

ALL ABOUT HERMAPHRODITES

A lesson plan based on

Lecture 2: Hermaphrodites: The Safer Sex

By Thomas & Ramona Avant, Pitkin High School, Pitkin, LA



Goal: To teach the students about sex determination using *Caenorhabditis elegans*.

Learning Outcomes:

- discuss the importance of using model organisms in research
- describe the two sexes in *C. elegans*
- distinguish between the anatomical structures of male and female worms
- explain why sexual reproduction is advantageous to a species
- describe how sex is determined in worms
- explain the role of gene *xol-1* in worms
- discuss how mutations might affect sex determination in worms

Assignment:

View lecture II and answer the following questions.

1. What are model organisms and why do we study them? Name some model organisms that we use?
2. Do we have genes and proteins in common with model organisms and, if so, why is this important?
3. How could we go about studying the behavior of one of our genes using a model organism?
4. Discuss the characteristics of *C. elegans* that make it an excellent organism to study.
5. What are the two sexes that exist in *C. elegans*?
6. Describe the sperm of the *C. elegans*.
7. How does fertilization of an ovum occur? Does it occur the same way with or without mating? Explain.
8. How is sex determined in *C. elegans*?
9. Describe the role of the gene *xol-1* in producing males or hermaphrodites.
10. If hermaphrodites can produce offspring, why is it advantageous to have sexual reproduction?
11. Is *xol-1* the end or beginning of sex determination? Explain.

Activities:

1. Draw and label the parts of both sexes of *C. elegans*. Make your drawings to scale. (Make the proportions of smaller and larger match.)
2. Review the answers to the questions with the teacher for a test.
3. Take a test on the lectures.

References:

HHMI Holiday Lecture Series - The Meaning of Sex Genes & Gender - Lecture 2

<http://www.sanger.ac.uk/sitemap/projects.shtml>

<http://worms.aecom.yu.edu/index.html>

<http://elegans.swmed.edu/>

<http://www.biotech.missouri.edu/Dauer-World/Wormintro.html>

<http://www.bio.unc.edu/faculty/goldstein/lab/movies.html>

Lecture II Key

View lecture II and answer the following questions.

1. What are model organisms and why do we study them? Name some model organisms we use to study?

We can't use humans for experimentation so we must find lower animals with which to study the effects of substances and genes. If the outcome is very bad, we haven't done harm to a human. Some model organisms are mice, rats, *C. elegans*, and monkeys.

2. Do we have genes and proteins in common with model organisms and, if so, why is this important?

Yes we do have genes and proteins in common with model organisms and this is important because we can see how these genes work in these organisms by excluding or modifying these genes to see how it affects the model organism. This gives a pretty good idea how this gene works on humans.

3. How could we go about studying the behavior of one of our genes using a model organism?

We could produce a transgenic organism with the gene we want to study in it. We could measure the behavior of this gene.

4. Discuss the characteristics of *C. elegans* that make it an excellent organism to study.

C. elegans is an excellent organism to study because all of its genes have been identified and its genetic code has been sequenced, they are easy to grow, and can be genetically manipulated easily.

5. What are the two sexes that exist in *C. elegans*?

The two sexes in *C. elegans* are male and hermaphrodite.

6. Describe the sperm of the *C. elegans*.

The sperm is amoeboid in nature and moves by amoeboid motion.

7. How does fertilization of an ovum occur? Does it occur the same way with or without mating? Explain.

The ovum passes through the spermatheca, thus being fertilized. It works the same way in either case because the sperm is stored in the spermatheca regardless of the source of the sperm.

8. How is sex determined in *C. elegans*?

In *C. elegans*, males have one X designated (XO) and females have two Xs designated (XX).

9. Describe the role of the gene *xol-1* in producing males or hermaphrodites.

When the *xol-1* gene is activated it produces XOL-1 protein, which produces a male. In females, the gene is turned off so no XOL-1 protein is produced.

10. If hermaphrodites can produce progeny, why is it advantageous to have sexual reproduction?

Sexual reproduction increases genetic diversity.

11. Is *xol-1* the end or beginning of sex determination? Explain.

It is the beginning. Sex determination requires a series of steps within cells and tissues during which one gene's product acts on the next in line. Once the *xol-1* master switch is flipped, it activates a genetic cascade in which subsequent sex-determining genes are turned on or off, as appropriate. Each gene along the line passes the message to the next until all have received the message that this worm is a male or female.