United States Botanic Garden

Flower to Seed, Seed to Flower

Grade levels: K - 2nd | Duration: 45 minutes

Lesson Description: This lesson explores the life cycle of a flowering plant by examining how and why plants make seeds. During this lesson, students learn where seeds come from, what they need in order to grow, and what seeds become once they develop.

Student Experience: For students, there is often a disconnect between flowers, fruits, and seeds. Seeing these structures as part of the same life cycle can be eye-opening. In the first activity, The Reason for a Flower, each student will use their observation skills to connect real flower parts to a diagram of flower parts. Through this experience, students will understand how each part facilitates the creation, protection, and distribution of seeds. In the second activity, Wearable Greenhouse, each student takes on the role of a horticulturist by creating their own ideal environment for developing seeds.

GOALS & OUTCOMES

Goal: Students will use plant biology knowledge and the scientific skills of observation, asking questions, deductive reasoning, and making predictions to understand the full life cycle of a flowering plant.

Learning Objectives

During this lesson, students will:

- Learn how all parts of the flower perform a function related to reproduction and making seeds
- Learn the parts and purpose of a seed
- Learn that a seed is alive
- Discuss the needs of a seed and create a model of an ideal growing environment
- Observe and discuss the development of a seed into a mature plant

Student Outcomes

After participating in this lesson, students will better understand:

- The connection between seeds, flowers, and fruits
- The function of seed and flower parts within a plant's life cycle
- That pollinators (bees, butterflies, etc.) unintentionally move pollen amongst flowers and facilitate plant reproduction
- How to use a diagram during a dissection
- What plants need to survive and how, by understanding those needs, humans can cultivate plants

CENTRAL QUESTIONS & CONCEPTS

- Why do plants have flowers? Seeds?
- Flowers are special structures that help flowering plants make more plants.
- In order to make more plants, pollen must move from the male part of a flower to the female part of a flower, and then the pollen tube must grow to the ovary to make a seed.
- Pollination is the process by which pollen is moved from the male part of a plant to the female part of a plant. In flowering plants, pollen moves from the male stamen to the female pistil.
- Do pollinators intentionally move pollen to help plants make seeds? No, pollinators unintentionally move pollen from flower to flower while they eat nectar or collect pollen or fragrances for their own uses.
- Once pollen gets to the ovary within the flower, the ovary develops into a fruit. The ovules inside the ovary develop into seeds inside of this fruit.
- Planting a seed begins the process anew – the new plant, while similar to the parent plant, is not identical.

VOCABULARY

Anther: pollen-producing structure at the tip of the stamen

Cotelydon: seed leaf; plant's first leaf

Filament: part of the stamen that supports the anther

Ovary: structure at the base of the pistil; grows into the fruit in which the seeds develop

Pistil: the female part of the flower made up of the stigma, style, and ovary

Pollination: the movement of pollen from the male part of a plant to the female part of a plant

Seed: part of a plant that is capable of growing into a new plant

Stamen: male part of the flower made up of the anther and filament

Style: structure that connects the stigma and the ovary

Stigma: structure at the top of the pistil that receives pollen

MATERIALS

- Pre-soaked large dry beans (such as lima, pinto, or kidney beans)
- Anatomy of a Bean Seed diagram (see Resources)
- Paper
- Pencils
- Magnifying glasses
- Alstroemeria flowers (lilies also work)
- Parts of a Flower diagram (see Resources)
- Cotton pads
- Small, sealable plastic bags with pre-punched holes for string
- String
- Water squirters
- Winter wheat seeds (peas and beans also work well)

ENGAGEMENT

The purpose of the engagement is to inspire student interest through hands-on learning. During this activity, students will dissect a pre-soaked bean and sketch what they observe. Use this activity to spark discussions on the origin and purpose of seeds.

- Pass out one pre-soaked bean and Anatomy of a Bean Seed diagram per student (see Resources) to each student.
  - *What do you think this is? What are some of your observations?*
  - *What do you think is inside this seed?*
- Invite students to gently open a seed using their fingers. Have them use a magnifying glass to explore the inside.
- Have students sketch their bean and label its parts using the Anatomy of a Bean Seed diagram. Invite students to also write down any questions that come up as they dissect.
- As students explore the seed, discuss the name and function of each part.
- Help students understand that a bean is a seed and that seeds have parts that protect them, provide nutrients, and grow into a new plant.
- To prime students for the next activities, ask them where they think seeds come from.

EXPLORATION

The Exploration allows students to take a deeper dive into concepts introduced during the Engagement. This exploration includes two Learning Activities. In the first, The Reason for a Flower, students dissect a flower and discuss its form and function. In the second, Wearable Greenhouse, students create a model of an ideal environment for growing seeds and observing their development over time into mature plants.

