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AP® Biology Investigation #7:

Genetics and Information Transfer: Mitosis and Meiosis

Meets Revised College Board AP Biology Standards

ward's science

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abstract

In this lab, students examine and compare the phases of mitosis and meiosis in plant and animal cells. Students then determine the relative time cells spend in each phase and calculate the distance between a specific gene and the chromosome centromere. Students accomplish this by preparing slides, making observations using a compound microscope, and manipulating data.

required prior knowledge

Students should:

- be able to make and record good observations.
- know the structure of the cell and its organelles.
- understand the purpose of cell division.
- predict the outcomes for mitosis and meiosis.

activity learning objectives

In this investigation, students will perform activities to help them answer the following question:

Why are some progeny of organisms identical to their parent, while progeny from two parents are similar to each?

Students will model the process of mitosis and meiosis in the eukaryotic cell. Students will also observe mitotic process in both plant and animal cells. By observing a classic fungal specimen, *Sordaria fimicola*, students will determine the crossing over frequency and approximate the location on the chromosome of the gene for spore color.

materials checklist

*For a list of replacement items, visit: www.**wardsci.com**, and click on the AP Biology tab for this kit/item #.*

materials included in kit:

- 8 scalpels, disposable
- 1 box /72 pre-cleaned microscope slides
- 1 box /100 glass coverslips (22 mm)
- 1 materials coupon for *Sordaria* cross demo plate (*see below for redemption timing)
- 8 large wooden clothes pins
- 4 prepared slides, animal mitosis
- 4 prepared slides, allium mitosis
- 8 disposable inoculating loops
- 15 pipets, 6" graduated
- 100 wooden skewers
- 1 hydrochloric acid, 1 M, 30 mL
- 1% Toluidine Blue solution, 100 mL
- 1 70% isopropyl alcohol, 30 mL
- 1 *Sordaria* crossover flash cards
- 600 red pop beads
- 600 pink pop beads
- 32 magnetic yellow centromeres
- 32 centrioles, clear
- 1 instructions (this document and student guide copymaster)

materials needed but not provided:

- Lab notebook
- Garlic cloves
- Compound microscopes
- Absorbent wipes
- Glass marking pens
- 100 mL beakers
- Ruler
- Toothpicks
- Box (or dark area to grow roots)
- Dissection scissors
- Timer
- Forceps
- Goggles, aprons, and gloves
- Containers (beakers, etc.)

optional materials (not provided)

- Prepared *Sordaria* squash slides (912200)
- pH 3 buffer and/or pH 10 buffer
- Lectin
- (Phytohemmaglutinin PHA-m, increases mitosis)
- Uric acid (decreases mitosis)
- NaCl
- Razor blades
- Normal cell or Hela cell karyotype images
- Petroleum jelly

* It is recommended that you redeem your coupon for live/perishable materials as soon as possible and specify your preferred delivery date. Generally, for timely delivery, at least two weeks advance notice is preferred.

standards alignment

This lab activity is aligned with the 2012 AP Biology Curriculum (registered trademark of the College Board). Listed below are the aligned Content Areas (Big Ideas and Enduring Understandings), the Science Practices, and the Learning Objectives of the lab as described in AP Biology Investigative Labs: An Inquiry-Based Approach (2012). *This is a publication of the College Board that can be found at: http://media.collegeboard.com/digitalServices/pdf/ap/APBioTeacherLabManual2012_2ndPrt_lkd.pdf*

Big Idea	**3**	Living systems store, retrieve, transmit, and respond to information essential to life processes.
Enduring Understandings	**3.A2**	In eukaryotes, heritable information is passed to the next generation via processes that include the cell cycle and mitosis or meiosis plus fertilization.
	3.A3	The chromosomal basis of inheritance provides an understanding of the pattern of passage (transmission) of genes from parent to offspring.
	3.C2	Biological systems have multiple processes that increase genetic variation.
Science Practices	**1.2**	The student can describe representations and models of natural or man-made phenomena and systems in the domain.
	5.3	The student can evaluate the evidence provided by data sets in relation to a particular scientific question.
	6.2	The student can construct explanations of phenomena based on evidence produced through scientific practices.
	6.4	The student can make claims and predictions about natural phenomena based on scientific theories and models.
	7.1	The student can connect phenomena and models across spatial and temporal scales.
	7.2	The student can connect concepts in and across domain(s) to generalize or extrapolate in and/or across enduring understandings and/or big ideas.
Learning Objectives	**3.7**	The student can make predictions about natural phenomena occurring during the cell cycle.
	3.8	The student can describe the events that occur in the cell cycle.
	3.9	The student is able to construct an explanation, using visual representations or narratives, as to how DNA in chromosomes is transmitted to the next generation via mitosis, or meiosis followed by fertilization.
	3.10	The student is able to represent the connection between meiosis and increased genetic diversity necessary for evolution.
	3.12	The student is able to construct a representation that connects the process of meiosis to the passage of traits from parent to offspring.
	3.28	The student is able to construct an explanation of the multiple processes that increase variation within a population.

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time requirements

	TIME FRAME	TEACHER TASK(S)	STUDENT TASK(S)
pre-lab prep	2 weeks to 2 days before lab	See page 11 to order *Sordaria* and to grow root tips.	Read background and answer pre-lab questions.
activity 1	1a: 20 minutes 1b: 45 minutes 1c: 45 minutes		Model and investigate Mitosis
activity 2	2a: 20 minutes *This part may be done alongside activity 1a to save time.* 2b: 45 minutes	See page 29 for optional extension activity.	Model and investigate Meiosis
activity 3	Varies, depending on students' experiment designs	If you choose to have chemicals that modulate mitosis available for student directed inquiry, order these far enough in advance to assure they arrive prior to the start of the lab. Students will have to re-grow garlic roots as part of their experiments.	

lab-specific safety 

- 70% isopropyl alcohol is poisonous if ingested, and will irritate the eyes. Wear safety goggles. Read the SDS for this chemical.
- Hydrochloric acid is a mild irritant. Avoid contact with the skin and eyes. Poisonous if ingested. Read the SDS for this chemical.

general safety:

- The teacher should 1) be familiar with safety practices and regulations in his/her school (district and state) and 2) know what needs to be treated as hazardous waste and how to properly dispose of non-hazardous chemicals or biological material.
- Consider establishing a **safety contract** that students and their parents must read and sign. This is a good way to identify students with allergies (e.g., latex) so that you (and they) will be reminded of specific lab materials that may pose risks to individuals.
- Students should know where all **emergency equipment** (safety shower, eyewash station, fire extinguisher, fire blanket, first aid kit etc.) is located.
- Require students to remove all dangling jewelry and tie back long hair before they begin.
- Remind students to **read all instructions, SDSs and live care sheets** before starting the lab activities, and to ask questions about safety and safe laboratory procedures. The SDSs and the most updated versions of live care sheets can be found at www.**wardsci.com**. Updated SDSs can also usually be found on each chemical manufacturer's website.
- In student directed investigations, make sure that collecting safety information (like SDSs) is part of the experiment procedure.
- As general laboratory practice, it is recommended that students **wear proper protective equipment**, such as gloves, safety goggles, and a lab apron.

at the end of the lab:

- Before disposing of any chemicals in the trash or down the drain, review local regulations or consult with local authorities.
- All laboratory bench tops should be wiped down with a 10% bleach solution or disinfectant to ensure cleanliness.
- Remind students to wash their hands thoroughly with soap and water before leaving the laboratory.

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