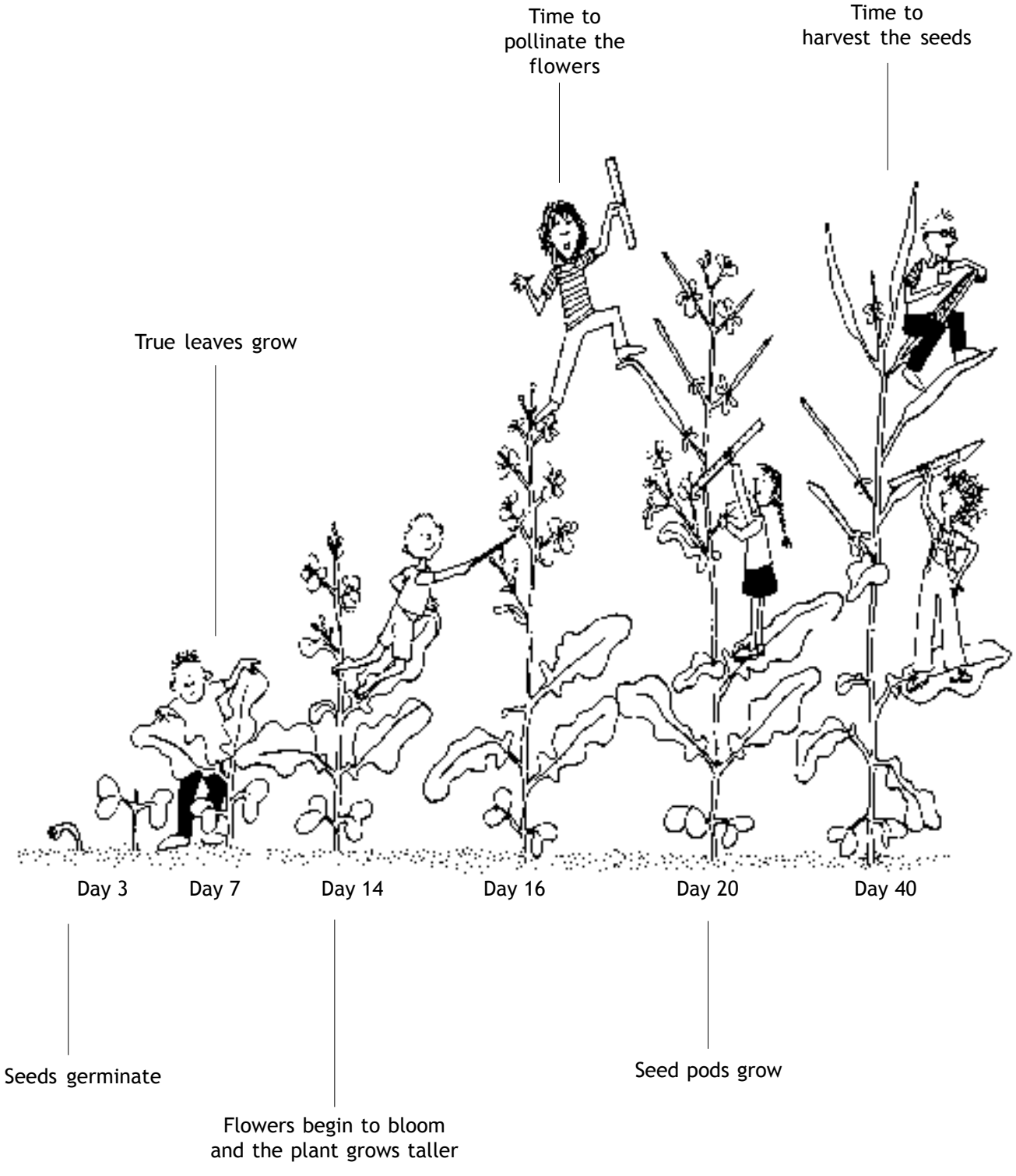
The Seed Challenge

How Many Seeds Can You Get from a Single Seed?

Grade Level: K-4
Catalog Number: 15-8973



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The Seed Challenge *was designed in collaboration with K-8 teachers and the Wisconsin Fast Plants Program at the University of Wisconsin - Madison. Acknowledgements: Deb Spencley (Verona School District, Wisconsin), Julie Walworth, (Minneapolis School District, Minnesota), and Becky Rosenberg (Madison Metropolitan School District, Wisconsin); Dan Lauffer, Paul H. Williams, and Coe Williams (Wisconsin Fast Plants Program); Lisa Darmo and Kathy Douglas (Carolina Biological Supply Company).*

Written by Sarah Lauffer and illustrated by Amy Kelley. For more information about Wisconsin Fast Plants™, go to www.fastplants.org or www.carolina.com/fastplants.

How many seeds can you get from a single seed?

Is this a riddle? Yes...and the answer lies at the end of the life cycle of Wisconsin Fast Plants™!

Wisconsin Fast Plants™ are easy to grow, and their small size makes them perfect for a classroom bustling with kids. With this kit, an entire classroom of students can grow plants through a complete life cycle, in just over 40 days. Wisconsin Fast Plants™ are *Brassica rapa*, a member of the crucifer family. They are closely related to broccoli, cabbage, canola, chinese cabbage, turnips, and many other foods you can find at the market.

In *The Seed Challenge*, students tend their own plants through an entire life cycle. They are responsible for recording the many changes that they witness, using words, drawings, or measurements. From their own observations, students ask questions about what plants need to stay healthy and produce seeds. As each day passes, students get closer to an answer to the riddle: How many seeds can you get from a single seed?

And the best part...the new seeds can be used to plant more generations of Wisconsin Fast Plants™, over and over again!

