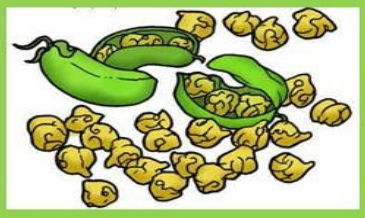
Lesson 2. Classroom Discussion and Activity:
Experience the Life Cycle of a Bean Plant



SPRING or FALL

Time required for discussion and activity: 1 hour

Materials:
- Cards with stages of the bean life cycle written on them (see stages listed below or see cards on following pages)
- Pencils and colored pencils for handout
- Student Handout: *The Life Cycle of a Bean Plant*, 1 per student

Preparation:
- Print the cards showing the stages of the life cycle of a bean plant (see following pages).
- Make room for a circle of 9 students in the classroom.

Curriculum Enhancement Options:
- The Life Cycle of a Bean Plant video: http://www.youtube.com/watch?v=9CrkJgxhjV8.

Learning Target:
- How do I calculate the germination rate of bean plants?

Success Criteria:
- I can observe and conclude what seeds need to germinate.

Overall Learning Target: All living things have a life cycle.

Key Words;
- **Cotyledons** are the first leaves that emerge from a seed.
- **Transpiration** is a process by which moisture is carried through a plant, from the roots to small pores on the underside of leaves, where it is converted to vapor and is released to the atmosphere.

<u>Stages of the life cycle of a bean plant</u>:
- Seed is planted in the ground
- Seed germinates underground
- Roots develop and seed emerges above ground
- **Cotyledons** emerge from seed
- Leaves develop
- Flowers develop
- Bean pods develop
- Bean pods dry out and are ready for harvest
- Bean seeds are collected

Instructional Process

Science journal options:

- Draw a t-chart and label one column ‘Plant structure’, and one column ‘Function’.
- List each structure and its function in the table.
- Draw an example of each plant part

Engage students by having them recall why people need plants and what plants need to grow.

Step 1. Distribute the Student Handout: *The Life Cycle of a Bean Plant*. Haves students identify the following plants parts: seeds, roots, leaves, flowers, and pods, coloring in each plant part on their handout a different color. Keep document projected throughout the hands-on activity that follows as a reference for students if needed.

Background information:

Functions of plant structures -

- **Seeds** are a flowering plant’s method of reproduction; capable of developing into another such plant.
- **Roots** are the part of a plant that are found in the ground, provide support, water, nutrients, and are the location where nodules form to fix nitrogen.
- **Leaves** attach to the stem or directly to a plant stalk and are the primary location for photosynthesis and **transpiration**.
- **Flowers** are the reproductive organs (**stamens** and **pistils**) that are typically surrounded by brightly colored **petals** (collectively called **corolla**) and a green **sepals** (collectively called **calyx**), and their seeds mature into an enclosed **ovary**.
- **Pods** provide protection for developing seeds of leguminous plants (e.g., dry bean, dry pea, lentil, garbanzo, etc.), which splits open on both sides when ripe.

Engage students by having them count how many times they see each plant part on the handout? (The goal is to engage students in the upcoming activity, not necessarily provide right or wrong answers)

Step 2. Have 9 students stand in a line (while the remaining students watch their progress). Hand out all 9 cards with life cycle stages on them and instruct students to silently read their cards and place them on their foreheads for others to read.

Step 3. Instruct students to stand next to each other in order of the bean life cycle; the students with cards must remain silent, but can use non-verbal communication while getting in proper order. The students in the audience can use their voice to direct the students.

Step 4. Once the students have completed this task, ask them to look at their cards and then the cards on either side of them. Ask students in the audience if they think they are in the correct position for each spot in the bean life cycle. Starting at the beginning of the life cycle, have the class vote by showing a 'thumbs up' or 'thumbs down' to confirm the placement of each stage of the lifecycle. If a student is in an incorrect position, have the class decide as a group where to relocate that student.

Step 5. Once the students are in the correct order, have them get in to a circle to emphasize the cycle.

Background information:

The list of stages on the front page of this lesson is in chronological order to guide your discussion with the students.

Step 6. Once completed, have the students keep their cards and return to their desks.

