can embryos created during the procedure be frozen for later use? How long can they be frozen?
9. What is the success rate for first-time IVF procedures? Do the chances for success increase or decrease with repeated attempts?

Case Study: In Vitro Fertilization

Read the case study below. Using the questions you answered in class as background, write a conversation between the couple and the doctor. Consider important questions the doctor must ask and the couple's concerns.

Mr. and Mrs. Taylor, both 35, enter Dr. Novak's office anxiously. For the past year, they have had no success conceiving a baby. They hope Dr. Novak, an infertility specialist, can help them. Dr. Novak performs many tests, including a sperm count on Mr. Taylor, sonograms of Mrs. Taylor's reproductive system, and blood tests measuring the hormone levels of both Mr. and Mrs. Taylor. The tests reveal that Mrs. Taylor's fallopian tubes are blocked by scars, but everything else is normal. The doctor believes she is an excellent candidate for in vitro fertilization. The Taylors are excited and hopeful about the possibility of conceiving a baby, but they have a lot of questions about the procedure. In fact, they scarcely know where to begin.