Life Science Standards and the Objectives of the Seed Challenge Activity

K-4 Life Science Standards
- Characteristics of organisms
- Life cycles of organisms
- Organisms and environment

At the end of this activity, students will be able to:
- Explain how plants grow and reproduce (how they change over time)
- Identify the parts of a plant
- Describe stages in the life cycle of a plant
- Recognize what plants need to grow

Materials List

The following materials are included with The Seed Challenge Kit:

Written Materials

- The Seed Challenge Book
- Wisconsin Fast Plants™ Growing Instructions

Growing Materials

- 8 Growing Systems

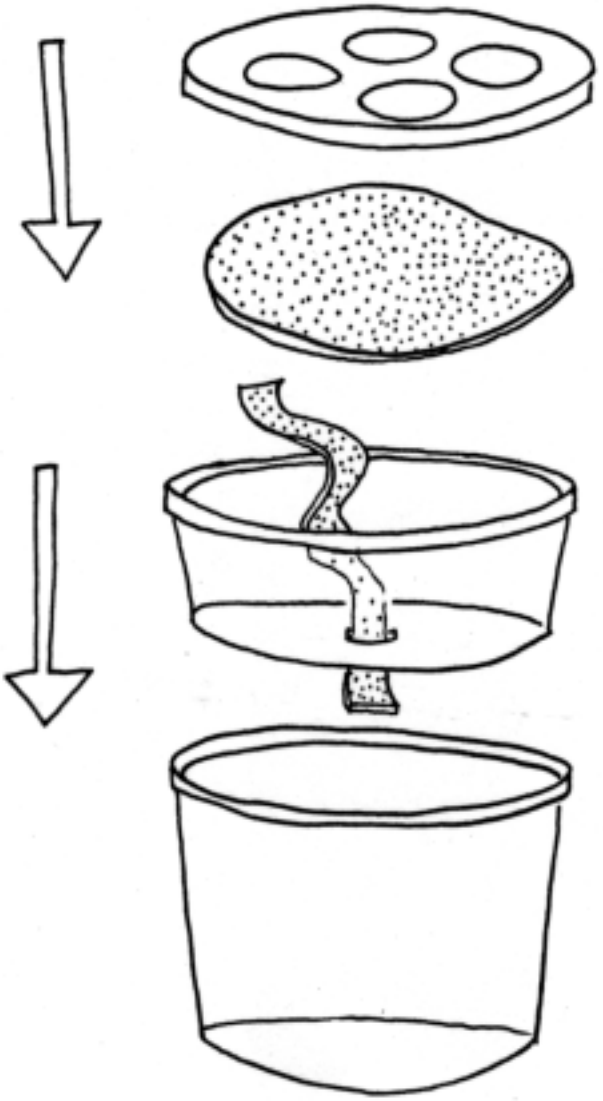
  Each growing system includes:
  - 1 lid
  - 1 circular watermat
  - 1 long watermat wick
  - 1 small container
  - 1 large reservoir
  - 4 pots
  - 4 small blue watermat wicks

- Potting Mix
- Fertilizer
- Stakes and ties
- Labels
- Bees (dehydrated)
- Wisconsin Fast Plants™ Standard Seeds

Materials that you may need to supply or order separately

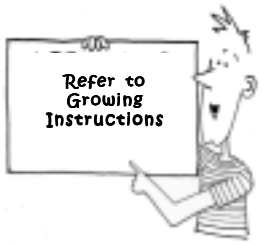
- Plant Light House or Plant Light Bank (Purchase through Carolina Biological Supply Company, Catalog Number 15-8997 or 15-8998) or make your own (see **www.fastplants.org** for instructions).

Growing System Assembly



Getting Started

One day before starting:



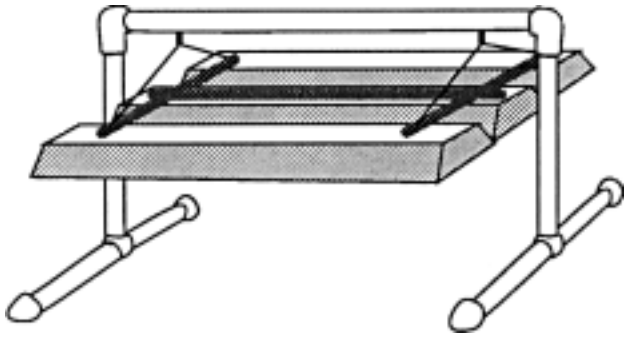
- **Read through the *Wisconsin Fast Plants™ Growing Instructions*.** The *Growing Instructions* describe how to plant seeds, tend plants, pollinate flowers, and harvest seeds. The icon (at right) will remind you to refer to them frequently throughout the activity.

- **Assemble a lighting system (a Plant Light House or a Plant Light Bank).** Plan to leave it on 24 hours a day throughout the entire life cycle. See *Growing Instructions* for details.

- **Set up to plant seeds.**
  There are enough materials for 4 groups of 2-4 students.
  Each group will share one reservoir of 4 pots, with 2-3 plants per pot.

Successful Wisconsin Fast Plants™ require continuous water, fertilizer, and fluorescent light, 24 hours a day. The optimal temperature is 65—78 °F (18—26 °C).

Plant Light House



Plant Light Bank

?

Need a quick refresher on your plant biology?

The Seed Challenge includes a synopsis of plant biology at each stage of the life cycle.
Look for the title "What's Happening?"

The Seed Challenge Calendar

Monday	Tuesday	Wednesday	Thursday
0 Plant Seeds 	1 	2	3
7 	8 	9	10
14	15 Pollinate 	16	17 Pollinate 
21	22 	23	24
28	29 	30	31
35	36	37 Stop watering 	38
42	43	44 Harvest seeds 	

Friday	Sat.	Sun.
4 **Thin plants** 	**5**	**6**
11 	**12**	**13**
18 **Cut off unpollinated buds** 	**19**	**20**
25 	**26**	**27**
28 	**29**	**30**
39	**40**	**41**

Key

Tend Plants

Check Nutrient Solution

Observe and Measure Plants

Time

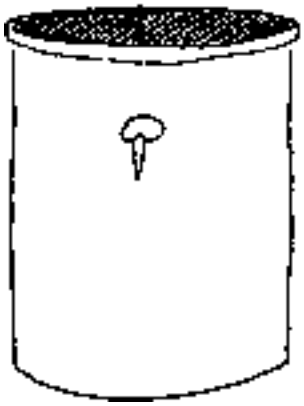
This investigation spans the entire life cycle of the plants (about 44 days, with proper care).