Step 7. Discuss each stage of the bean life cycle on the handout, asking students to raise their hand if they have the stage being discussed. For each blank box on our handout, decided where each stage of the life cycle fits. Have students fill in their handout.

Step 8. Challenge students to share the life cycle handout with family and friends at home and explain the life cycle to them.

Teacher's Key:
The Life Cycle of a Bean Plant

Seed is planted in the ground

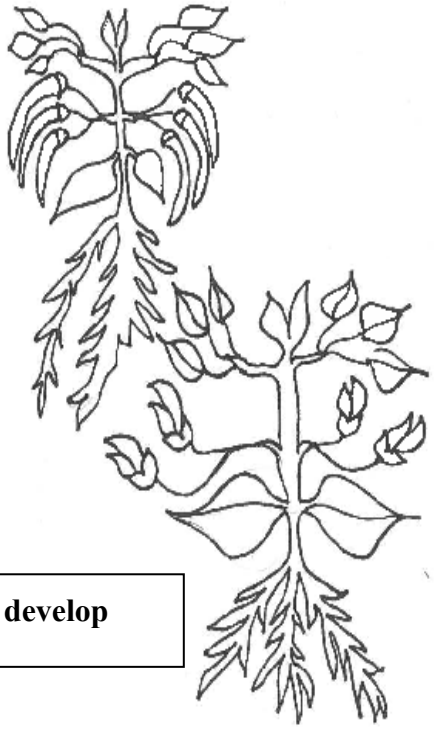
Seed germinates under ground

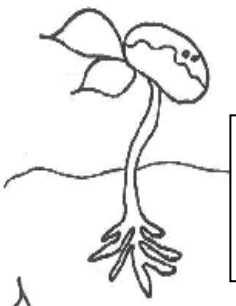
Bean seeds are collected

Roots develop and seed emerges above ground

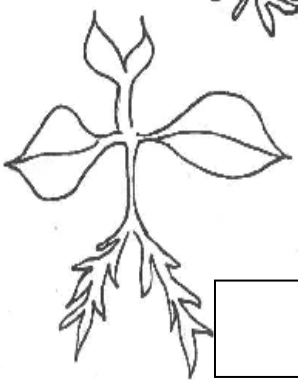
Bean pods dry out and are ready for harvest

Bean pods develop





Cotyledons emerge from seed

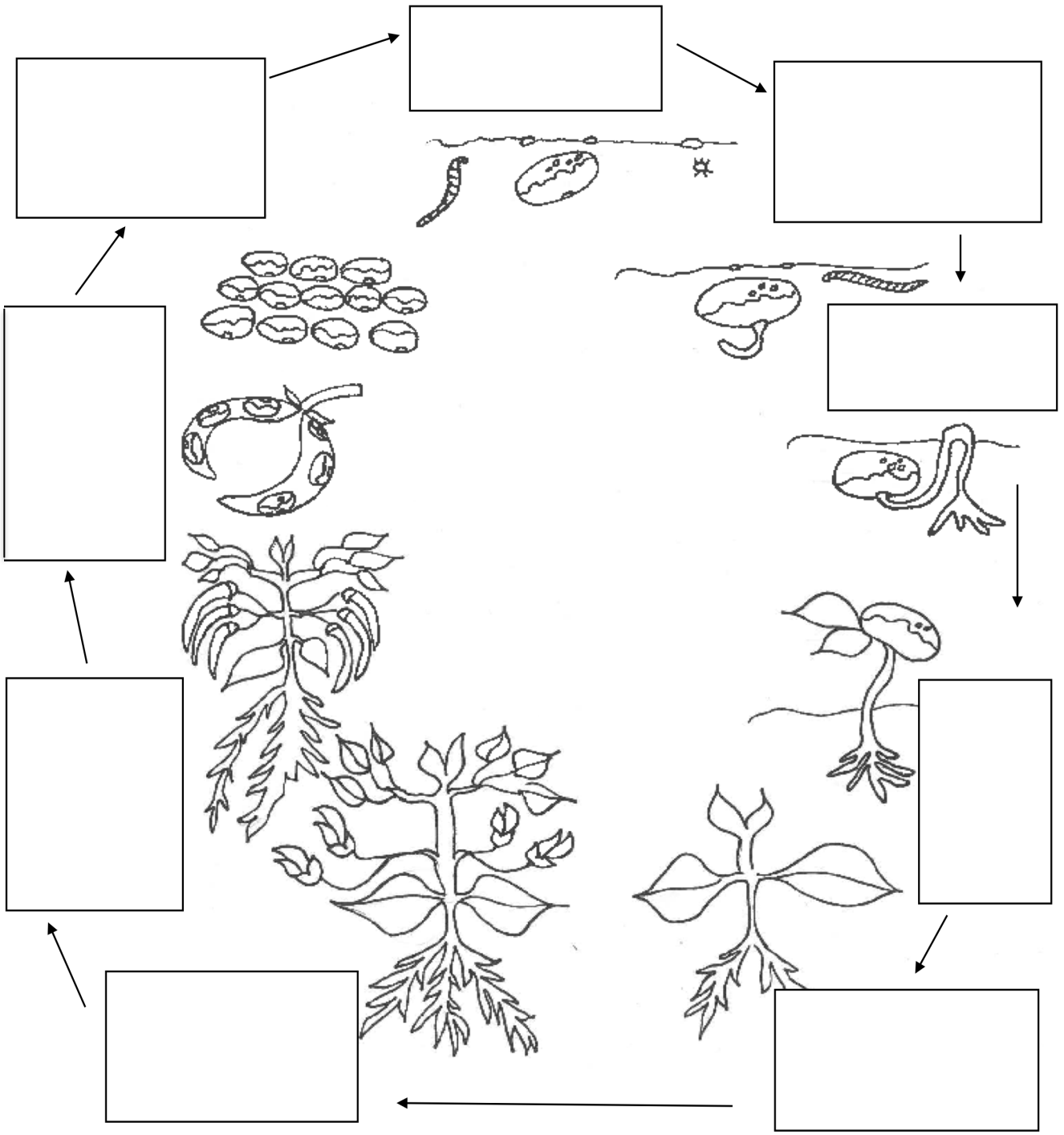


Flowers develop

Leaves develop

The Life Cycle of a Bean Plant

Name_____ Date_____



Seed is planted in the ground	Seed germinates under ground
Roots develop and seed emerges above ground	Cotyledons emerge from seed
Leaves develop	Flowers develop

Bean pods develop
Bean pods dry out and are ready for harvest
Bean seeds are collected

Lesson 2. Fall School Garden Activity: Identify Bean Plant Plants and Understand Their Functions

FALL

Time required for garden activity: 30 minutes

Materials:
- Ruler
- Calculator
- Clipboards
- Paper or science journal
- Pencil

Learning Targets:
- What are the functions of the bean plant structures?

Success Criteria:
- I can explain the functions of all structures of a bean plant.

Big Idea: Bean plants have structures that function to support survival, growth, behavior, and reproduction.

Key Words:
- **Transpiration** is a process by which moisture is carried through a plant from the roots to small pores on the underside of leaves, where it is converted to vapor and is released to the atmosphere.

Instructional Process

Science journal options:
- Draw a bean plant and label with structure and function.

<u>Background information</u>:

Functions of plant structures -
- **Seeds** are a flowering plant's method of reproduction; capable of developing into another such plant.
- **Stems** allow for movement of water and nutrients, and provide structural support.
- **Roots** are the part of a plant that attaches to the ground for support, water, nutrients, and are the location where nodules form to fix nitrogen.
- **Leaves** attach to the stem or directly to a stalk of plant and are the main plant organs of photosynthesis and **transpiration**.
- **Flowers** are the reproductive organs (**stamens** and **pistils**) that are typically surrounded by brightly colored **petals** (collectively called **corolla**) and a green **sepals** (collectively called **calyx**), and their seeds mature into an enclosed **ovary**.
- **Pods** provide protection for developing seeds of leguminous plants (e.g., dry bean, dry pea, lentil, garbanzo, etc.), which splits open on both sides when ripe.

Step 1. In the garden, identify bean structures and functions by having students team up with their elbow partner and take turns pointing out the structure and share ideas about the functions with each other.