Learning Activity 1: The Reason for a Flower

- Plants have flowers in order to reproduce. Seeds result from successful fertilization.
  - *Where do you think seeds come from?*
- Provide each student with a flower from an alstroemeria or lily plant and a Parts of a Flower diagram.
- Ask students to make observations about the flower.
  - *What colors do you see? What patterns?*
  - *Can you describe the shape of the flower?*
- Have students pull the petals off of the flower. Discuss the role of petals in attracting pollinators.
  - *Why do you think petals are colorful? Who or what are they attracting?*
  - *What else do flowers have that attracts pollinators?*
  - *What happens to pollinators when they visit flowers?*
- Have students observe the inner parts of the flower. Invite them to pull off the stamens.
- Discuss the role of the stamen in making pollen. Use the Parts of a Flower diagram to name the parts of the stamen.
  - *Where is the pollen located on the stamen?*
  - *What happens to the pollen when pollinators visit?*

The Reason for a Flower, continued:

- Ask students to make observations about what's left of the flower. Use the diagram to identify the pistil and stigma.
  - *What do you notice about the stigma?*
  - *When a pollinator visits, what happens to the stigma?*
  - *Once pollen lands on the stigma, where does it go?*
    - *Pollen grains grow a thin tube down to the ovary.*

- Have students pull off the stigma and style and observe the ovary. Discuss the role of the ovary in holding and dispersing seeds.
  - *After pollen gets to the ovary, the ovary begins to swell into a fruit. Many fruits are sweet. Why do you think plants have sweet fruits?*
- Ask students to gently open the ovary to see the ovules, or unfertilized seeds, inside.
- Discuss how pollen grows a tube from the stigma to the ovary. Explain that each ovule needs a grain of pollen in order to grow into a seed, which can then grow into a new plant.
  - *If you were to plant these seeds, what kind of plant would grow?*
  - *Pollinators move pollen from flower to flower. After your dissection, can you explain how pollinators help plants make seeds?*

Learning Activity 2: Wearable Greenhouse

Plants, like all living things, have basic needs: light, air, water, and nutrients. The advantage of most seeds is that they have a protective coating and a built-in food source. This allows the seed to wait until conditions are right for growing. Once a seed sprouts, its first leaves (cotyledons) begin making food for the young plant.

- Review the basic needs of plants: sun, soil, water, and air.
- Provide each student with a cotton pad.
  - *Where does cotton come from?*
  - *What part of the cotton plant is it?*
  - *The fruits, called bolls, contain the seeds and the cotton fibers to which they are attached.*
- Remind students that they told you that plants need water. Have students moisten their cotton pads that represent soil. The pads will provide a stable place for roots to grow.
- Which part of the plant is responsible for water absorption?
- Ask each student to take five seeds (winter wheat) and place them on the center of their moist cotton pad. Have them fold the pad in half, covering the seeds.
- Remind students that they told you plants need sunlight. Provide each student with a small plastic bag. Like a greenhouse, the clear plastic bag allows in sunlight and provides a controlled environment.
  - *What are most greenhouses built from?*
  - *Hold the bag up to the light, do you think sunlight can get through?*

Wearable Greenhouse, continued:

- Have students place their cotton-wrapped seeds inside the plastic bag, but ask them not to seal the bag.
  - *Other than soil, water, and sunlight, what else do plants need that should go in the bag?*
- While ensuring that students do not place their mouths on the bag, have students blow air into the bag and seal their bags.
  - *What did the students blow in to the bag that plants need?*
  - *Introduce the term "carbon dioxide."*
  - *What gas do plants give us that we need to breathe?*
- Provide each student with a string that they thread through the small hole in the top of the bag. Help students to tie the ends to create a wearable greenhouse.
- Winter wheat seeds are chosen because they germinate and sprout in several days if given enough light. While grasses do flower, their flowers tend to be small and green. If you have space and a longer time with students, you could select a seed that will have a more prominent flower. Suggestions include peas and beans.
- Have students observe their seeds over the coming days and track their growing plant's development. Discuss what will happen once the plant produces flowers, as well as the plant's complete life cycle.
- Once the plants are too tall for the plastic bag, have your students transfer them to soil or potting mix. You can transfer your plants to a garden or a pot.

EVALUATION & EXTENSION

The Evaluation & Extension helps students use their critical thinking skills by applying the concepts learned in Engagement and Exploration beyond this lesson.

Discussion and Reflection:

- Encourage students to reflect on what they have learned about seeds, flowers, and reproduction.
  - A plant has one reason to grow – to reproduce and make more plants like it.
  - Flowers are the reproductive parts of most plants.
  - In order for a seed to develop, pollen has to move from male to female parts of flowers and grow down to the ovary.
  - Pollinators visit flowers to eat the sweet nectar and accidentally move pollen from stamen to stigma.

Assessment Suggestions:

- Have students write a Claim, Evidence, Reasoning (CER) statement reflecting on one of the discussion questions or claims (worksheet included in Resources).
  - For example, you could have students work through a CER for the following statement: *Flowers help most plants make seeds.*

LIVING PLANT CONNECTIONS

Studying living plants in conjunction with this lesson can help cement core concepts and inspire new discussions. You can connect your students with living plants by going to an outdoor playground, nearby park, or visiting a botanic garden. If it is not possible to conduct an outdoor visit, we suggest bringing a variety of flowers into the classroom.