It is recommended that you begin this activity on a Monday.

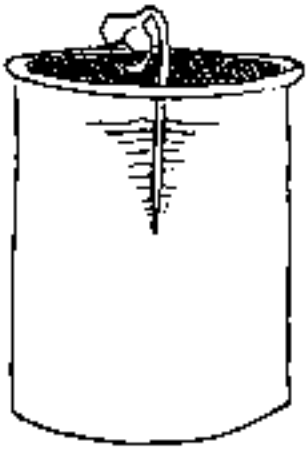
Plan on a full class for planting seeds, pollinating flowers, terminating buds, and harvesting seeds.

All other observation or plant care days require 10-30 minutes.

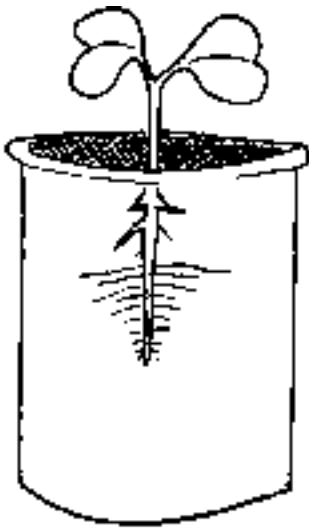
Stages in the Life Cycle of Wisconsin Fast Plants™



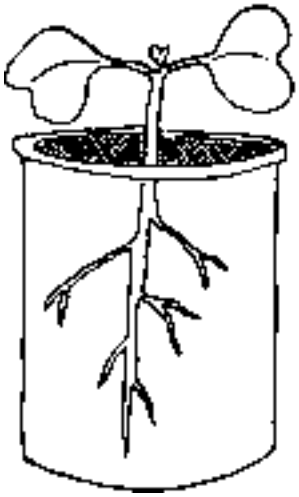
24 hours



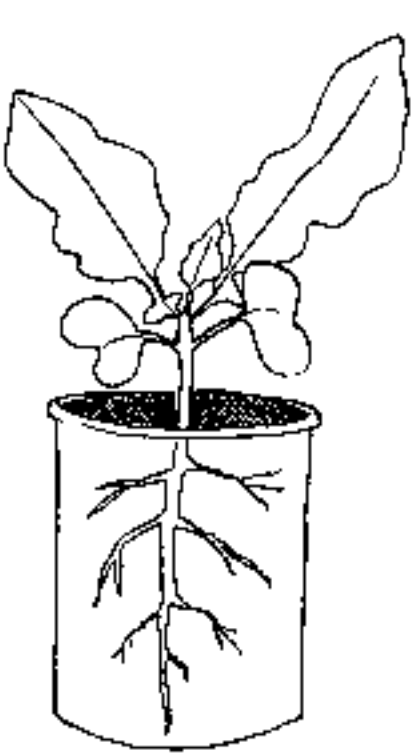
24-48 hours



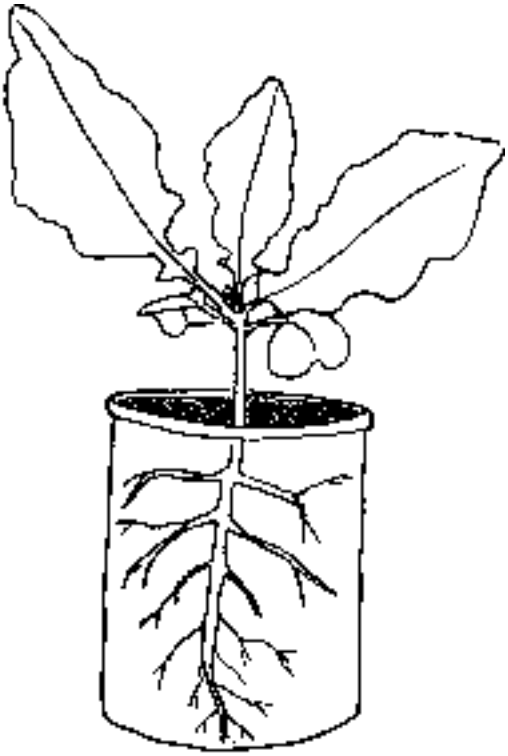
48-72 hours



Day 4-5

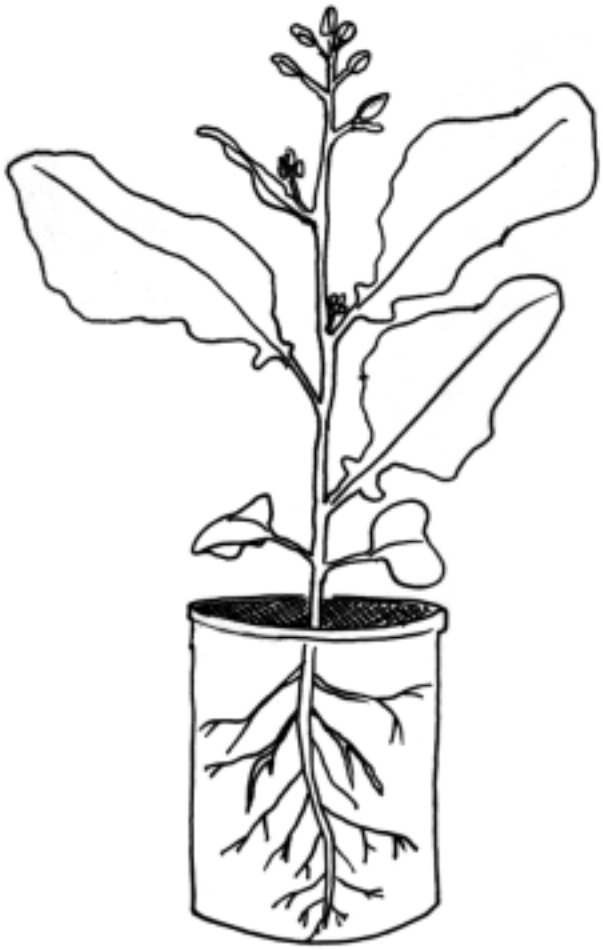


Day 7



Day 9

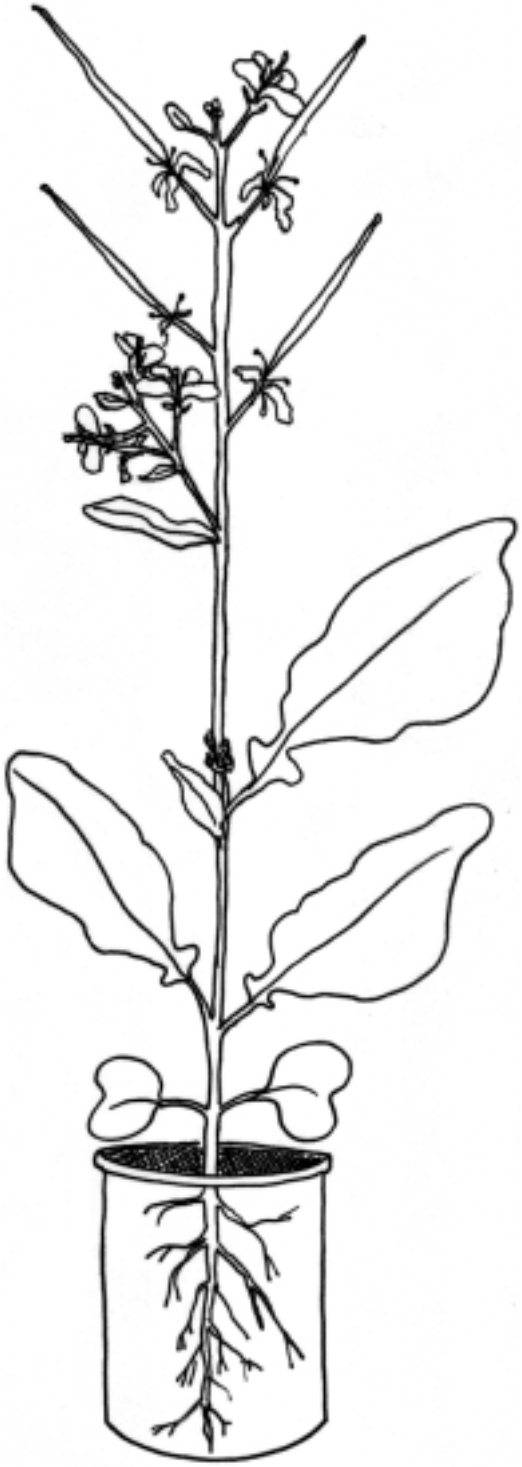
Stages in the Life Cycle of Wisconsin Fast Plants™



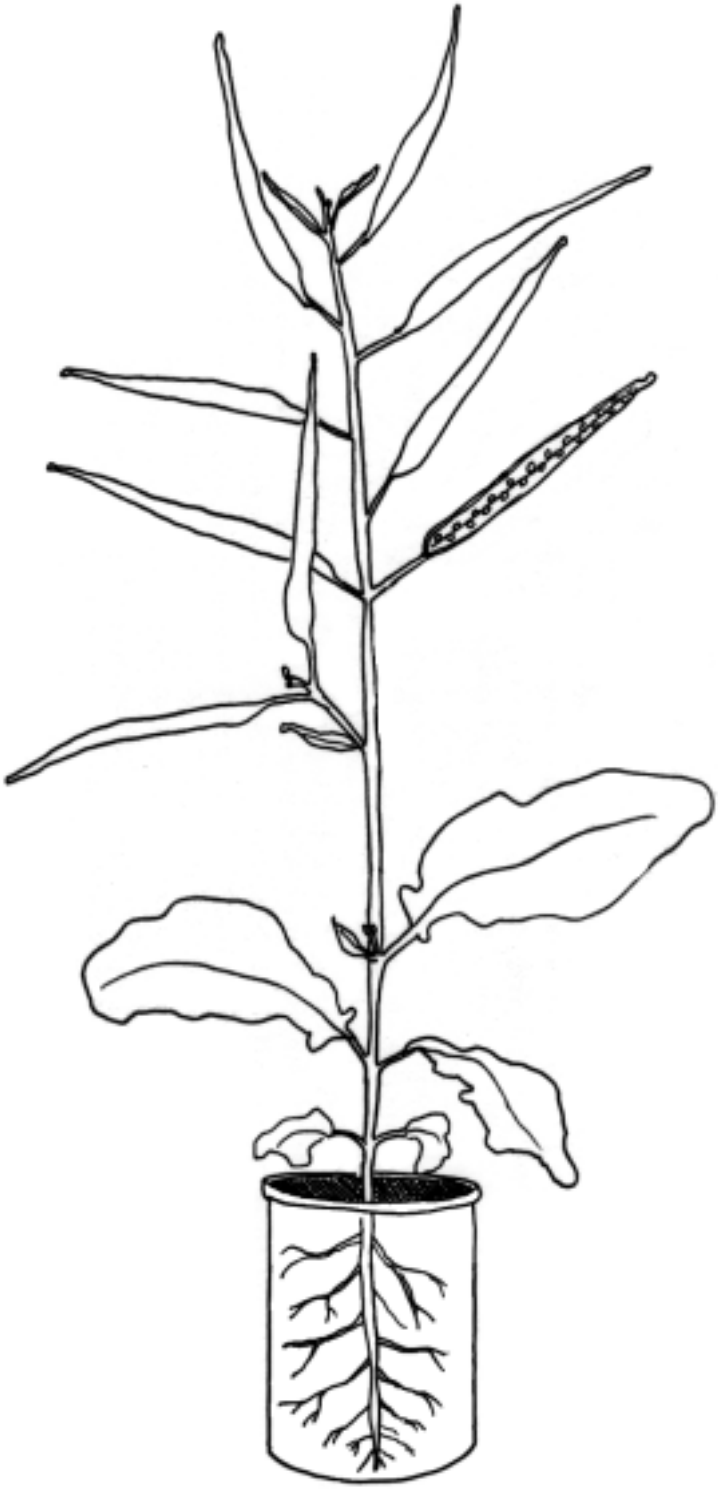
Day 11

Day 13

Stages in the Life Cycle of Wisconsin Fast Plants™



Day 18



Day 28

Student Plant Journals

With guided phrases and observation cues, the student Plant Journals are designed to help young children hone their skills in observation, questioning, and journaling. The large, blank spaces encourage students to draw pictures, record measurements, and write observations, questions, and hypotheses.

On each day that students observe or tend their plants, they should record their plants' growth and their own actions on a **new Plant Journal sheet**. Over the course of the life cycle, they will create their own journal of their plants' growth. On the back of each page, students can write poems, glue pictures, or tape pressed plants to help them remember their plants at each stage. At the end of the activity, have students make a Life Cycle Log that binds all their Plant Journal pages together as a journal, so they can see how their plants grew.

Two
Plant Journal
Pages:

Grades K-2
Grades 3-4

The Plant Journal pages prompt students to:

1. **Write their name and identify the date/day.**

2. **Make observations about their plants' growth and development:**
   - Draw pictures of their seeds or plants (large box)
     Count how many units (centimeters, inches, or other measurement) tall their plants are, then color the same number of boxes (tower of boxes on the right)
   - Use words to describe their seeds or plants ("The ___ is ___." and "Today, I ___ my plant.")

3. **Ask questions and make predictions, based on their observations:**
   - Wonder how and why the plants will grow and produce seeds ("I think..." and "I wonder...")
   - Predict how many seeds their plants will produce.

4. **Gather evidence that will help them answer their questions and predictions.**

Plant Journal (K-2)

Date

Name: _____

Monday Tuesday Wednesday Thursday Friday

Draw your plant here.

The _____ is _____ .

I think my plant will have this many seeds:

Plant Journal (3-5)

Name: _____

1 Your Plant's Age

Planting Date (Day 0): _____

Today's Date: _____

My plant is _____ days old.

2 Measurements

My plant is _____ cm tall.

3 Tending Plants

Fill in the blank with a phrase from the Word Bank:

Today, I _____

_____ my plant.

4 Questions

I wonder _____

_____?

5 Draw Your Plant Here

Day 0
Planting Seeds

What's Happening?

A **seed** contains a tiny, new plant. The outside of the seed is called the **seed coat**. Inside the seed is an **embryo** (baby plant).

A seed can remain quiescent (sleeping) for years, as long as it stays dry and cool. When it gets wet and warm, the seed expands until the seed coat cracks, and the tiny plant begins to grow.

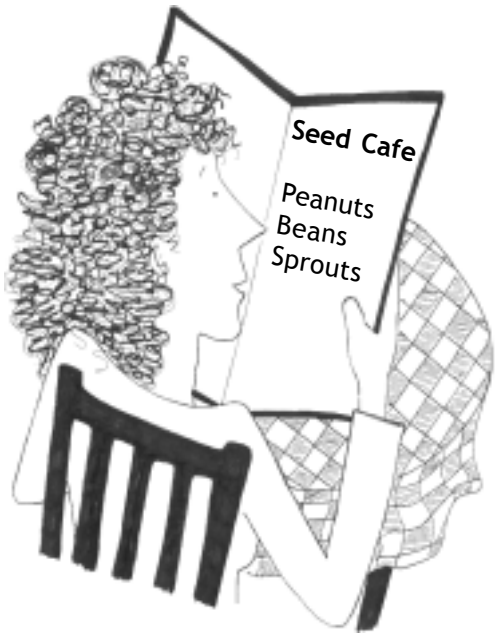
Environmental Matters

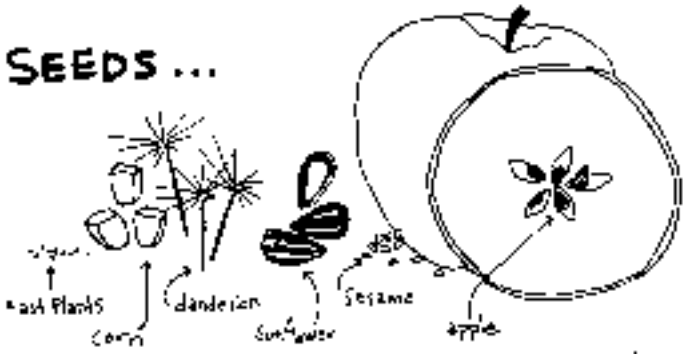
Seeds need water, air, and warmth to germinate.

Plants need water, air, warmth, nutrition, light, and space to grow.

Quick Activity

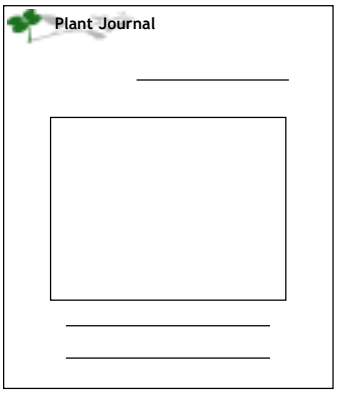
Name 3 types of seeds that you can eat.





Day 0
Activities and Investigations

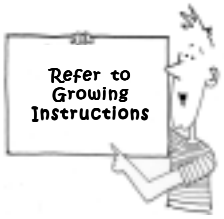
Plant Journals

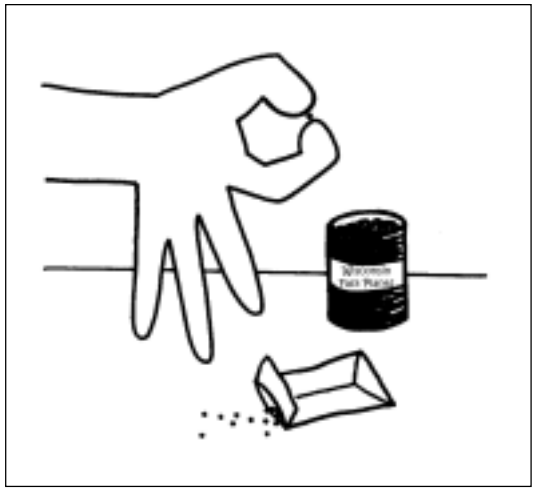


- ☐ **Draw** and color a seed (K-4).
- ☐ **Measure** the seed (3-4) or **compare** its size to another type of seed (K-2).
- ☐ **Complete** the prompted sentences (K-4) and word bank matches (3-4).

Action

- ☐ **Plant** seeds according to the *Growing Instructions*. Each group (2-4 students) should plant 3-4 seeds in 1 pot.





Some Discussion Ideas...

- Where do seeds come from?
- What can this seed become?
- What's inside the seed?
- What does this seed need to grow?
- Are seeds alive?

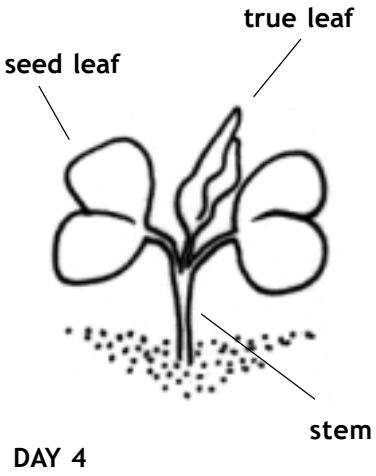
Extension

Learn about variation!

Each seed is different, and each plant will be different, just like every person is different. **Measure** the height of each student in the class. Is everyone the same height? Will all your plants be the same height? Are all your seeds the same size?

What's Happening?

Under the soil, the tiny seeds will **germinate** a day or two after planting. During germination, the seed takes up water and swells until its seed coat cracks. The **root** comes out first, then the stem and two **seed leaves** appear. Watch the top of the soil each day. By day 2 or 3, each new **seedling** should push through the soil.



DAY 4

Why do we thin the plants?

Plants need

space

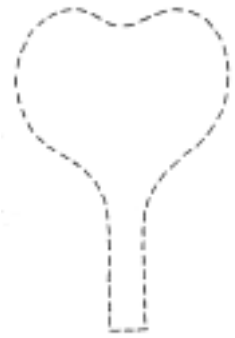
to grow.

Easy Activity

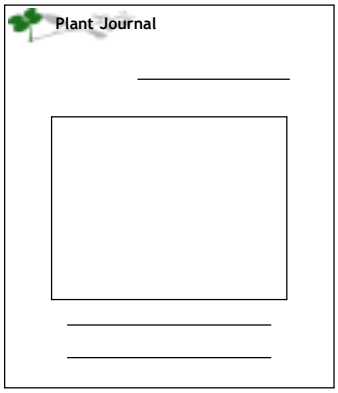
Seed Sponge Germination

Cut a sponge into a seedling shape, then watch it germinate in water!

(See page 27 for details.)



Day 4
Activities and Investigations

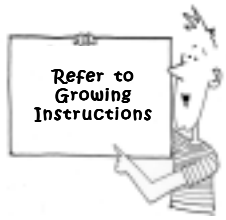


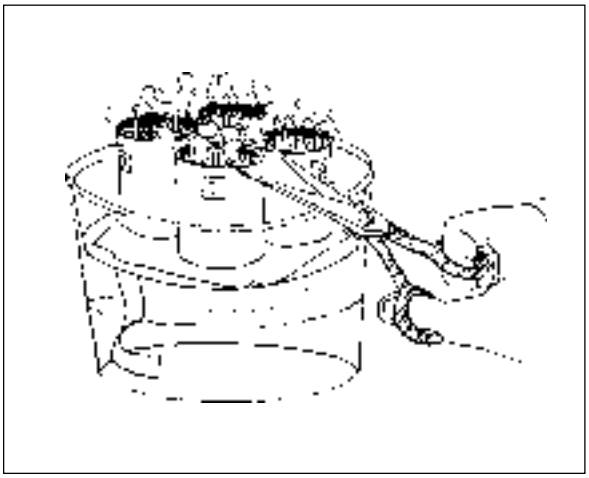
Plant Journals

- ☐ **Draw** and color your seedling (K-4).
- ☐ **Measure** how tall your plant is. Fill in the same number of boxes on the growth chart (K-4), or record the number (3-4).
- ☐ **Complete** the prompted sentences (K-4) and word bank matches (3-4).

Action

- ☐ **Snip** off all but two plants per pot. This is called **thinning**.
- ☐ **Check** the nutrient solution.





Some Discussion Ideas...

- What came out of each seed?
- How many days did it take for the seedlings to push through the top of the soil?
- Did all the seeds germinate?
- What is germination?

Extension

Compare germination of different seeds!

Try beans, peas, alfalfa sprouts, corn, sunflowers, or any other seed you can find. Place a few seeds in a plastic bag with a moist paper towel, then tape the bag to a window or to the inside of your plant light house. In a few days, the seeds will take up water and begin to germinate. Do they all look the same when they are seeds, or when they are sprouts? Did they all germinate on the same day?

