Name _____ Class _____ Date_____

Seeds, Spores, and Sperm

Comparing Fern and Angiosperm Life Cycles

Questions How do seeds, spores, and sperm differ in structure and function? Which types of plants have these structures, and what are they used for?

Lab Overview In this investigation you will compare seeds and spores, sow them, and observe the results. You will sketch your observations over several weeks to compare fern and angiosperm life cycles. After three weeks, you will observe swimming sperm produced by the fern gametophyte.

Introduction The fern spores you will sow in this lab will develop into two types of gametophytes (the gamete-producing plant generation): male gametophytes and hermaphrodite gametophytes. Male gametophytes produce sperm. Hermaphrodites (hur MAF roh dyts) are animals or plants that possess both male and female organs. Therefore, hermaphrodite gametophytes produce both sperm and eggs. After a fern sperm fertilizes an egg, the resulting zygote may grow into a sporophyte that is capable of producing more spores. In the lab you will also observe the behavior of sperm released from a fern gametophyte and the development of a fern sporophyte.

In contrast to the fern life cycle, angiosperms do not release their spores. Instead, gametophytes develop in the stamens and carpels of sporophyte flowers. Male gametophytes, or pollen grains, are carried away from the sporophyte by wind or animals. If pollen grains reach the carpels of another plant, a pollen tube and two sperm cells may develop. The pollen tube extends to the female gametophyte (the embryo sac) and deposits the two sperm cells into the embryo sac where they fertilize two cells. The result of this double fertilization is a seed containing an embryo, nourishing materials, and a protective coat. Under the right conditions, this seed will grow into a sporophyte. You will begin your investigation of the angiosperm life cycle at this point by sowing angiosperm seeds and observing their development into sporophytes.

Prelab Activity Based on the information you read in the Introduction section, on the next page develop a graphic organizer that describes the life cycle of a fern and a separate organizer that describes the life cycle of an angiosperm. Begin both life cycles at the "spore" stage.

Life Cycle of a Fern

Life Cycle of an Angiosperm

Prelab Questions

1. The dominant generation of a plant is the generation that is the most prominent—the one that is most likely to be seen. Which generation—the gametophyte or sporophyte—is dominant in ferns? In angiosperms? Explain your response.

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2. Describe one difference between spores and seeds.

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3. Match the plant part with the letters that describe it. (*Hint:* Each plant part has two letters that describe it. Some letters will be used more than once. Refer to Chapter 19 in your text, if needed.)

_____ Spore
_____ Pollen
_____ Seed

a. contains an embryonic sporophyte and stored food
b. contains two sperm nuclei and a structure that can grow into a pollen tube
c. contains a cell that can grow into a gametophyte
d. found only in angiosperms and gymnosperms
e. found in all plant life cycles

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Materials

- vial of *C-fern*® spores
- sterile water
- transfer pipette
- microscope slides and cover slips
- marker
- agar plate
- plastic spreader
- Fast Plant™ or radish seeds (5)
- growing container(s) filled with soil (10-cm-wide plastic pot or 2 plastic film canisters)
- vermiculite
- metric ruler
- plastic container
- water
- growing box
- colored pencils
- unlined white paper
- microscope
- well slide
- 2 toothpicks
- section of an apple
- plastic spoon

Procedure

Part A: Sowing Spores and Seeds, Day 1

1. Examine the vial of spores. The spores should look like specks of dark dust on the side or bottom of the vial. Compare the size of the spores to the size of the seeds.
2. Use a transfer pipette to add 1 mL of sterile water to the vial.
3. Use the same transfer pipette to place one drop of the spores suspended in water onto a microscope slide. Cover the slide with a cover slip and label it "Spores."
4. Mix the remaining spores in the vial by using the transfer pipette to gently draw them up and replace them in the vial several times. Then, use the pipette to add 1 drop of the liquid to the surface of the agar plate. Use the plastic spreader to gently spread the liquid over the top of the agar to distribute the spores. Do not dig into or press down on the agar as it is soft and will tear.
5. Next you will sow the seeds. Place 4 of the seeds about 1 cm apart from each other on top of the soil in the growing container. Cover the seeds with about 0.5 cm of vermiculite. Follow your teacher's instructions to water the soil.

6. Place both the agar plate with the spores and the growing container with the seeds under the light in the growing box as directed by your teacher.
7. Observe the slide labeled "Spores" under the microscope. Sketch the spores below.

8. Observe the remaining seed under the microscope. Sketch the seed below.

Part B: Observing the Plants, Days 3–14

1. Observe the developing plants and spores every few days from Day 3 to Day 14 as directed by your teacher. Each time you make observations, make a colored sketch of the plants developing from the spores and seeds. Date each sketch and keep them together in your notebook. With the sketches, record differences you see in the structures and shapes of the developing gametophytes and sporophytes.
2. To observe a developing spore, carefully use a toothpick to transfer a developing spore onto a microscope slide. After sketching the spore, wipe your slide with a dry paper towel then rinse the slide in the sink.

Part C: Observing Sperm, Day 21

1. Observe the surface of the agar plate. The tiny green oval-shaped specks on the agar are male gametophytes. The larger green spots shaped like mittens, are hermaphrodite gametophytes. An egg is located at the notch of the hermaphrodite gametophyte. Use a toothpick to transfer several male and hermaphrodite gametophytes from the agar plate to a well slide. Do not put a cover slip on the slide.
2. Observe the gametophytes under low power through a microscope. Use dim light, but be sure that you can clearly see a male gametophyte.

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3. Add one drop of water to the slide and observe the male gametophyte again. Adjust the lighting and focus, if needed. In a few moments, you should observe the release of sperm into the water. Once you see the sperm, switch to the medium- and then to the high-power objectives to observe them more closely. Describe your observations below.

Observations:

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4. The structure on a hermaphrodite gametophyte that holds the egg also releases chemicals that attract sperm. Apples contain a chemical that is structurally similar to the chemical released by the hermaphrodite gametophyte. Push a toothpick into a piece of apple and remove it. Switch back to low power. While looking through the eyepiece, bring the toothpick into view above the slide. Touch the end of the toothpick that has apple juice on it to the water. Observe the sperm. Describe your observations below.

Observations:

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5. Use a transfer pipette to add a thin layer of sterile water to the agar dish. This will allow for the release of sperm and fertilization among the gametophytes remaining on the dish. Replace the agar dish in the growing container to allow the sporophytes to grow.

Analysis and Conclusions

1. Summarize the life cycle of a fern from spore to spore.

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2. Summarize the life cycle of an angiosperm from spore to spore.

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3. Describe one major difference between the spores of a fern and the spores of an angiosperm.

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4. Do all male gametophytes produce motile sperm? Explain.

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Extension

Continue observing the life cycle of a fern by planting a sporophyte. Use a plastic spoon to transfer one or two healthy-looking sporophytes from the agar dish to a pot of soil. Eventually, the sporophytes should develop spores.

You can also continue to observe the life cycle of an angiosperm. By the time you complete Part D, flowers should be growing on the angiosperms you planted. Use a bee stick or chenille stem to transfer pollen from the anther of one flower to the stigma of another flower on a different plant. If fertilization occurs, seeds with a developing embryo may develop. You will be able to observe the seeds within the pods left behind after the flower falls away.