Step 2. Assign a bean variety to each pair of students (elbow partners) and have them:

- Draw and label the table below on paper or in science journal.
- Harvest 1 pod from their assigned variety.
- Measure and record length of pod.
- Open pod; count and record number of seeds in the pod.
- Using the measurements from 2 other groups counting the same variety, have students record the numbers in rows 2 and 3 in table.
- Using a calculator, find and record the average pod length and seeds per pod to complete in the table.

Average Pod Length and Seeds Per Pod of (Insert bean variety name)		
	Length of pod	Seeds per pod
1		
2		
3		
Average		

Lesson 2. Spring School Garden Activity:
Count and Calculate Germination Rates

SPRING

Time required for garden activity: 1 hour

Materials:
- Trowel
- Clipboards
- Student Handout: *Count and Calculate Germination Rates,* 1 per student

Learning Targets:
- How do I determine which bean plant germinated from the ground best?

Success Criteria:
- I can calculate percentage of germinated seeds (germination rate).

Big Idea: Calculating germination is useful in determining how well bean plants perform.

Key words:
- **Denominator** is the number below the line in a fraction showing the total number of parts.
- **Germination** is the first stage in the process by which a plant grows from a seed.
- **Germination Rate** is the percent of seeds that **germinate**.
- **Inference** is a conclusion based on evidence.
- **Numerator** is the number above a line in a fraction showing how many of the parts indicated by the denominator are taken.
- **Vigor** describes the healthy, well-balanced growth of a plant.

Instructional Process

Science journal options:
- Germination rate equation for each variety planted in school garden.
- A bar graph to compare each variety's germination rate.
- Draw seed and plant.

Background information:

Germination rate is the percent of seed that has germinated and is important for determining the

correct timing of planting seeds and to evaluate the seed **vigor**. Inferences can be made based on the germination rate. The higher the germination rate, the more plants will grow to produce more beans.

Step 1. Before taking students to the garden, distribute Student Handout: *Count and Calculate Germination Rates* and a clipboard.

Discuss with students:
When we say percent, we are really saying 'per 100' (e.g., 50% means 50 per 100). A **percentage** is calculated by dividing the numerator by the denominator and then multiplying that answer by 100. In determining the germination rate, the numerator *must* be less than the denominator. If the numerator was larger than the denominator, the germination rate of the beans would be higher than 100%, which is not possible.

Discuss with students:
Have students discuss the meaning of germination.
A bean should be counted when you can see at least a green or white stem sprouting from the ground.

Step 2. Have students write the number of seeds planted in the denominator of each equation (this number is written on the stakes on planting day). In the garden, count the number of plants that are visible above ground (e.g., cotyledons) for each variety. Have students write the number of germinated seeds in the numerator of each equation (handout provides one equation per variety or row).

Engage students by directing them to compare their counts of germinated seeds with 2 other students for accuracy.

Step 3. Discuss reasons plants may have germinated or not (i.e., unhealthy/diseased seed, buried too deeply, birds ate seeds, seed rotted, too cold, too dry, too old). Have them think about it, pair up with a buddy and share their idea with their buddy. Ask a few students to share what they think.

Step 4. With a trowel, dig up at least one seed in each row that may have not germinated.

Step 5. Have students draw seeds that did not germinate and a growing plant on the handout.

Step 6. Return to the classroom and have students calculate germination rate: (Number of visible plants) / (Number of seeds planted) x 100 = % of seeds that germinated.

Ask students
- Can you make an inference, based on your germination rate data, which varieties will perform best in our region?
- What can gardeners do to increase the number of seeds that germinate?
  - Plant seeds later in the season (closer to June 1).
  - If birds are eating the seeds, place row cover over the young seedlings.

Count and Record Germination Rates

Name_____ Date_____

Garden numbers: How many seeds germinated per variety?

Equation: $\left(\frac{\text{(number of germinated seed)}}{\text{(number of seeds planted)}}\right)$ **x 100 = (germination rate)**

Variety 1: _____ = (_____) x 100 =

Variety 2: _____ = (_____) x 100 =

Variety 3: _____ = (_____) x 100 =

Variety 4: _____ = (_____) x 100 =

Draw seed	Draw plant

What inferences can you make about which bean variety will produce the highest yield?