Days 5-12
Growth and Development

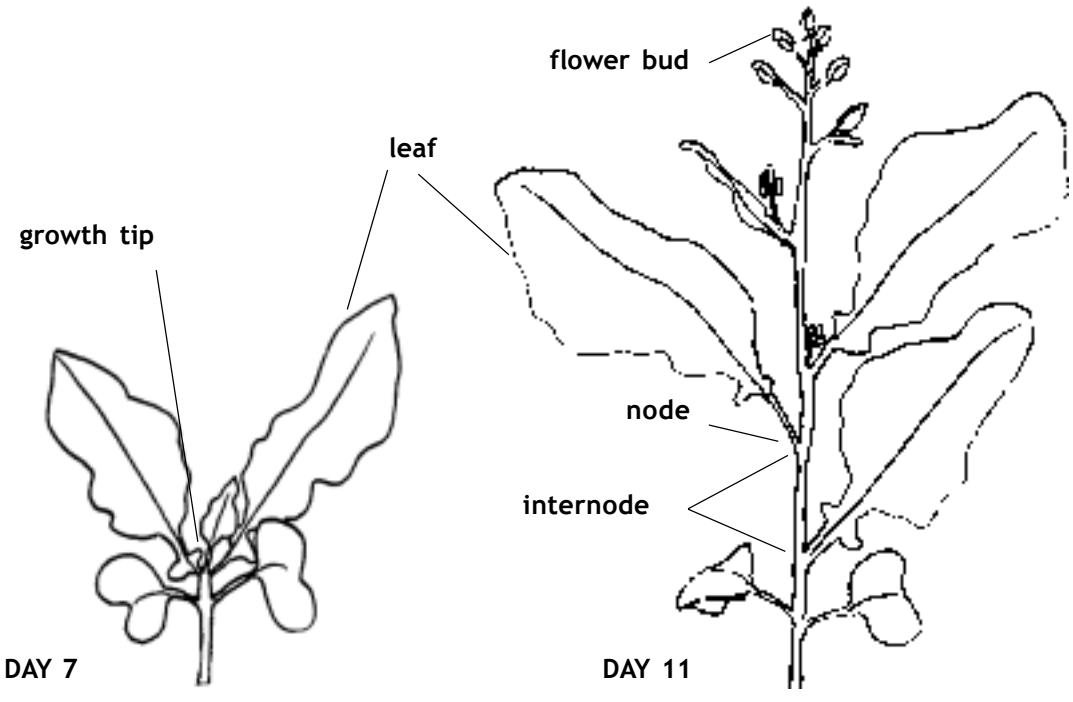
What's Happening?

Plants grow new parts, and the parts grow bigger. Above ground, new **stems, leaves,** and **flowers** originate at a point at the very top of the plant, called the **growth tip**. Each part emerges gradually, then grows larger — and the growth is measurable from day to day.

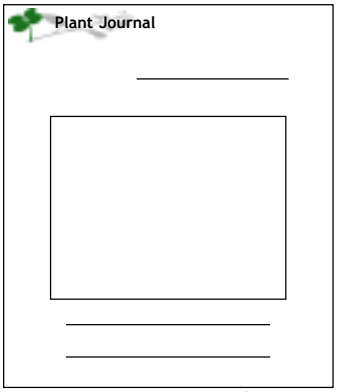
The **stem** elongates at the **internodes**, which is the space between the **nodes** (where the leaves attach). This allows the plant to grow taller and spread out the **leaves** and **flowers** so they are in the best position to do their jobs. Stems also allow food, water, and minerals to move throughout the plant.

Leaves contain many pores (called **stomata**) on their surfaces, which allow the plant to "breathe" by uptaking **carbon dioxide** (CO_2) from the air, and expelling oxygen. A green pigment, called **chlorophyll**, makes the leaves appear green and captures energy from light. When carbon dioxide and water are combined in the presence of light, *the plant makes its own food*, called carbohydrates (or sugar). This amazing process is called **photosynthesis**.

Where does the water come from? Under the soil, the **root** is growing downward. Roots anchor the plants into the soil so they don't blow or wash away. The **root hairs** absorb water and minerals from the surrounding soil and bring them to the rest of the plant. Most of the water is not used for photosynthesis, however; it is used to cool the plant down as it evaporates from the leaves.



Days 7 and 11
Activities and Investigations

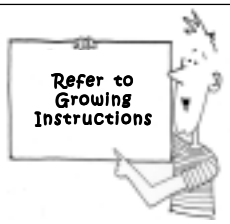


Plant Journals

- ☐ **Draw** and color your plant (K-4).
- ☐ **Measure** the height of your plant. Fill in the same number of boxes on the growth chart (K-4), or record the number (3-4).
- ☐ **Complete** the prompted sentences (K-4) and word bank matches (3-4).

Action

- ☐ **Check** the nutrient solution more often.
- ☐ **Lower** the plants frequently so the plants are always 10 cm below the light.



Some Discussion Ideas...

- Find the growth tip. What plant parts come from it?
- What will the flower buds become?
- Why are the plants using so much more water?

Extension

Experiment with the Environment!

What would happen if you stopped watering your plants? What if they were in the dark? What if you fed them salt water instead of fertilizer in the water?

As a class, **design** an experiment that will test one environmental factor (such as water vs. no water, light vs. dark, or salt vs. fertilizer). Then, **change** that factor for half the plants in the classroom for the rest of the life cycle. For comparison, keep growing the other half of the plants without any changes. **Predict** which set of plants will grow the most seeds...then wait and see!

Plants use a lot more water as they grow taller.

If your plants seem to be growing more slowly than expected, refer to the *Growing Instructions* for tips.

Days 13-18
Flowering, Pollination, and Fertilization

What's Happening?

The flowers bloom. At the **growth tip**, new flower buds begin to appear. Each bud is protected by four green **sepals**. Once a flower opens, the sepals are hidden beneath four bright yellow **petals**. The flower's center holds a single **pistil**, which is the female part of the flower. The pistil is surrounded by six yellow **stamens**, which are the male parts of the flower. Each stamen is covered with lots of powdery, yellow **pollen**.