Continue discussing flowers, seeds, and fruits as you explore:

- Do all the flowers you find look like the one you dissected? What is similar? What is different?
- Can you find any plants that don't make flowers (like ferns, pine trees, and mosses)?
- Can you find any seeds or fruits growing on plants? Seeds or fruits that have fallen off plants?
- How do you think the seeds traveled to where they are now?
- Do you think all seeds end up in a suitable place for growing?

To find a public garden near you, please visit: https://www.publicgardens.org/about-public-gardens/gardens#

To book a field trip to the U.S. Botanic Garden, please visit: www.USBG.gov/FieldTrip

For a virtual tour of the U.S. Botanic Garden, please visit: www.USBG.gov/VirtualTour

CURRICULUM CONNECTIONS

Science and Engineering Practices:

- Developing and Using Models
- Obtaining, Evaluating, and Communicating Information
- Engaging in Argument from Evidence

Crosscutting Concepts:

- Patterns
- Structure & Function
- Systems and System Models

Maryland and Washington, D. C. (Next Generation Science Standards by DCI):

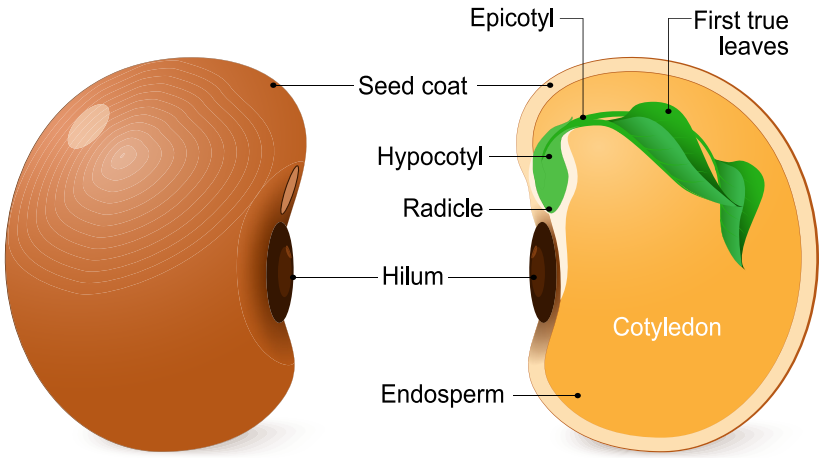
- Molecules to Organisms: K-LS101
- Ecosystems: Interactions, Energy, Dynamics: 2-LS2-1
- Earth and Human Activity: K-ESS3-1

Virginia (Science Standards of Learning):

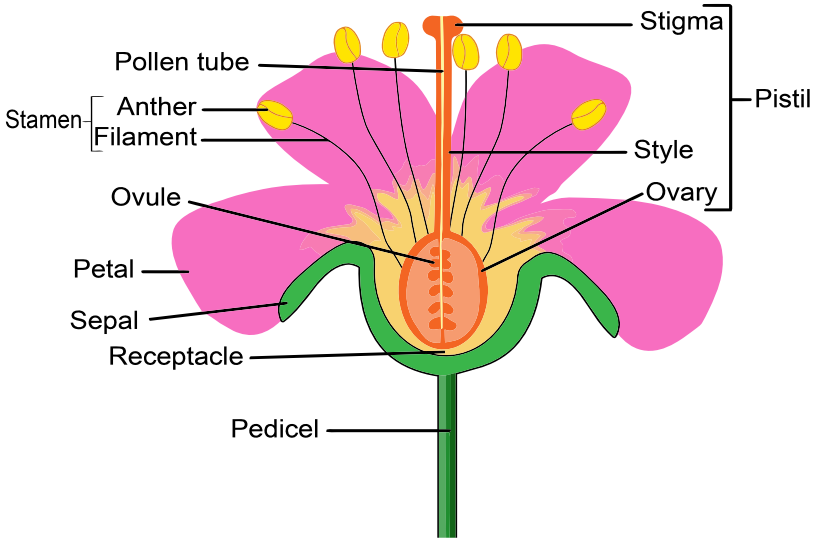
- Living Systems and Processes: K.7, 1.4, 2.4

RESOURCES

ANATOMY OF A BEAN SEED



PARTS OF A FLOWER



Student Worksheets
The following worksheets are included with your resources:

- The Claim-Evidence-Reasoning (CER) Student Page helps students develop their critical analysis skills by exploring a claim and using evidence and reasoning to support or disprove it.

- The Plant Connections Field Guide helps students use living plant material and the natural world to explore the concepts in this lesson.

Name: _____

Claim-Evidence-Reasoning (CER) Student Page

You can use this page to explore a claim made during this lesson. For example, you could go through the evidence and reasoning for the claim: "Flowers help most plants make seeds."

Claim (Statement made in the lesson): _____

_____

_____

_____

Evidence (How do you know?):

Reasoning (How does your evidence support your claim?):

Name: _____

Plant Connections Field Guide

Type of Plant: _____

Location:_____

Size (height):_____

Part of the plant Life Cycle (circle):

Beginning Middle End

Evidence (How do you know?): _____
_____
_____

Observations: