

Investigate how chickens pass on traits

How do chickens pass down their traits from one generation to the next?

Standards

- **B.C.1:** Cell structure and function
- **B.H.3:** Genetic mechanisms and inheritance

Introduction

Did you know that there is more than one way that traits can be passed on between parents and their offspring? In this lesson students will explore sexual reproduction as they consider how heritable information is passed on to the next generation. Through song and dance, students will learn about meiosis and the creation of sex cells.

Student prior knowledge

The goal of meiosis is to produce haploid gametes that have half the DNA of the parent cell. Meiosis occurs in gamete cells to produce haploid cells for sexual reproduction. Students should have prior knowledge of cell anatomy, where the nucleus is located, and that chromosomes exist inside the nucleus. Students should understand that DNA contains information for heritable traits that are passed from one generation of organisms to the next and the forms of cell division (mitosis and meiosis).

Suggested timeline

One class period (50 minutes)

Materials

- Play-Doh or modeling clay (different colors)
- Tape or something to make circles
- Song/music
- Copies of Meiosis in motion review sheet

Teacher preparation

- Make small pieces of clay to represent the chromosomes.
- Make circles or an area large enough to move students.
- Make copies of the student worksheet.

Procedure

Complete the meiosis modeling steps in the song (speak or sing the lyrics). The Meiosis song review is in the student worksheet: Meiosis in motion review.

1. Have students get a piece of Play-Doh and stand in a circle shape on the floor.
2. Have the students pair with a partner.
3. Prophase I
 - Students (chromosome pairs) move into the first cell boundary.
 - Have students “synapse” by linking arms, representing homologous chromosomes pairing up.
 - Explain “crossing over” by having them mix Play-Doh pieces together.

4. Metaphase I
 - Chromosome pairs line up in the middle of the cell (the equator).
 - Use tape to mark the metaphase plate and have students stand along it.
 - Independent assortment happens to make sure to mix genes with tetrad.
5. Anaphase I
 - Students unlink arms from the group but stay in new pairs and move to opposite sides of the cell boundary.
 - Explain the separation of homologous chromosomes.
6. Telophase I and Cytokinesis
 - Have a student “cut” the circle in two.
 - Students now separate into two groups, each within their own cell boundary.
 - Explain the formation of two new cells, each with half the original number of chromosomes.
7. Prophase II
 - Each group (new cells) starts in their own cell boundary.
 - Students prepare for the next division without pairing up (since they are now single chromosomes).
8. Metaphase II
 - Students line up in the middle of each cell again.
9. Anaphase II
 - Students drop arms with partner.
 - Students separate again, moving to opposite sides of each cell boundary, representing the sister chromatids being pulled apart.
10. Telophase II and Cytokinesis:
 - Have someone “cut” the circle in two again.
 - Each cell boundary now has students divided, representing the final four haploid cells.
 - Discuss the result: four genetically unique cells.

Suggested wrap-up activity

- Have students compare the similarities and differences in mitosis and meiosis. Students need to explain how each makes a different cell.
- Conduct lab activities using microscopes to observe onion root tip cells (for mitosis) and prepared slides of lily anthers or other suitable specimens (for meiosis).

Differentiation

- Have students wear signs or tags to show phases.
- Print out the lyrics and have students complete it in smaller groups.
- Make labels and signs to match the terms with the lyrics.
- Make cards instead of dancing—have them use cards with the drawing of the phases on it to symbolize the movement.

More challenges

- Students may draw phases as you are dancing or after you are done.
- Have students make their own dances or poems to show the phases. Develop crossword puzzles, word searches, or quizzes to reinforce terminology and concepts related to cell division. Use virtual labs and simulations if resources are limited. Many online platforms offer interactive simulations that allow students to explore cell division in a controlled virtual environment.
- Discuss real-world applications and case studies where understanding mitosis and meiosis is crucial, such as cancer research, genetic disorders, and reproductive technology. Highlight how errors in these processes can lead to medical conditions, reinforcing the importance of accurate cell division.

- **Home connection:** Research common genetic traits in chickens such as feather color, comb shape, and egg color. Create a chart that shows how these traits are inherited and the role of dominant and recessive alleles. If possible, visit a local farm or hatchery to observe different breeds of chickens and their traits.

Support information

- **Independent assortment:** refers to the random distribution of maternal and paternal chromosomes into gametes during meiosis.
- **Synapsis:** the pairing of two chromosomes that occurs during meiosis.
- **Crossover:** the exchange of genetic material between non-sister chromatids of homologous chromosomes during meiosis.
- **Tertard:** homologous pair of chromosomes that are crossed over.
- Something that students often miss or that takes time to sink in is the fact that in the first round of anaphase they are still with a “partner” or the replicated chromosome. Anaphase two is when the chromosome actually splits into a single chromatid. Independent assortment is random and is a mix of both egg and sperm genes.
- Understanding these concepts provides students with a solid foundation in genetics and cell biology: how genetic information is passed on, how genetic diversity arises, and the fundamental processes of cell division. Somatic cells have a complete set of DNA, and they are capable of reproducing by themselves as often as needed. This is important for body cells in order for an organism to grow and repair itself through its lifetime. A cell spends most of its life in interphase, not dividing but performing normal body functioning for the organisms. The cell spends a small portion of its time in mitosis dividing.

Meiosis: Where the Sex Starts - Crash Course Biology #13: youtu.be/qCLmR9-YY7o

Mitosis vs. Meiosis:

ck12.org/biology/mitosis-vs.-meiosis/lesson/mitosis-vs.-meiosis-ms-ls/

Teaching suggestions

Establish behavioral guidelines before playing the meiosis square dance.

Career connections

Have you ever wondered what type of poultry careers help to make a healthy, safe environment for commercial birds? Let’s take a look!

- **Geneticists** are biologists who study genetics, the science of genes, heredity, and variation of organisms.
- **Animal Scientists** apply principles of the biological, physical, and social sciences to the problems associated with poultry production and management. In other words, they study animal health and behavior in order to help design the perfect environment for commercial birds to live in and produce meat and eggs.
- **Veterinarians** care for the health of the poultry flock and work to protect public health. They diagnose, treat, and research medical conditions and diseases of pets, livestock, and other animals.

Meiosis in motion answer key

1. There are still 16 chromosomes present during Prophase I, but they are in pairs, making 8 pairs of homologous chromosomes. Homologous chromosomes pair up and crossing over occurs.
2. The 8 chromosomes (4 pairs of homologous chromosomes) line up in pairs at the cell's equator. In mitosis, individual chromosomes line up, not pairs.
3. Each pole will receive 5 chromosomes, representing one chromosome from each homologous pair (single chromatid). This separation ensures that each new cell will have a mix of maternal and paternal chromosomes, increasing genetic diversity (independent assortment).
4. Each resulting cell will have 11 chromosomes. The resulting cells are haploid because they contain half the original number of chromosomes.
5. The chromosomes in each of the resulting cells from Telophase I remain as 6 individual chromosomes. Homologous chromosomes do not pair up again; this occurs only in Prophase I.
6. The 36 chromosomes line up single-file along the equator of the cell. This ensures that each chromatid will be properly separated into the new cells.
7. 14 chromatids are pulled to each pole, since there are 28 chromatids in total (2 per chromosome). Each chromatid becomes an independent chromosome.
8. Each of the four resulting cells will have 24 chromosomes. These cells have half the chromosome number of the original cell, ensuring they are haploid and ready for fertilization in sexual reproduction.