

## Meiosis and Sexual Life Cycles

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**OVERVIEW AND RATIONALE:** The human body consists of millions of cells. However, human life began as only one cell. This cell is from the joining of two reproductive cells, one from the female, and one from the male. How are these cells formed? How can these two cells result in the genetic variation seen in humans, even among siblings?

With the combination of classroom discussion and the use of selected portions of the HHMI DVD The Meaning of Sex: Genes and Gender, student understanding of the role of meiosis in the life cycle of sexually reproducing organisms will be better understood.

**TIME FRAME:** Two (2) class discussion periods of 45 minutes each

**CONTENT AREA:** Biology 2; 11<sup>th</sup>/12<sup>th</sup> grade level

**CONTENT of DVD Used** (correlated with specific parts of Teacher Procedure)

Lecture One: Chapters 4, 5, 6, 24, 25,23,26,27 (in order of use).

**OBJECTIVES:** After reading textbook material, participating in class discussions, and viewing selected chapters from the HHMI DVD Sex Determination: Genes and Gender, students should be able to:

1. Distinguish biological differences between male and female.
2. Distinguish between asexual (cloning) and sexual reproduction.
3. Understand the stages and events of meiosis.
4. Understand the role of meiosis in sex determination.
5. Understand the role of meiosis in sexual life cycles and genetic variation.
6. Explain why heritable variation is crucial to evolution.

**CORRELATION WITH STANDARDS:**

National Science Education Standards, Grades 9-12

Unifying Concepts and Processes: Systems, order, and organization; evidence models explanation, form and function, evolution and equilibrium

Life Science: the cell, molecular basis of heredity, biological evolution

Science and Technology: Understanding technology (cloning)

**MATERIALS:** HHMI Holiday Lectures on Science, November 2001, The Meaning of Sex: Genes and Gender DVD

Handouts: Student version of outline of concepts to be discussed during class (to be used for note taking and/or as a student study guide)

Diagram showing the stages of meiosis (teacher should provide diagram of his/her choice)

**PROCEDURE:** Teacher Version

Before topic is even discussed, the introduction is used as a class opener to stimulate student interest and thought.

Introduction: Ask for student responses to the following discussion questions:

- (1). List student responses
- (2). Show selected chapters of DVD Lecture One Chapters 4, 5, 6
- (3). Compare/relate student responses to those given on DVD

Discussion questions

- a. Who do you look like? Why?
- b. What gender are you? What determined your gender? When?
- c. When your parents first knew that you were expected, what do think are some questions/concerns they may have had?
- d. What are some characteristics which you associate with your gender?

DVD Lecture One Chapter 4 What was the first thing your parents asked about you?

DVD Lecture One Chapter 5 Characteristics of male and female

DVD Lecture One Chapter 6 Electron micrograph of egg and sperm

- I. I. Offspring acquire genes from parents by inheriting chromosomes

Inheritance is possible because of:

- a. DNA replication
- b. Fertilization

- II. Like begets like: a comparison of asexual (cloning) versus sexual reproduction

Class Discussion: What does the saying “a chip off of the old block” mean to you?

Do you feel that this saying applies to you? Why? Why not?  
Why is “Chip” sometimes used as a nickname?

Asexual Reproduction vs. Sexual Reproduction (some ideas)

- |                                      |                                       |
|--------------------------------------|---------------------------------------|
| 1. one individual                    | 1. two individuals                    |
| 2. all genes from one parent         | 2. each parent contributes ½ of genes |
| 3. offspring identical to parent     | 3. unique combination of 2 parents    |
| 4. results in a clone (no variation) | 4. genetic variation results          |

Students are asked to state differences between sexual and asexual reproduction.

Responses can be asked for before or after DVD chapters are viewed.

If responses are before DVD is viewed, student responses can then be compared to DVD

DVD Lecture One Chapter 24 Description of clonal reproduction

DVD Lecture One Chapter 25 Comparing cloning in Laredo striped whiptail with sexual reproduction in related species

### III. Fertilization and meiosis alternate in sexual life cycles

- a. Meiosis and fertilization result in alternation between the haploid and diploid
- b. Meiosis produces haploid gametes
- c. Fertilization produces a diploid zygote

View DVD Lecture One Chapter 23. Why does nature have two sexes? Are males really necessary?

(End of first class discussion session)

(Class discussion session 2)

### IV. Meiosis reduces chromosome number from diploid to haploid: a closer look

Handout: The stages of Meiotic Cell Division (diagram of teacher's choice)

Students will use diagrams in handout to discuss the events of Meiosis

Handout: Meiosis in Humans: Comparing Oogenesis and Spermatogenesis

View DVD Lecture One Animation Meiosis (Review after events of meiosis are studied).

### V. Sexual life cycles produce genetic variation among offspring as a result of:

- a. independent assortment
- b. crossing over
- c. random fertilization

VI. Evolutionary adaptation depends on a population's genetic variation as a result of:

- a. sexual reproduction
- a. mutations

View DVD Lecture One Chapter 26 *Meiosis* is the defining feature of sexual reproduction

View DVD Lecture One Chapter 27 Is sex, in an evolutionary sense, good?

REFERENCES:

HHMI DVD Holiday Lecture Series November 2001 The Meaning of Sex, Genes and Gender

Campbell, Neil *Biology* 4th edition. Menlo Park, California: Benjamin/Cummings 1996.

ASSESSMENT: Student responses to the two homework assignments will be graded as part of the homework component of the class.

MODIFICATIONS for SPED:

Students who take biology 2 are a heterogeneous group of 11<sup>th</sup> and 12<sup>th</sup> graders. Students in the class have taken biology 1 in the 9<sup>th</sup> grade, and have had a year of chemistry in the 10<sup>th</sup> grade. Some 11<sup>th</sup> grade students take Bio 2 before taking AP biology in the 12<sup>th</sup> grade. Both grade level of students also may take Bio 2 as a means of review before taking the SAT II in Biology.

