Sunshine State STANDARDS

SC.F.2.3.3: The student knows that generally organisms in a population live long enough to reproduce because they have survival characteristics.

SC.G.1.3.3: The student understands that the classification of living things is based on a given set of criteria and is a tool for understanding biodiversity and interrelationships.

SC.H.1.3.2: The student knows that the study of the events that led scientists to discoveries can provide information about the inquiry process and its effects.

388 Unit 3: Diversity of Living Things

VOCABULARY

- seed p. 388
- embryo p. 388
- germination p. 389
- pollen p. 390
- gymnosperm p. 392

KEY CONCEPT

Seeds and pollen are reproductive adaptations.

BEFORE, you learned

- Plant species evolved from algalike ancestors
- Mosses are nonvascular plants that reproduce with spores
- Ferns are vascular plants that reproduce with spores

NOW, you will learn

- How some plants reproduce with pollen and seeds
- About the advantages of pollen and seeds

THINK ABOUT

Is a seed alive?

A lotus is a type of pond lily that is commonly found in water gardens. The plants take root in the bottom of a pond. A plant scientist in California experimented with lotus seeds from China that were over 1000 years old. The scientist made a small opening in the hard covering of each seed and planted the seeds in wet soil. Some of the seeds sprouted and grew. What made it possible for these seeds to survive for such a long time? Is a seed alive?

Seeds are an important adaptation.

Spores are one adaptation that made it possible for plants to reproduce on land. Seeds are another. A seed is a young plant that is enclosed in a protective coating. Within the coating are enough nutrients to enable the plant to grow. Seeds and spores can both withstand harsh conditions. Seed plants, however, have several survival advantages over seedless plants. These advantages make it possible for seed plants to spread into environments where seedless plants are less likely to survive.

In all plants, fertilization brings about the growth of the next generation of the plant, beginning with an embryo. An embryo (EHM-bree-oh) is the immature form of an organism that has the potential to grow and develop. In seed plants, the embryo is protected. The seed coat protects the immature plant until conditions are right for it to grow.

VOCABULARY

Remember to make word triangles for seed and embryo in your notebook.
An embryo can remain inside a seed for a long time without growing. When moisture, temperature, and other conditions are right, a seed will start to grow. Germination (JUR-muh-NAY-shuhn) is the beginning of growth of a new plant from a spore or a seed. If you’ve ever planted a seed that sprouted, you’ve observed germination.

What is germination?

When a seed germinates, it takes in water from its surroundings. As the embryo begins to grow, it uses the stored nutrients in the seed for energy and materials. The nutrients need to last until the new plant’s roots and shoots can start to function.

Some plants reproduce with seeds.

In most places, plants that reproduce with seeds are common and easy to see. Trees, bushes, flowers, and grasses are all seed plants. It’s a bit harder to find plants that reproduce with spores, such as mosses or ferns. Why are there so many more seed plants in the world? The diagram below shows some of the differences and similarities between seeds and spores.

One important difference between a seed and a spore is that the seed contains a multicellular organism. If you look closely at the photograph above you can see the tiny leaves at the top of the embryo, with the root below. Spores are just a single cell. Seeds can be spread by wind, animals, or water. Spores are mostly carried by the wind. The sperm of seed plants, unlike the sperm of mosses and ferns, do not need water to reach the egg. One important similarity between a seed and a spore is that both can grow into a new plant.

Name three ways seeds are different from spores.
Pine trees reproduce with pollen and seeds.

Seed plants, such as pine trees, do not have swimming sperm. Instead, they have pollen. A pollen grain is a small multicellular structure that holds a sperm cell. It has a hard outer covering to keep the sperm from drying out. Pollen grains can be carried from one plant to another by wind, water, or by animals such as insects, bats, or birds. The process of pollination is completed when a pollen grain attaches to the part of a plant that contains the egg and releases the sperm.

The life cycle of a pine tree provides an example of how seed plants reproduce.

1. The reproductive structures of a pine tree are the pinecones. Meiosis occurs in the pinecones, producing sperm and egg cells. Each tree has separate male and female cones.