In view of the student population for whom this lesson plan was developed, SPED modifications are NOT included.

Biology 2 Homework Assignment #1: Responses to these homework assignments are based on class discussion, DVD Lecture One chapters 4, 5, 6, 24, 25 and textbook materials

KEY TERMS: Explain, in your own words, the meaning of each of the following terms:

chromosome	sexual reproduction
cloning /clone	sperm(atazoa)
DNA (replication)	gene
diploid (number)	chromosome
asexual reproduction	fertilization
egg	meiosis
embryo	zygote
gamete	life cycle
inheritance	parthenogenesis
haploid (number)	

SHORT ANSWERS: Give short answers for each of the following:

1. How is a human embryo's sex determined?
2. In a "broad biological sense" what is the most fundamental difference between male and female?
3. What does the production of a "big" or "small" gamete indicate?
4. Agree or disagree: Males are necessary. Explain.
5. Explain why the Laredo striped whiptail lizard is given as an example of cloning.
6. Do the eggs of the Laredo whiptail lizard undergo meiosis? Why or why not? Explain..
7. Discuss: Should cloning of humans be allowed? Why or why not?

CHECK YOUR UNDERSTANDING: Write a sentence that explains the connection between each

group of words.

- a. gametes, egg cell, sperm cell
- b. diploid, haploid, mitosis, meiosis
- c. gametes, zygote, fertilization
- d. fertilization, cloning, reproduction
- e. somatic cell, mitosis, cell division

Biology 2 Homework Assignment # 2: Responses to this assignment are based on class discussion, textbook reading material, and DVD Lecture One Chapters 23, 26, 27.

COMPLETE the following statements using terms from the list below.

gamete    divisions    egg    four    meiosis    diploid number

haploid number    polar bodies    two    somatic

The (1)\_\_\_\_\_ of an organism is twice its (2)\_\_\_\_\_

A (3)\_\_\_\_\_ contains half the number of chromosomes found in the (4)\_\_\_\_\_

cells of an organism, and are formed through (5) \_\_\_\_\_.

The first meiosis produces (6)\_\_\_\_\_ daughter cells. The second meiosis produces (7)\_\_\_\_\_

sperm cells in males.

In females, one (8)\_\_\_\_\_ and three (9)\_\_\_\_\_ cells are formed.

SHORT ANSWERS: Give short answers for each of the following:

- a. Discuss the long-term value of meiosis in the human life cycle.
- b. Discuss the role of meiosis in sex determination.
- c. Meiosis and fertilization make evolution possible. Agree or disagree. Explain your answer.
- d. If the body cell of a grasshopper contains 24 chromosomes, how many chromosomes does the egg cell of a female grasshopper contain? Explain how you determined your answer.
- e. Compare oogenesis to spermatogenesis.
- f. Compare and contrast meiosis and mitosis.

KEY TERMS: Explain, in your own words, the meaning of each of the following terms:

variation

evolution

ootid

adaptation

polar body

spermatid

recombination

independent assortment

differentiation/ differentiate

mutation

crossing over

synapsis

oogenesis

spermatogenesis

develop/development

EXTENSION: (To be done independently by student for extra credit)

- A. Watch DVD Lecture One Chapters 28, 29, and 30 which is a demonstration using familiar fruits and vegetables.
  1. Write up the demonstration as if it were a laboratory investigation. Be sure to follow class standard for laboratory reports and include:
    - a. Title
    - b. Purpose
    - c. Materials
    - d. Procedure
    - e. Observations
    - f. Results
    - g. Conclusions
- B. Using the Internet and/or printed material research Dolly the sheep that was cloned. Give the historical background oh how this technology was accomplished.
- C. Using the Internet and/or printed material, do research on cloning. What other organisms have been cloned? What has happened since Dolly?

PROCEDURE: Student Outline of Meiosis and Sexual Life Cycles

(To be used as a study guide for understanding concepts discussed in class; also helpful to be used as a review for test preparation)

We will use a combination of discussion, textbook material and selected Chapters from the HHMI DVD on Sex, Genes and Gender.

INTRODUCTION: Take a few minutes to prepare your responses to the following discussion questions:

- a. Who do you look like? Why?
- b. What gender are you? What determines gender? When?
- c. When your parents first knew that you were expected, what do you think are some questions /concerns they may have had?
- d. What are some characteristics that you associate with your gender?

I. Offspring acquire genes from parents by inheriting chromosomes

Inheritance is possible because of:

- a.
- b.

II. Like begets like: a comparison of asexual (cloning) vs. sexual reproduction

Class discussion: Have you heard the expression “chip off of the old block”?  
What do you think it means?

Do you feel that this saying applies to you? Why? Why not?

Why is “Chip” sometimes used as a nickname?

Asexual Reproduction      vs.      Sexual Reproduction

Either from past knowledge or class discussion list some ideas which compare sexual and asexual reproduction.

- |    |    |
|----|----|
| 1. | 1. |
| 2. | 2. |
| 3. | 3. |
| 4. | 4. |

III. Fertilization and meiosis alternate in sexual life cycles

- a.
- b.

c.

IV. Meiosis reduces chromosome number from diploid to haploid: a closer look

Handout: Diagram showing the stages of meiosis, which will be discussed

Meiosis in Humans: Comparing Oogenesis and Spermatogenesis

Events in meiosis: meiosis I

synapsis

tetrad formation

crossing over

independent assortment

meiosis II

V. Sexual life cycles produce genetic variation among offspring as a result of:

a.

b.

c.

VI. Evolutionary adaptation depends on a population's genetic variation as a result of:

a.

b.