2. In male cones, the sperm cells are contained in pollen grains, which are released into the air. In female cones, the egg cells are enclosed in protective compartments within the cone scales.

3. The female cone produces a sticky substance. When a pollen grain lands, it sticks. A pollen tube begins to grow from the pollen grain through the scale to the egg. Fertilization occurs when the pollen tube reaches the protective compartment and sperm travel through it to one of the eggs.

4. The fertilized egg grows into an embryo. The compartment, with its protective covering and supply of nutrients, becomes the seed. The pinecone eventually releases its seeds. The winged seeds can float through the air and may be carried long distances by the wind. If the seed lands on the ground and germinates, it can become a new pine tree.

In the life cycle of a pine tree, meiosis and fertilization occur completely within the tissue of the mature plant. Fertilization doesn’t require an outside source of water. The sperm cells in a pollen grain and the egg cells in a cone scale represent the first generation of the plant. The seed and the tree that grows from the seed represent the second generation.

What do pollen grains and cone scales contain?
Use the definition of a cycle to predict what happens after seeds are released from pinecones.
Gymnosperms are seed plants.

Pollen and seeds are reproductive adaptations. They did not appear in plants until millions of years after seedless plants such as mosses and ferns had already begun to live on land. Today, however, most of the plant species on Earth reproduce with seeds, and many species of seedless plants have become extinct. Some scientists think this is because over time Earth’s climate has become drier and cooler. Seed plants are generally better at reproducing in dry, cool environments than seedless plants are.

Fossil evidence shows that species of seed plants in the gymnosperm (JIHM-nuh-SPURM) group have existed on Earth for more than 250 million years. Plants classified as gymnosperms produce seeds, but the seeds are not enclosed in fruit. The word gymnosperm comes from the Greek words for “naked seed.” There are four types of gymnosperms living on Earth today.

Conifers

The conifers, or cone-bearing trees, are the type of gymnosperm you are probably most familiar with. The conifers include pine, fir, spruce, hemlock, cypress, and redwood trees. Many conifers are adapted for living in cold climates, where there is relatively little water available. Their leaves are needle-shaped and have a thick cuticle. This prevents the plant from losing much water to transpiration. Conifers can also keep their needles for several years, which means the plants can produce sugars all year.

What conditions make a pinecone open?

PROCEDURE

1. Place your pinecone in the beaker of water. Observe any changes that take place. Leave the cone in the water until the changes stop.
2. Remove the cone from the water and place it on a paper towel to dry. Observe any changes that take place as the cone dries.

WHAT DO YOU THINK?

• What did you observe when the cone was in the water?
• What happened when the cone dried out?

CHALLENGE Try this procedure on cones from different plant species.
Other Gymnosperms

The other types of living gymnosperms are cycads, gnetophytes (NEE-toh-fyts), and ginkgoes. These three types of gymnosperms appear to be quite different from one another. Cycads are palmlike plants that are found in tropical areas. They produce cones for seeds. Many cycads produce poisonous compounds. Gnetophytes are another type of tropical gymnosperm that produces cones. Chemicals taken from certain gnetophyte plants have been used to treat cold symptoms for thousands of years.

Ginkgoes are gymnosperms with fleshy seeds that hang from their branches. Ginkgoes are often grown in parks and along streets, but you will not often see them with seeds. People avoid putting male and female ginkgo trees together because the seed coat of a ginkgo produces a particularly foul smell.

KEY CONCEPTS
1. How are seeds different from spores?
2. How does fertilization in seed plants differ from fertilization in seedless plants?
3. Seed plants are found in environments where seedless plants are not. List at least two reasons why.

CRITICAL THINKING
4. Compare and Contrast
   What is the difference between a spore and a pollen grain? In what ways are spores and pollen grains similar?
5. Hypothesize Gymnosperms produce a lot of pollen, and most of it blows away, never fertilizing an egg. Why might this characteristic help a plant species survive?

CHALLENGE
6. Analyze Like all plants, a pine tree has a two-part life cycle. Look again at the diagram on page 391, and then make a new version of it in your notebook. Your version should show where in the life cycle each generation begins and ends. Hint: reread the text on page 390.