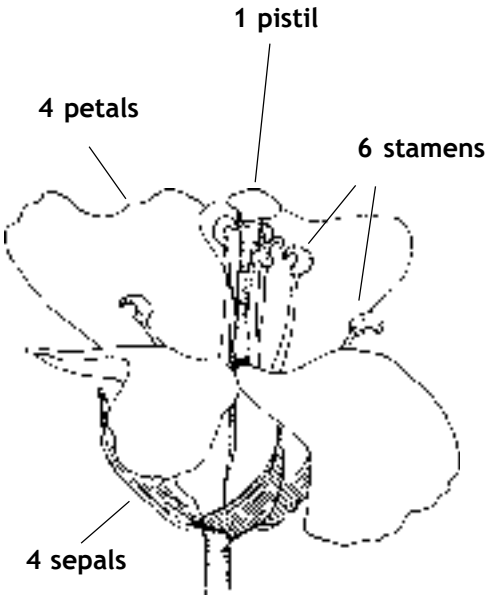
The bright yellow **petals** may catch your eye — and the eye of insects. The petals form a beacon that lets insects know that there is food available.

What food? Hidden deep inside the flowers are **nectaries**, which produce **nectar**. Nectar is a sweet, sugar-rich substance that insects *love* to eat. That's why bees and butterflies are attracted to flowers — they're hungry!

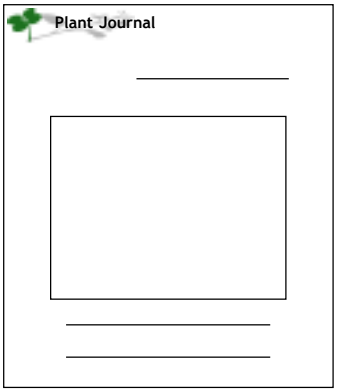
In exchange for food, insects **pollinate** flowers. When an insect moves from flower to flower looking for nectar, pollen from each flower gets caught in the insect's body hairs and is transferred to other flowers. After pollen has landed on the tip of another flower's pistil, it grows a tube down into the pistil, where the eggs are housed. Sperm (from inside the pollen) are then able move down the tube until they reach the eggs and fertilize them. The fertilized eggs then become new seeds.

DAY 15

Flower



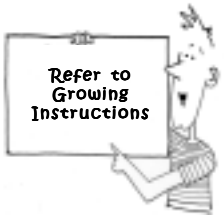
Days 15, 17, and 18
Activities and Investigations



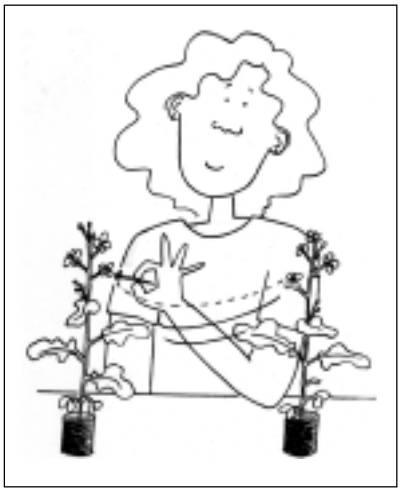
Plant Journals

- ☐ **Draw** and color your plant (K-4).
- ☐ **Measure** the height of your plant. Fill in the same number of boxes on the growth chart (K-5), or record the number (3-4).
- ☐ **Complete** the prompted sentences (K-4) and word bank matches (3-4).

Action



- ☐ When the flowers begin to open, **make** one beestick per group.
- ☐ **Days 15 and 17: Pollinate** the flowers each day. Make sure that each bee visits several plants — and picks up lots of dusty pollen — then comes back to the first plant so **every flower gets pollen from other plants each day**.
- ☐ **Day 18:** After the final pollination, **pinch** off the remaining unopened flower buds. **Do not pinch off any flowers that were pollinated!**



Some Discussion Ideas...

- If you were a bee, why would you want to land on a flower?
- If you were a flower, why would you want a bee to land on you?
- Name a flower that is important to you, and say why.

In order to produce seeds, each flower must receive pollen from a different plant. Pollen from a plant will not fertilize its own eggs. So make sure that your beestick visits lots of plants!

Extension

Flowers in Bloom!

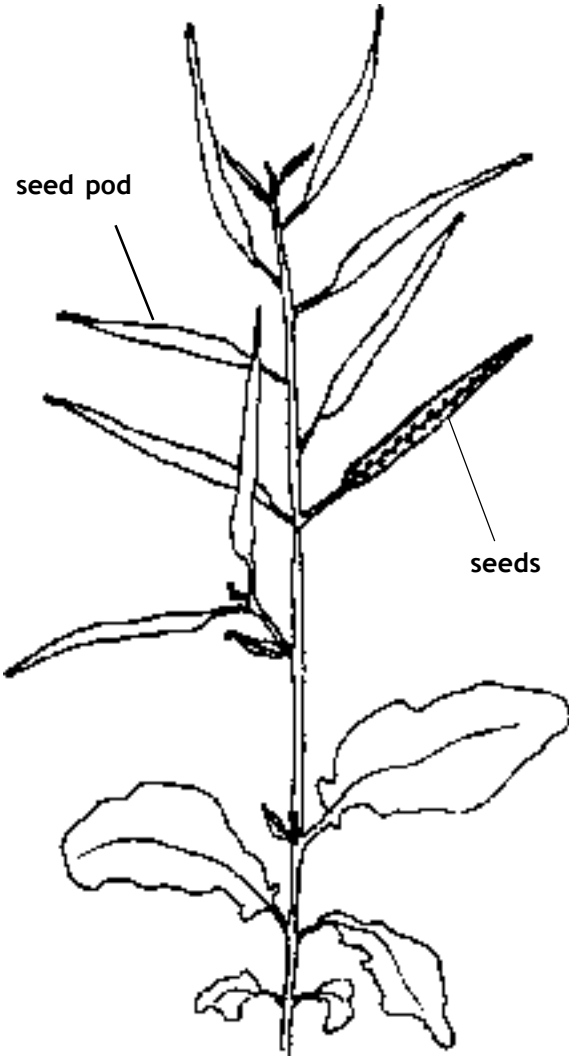
Observe a flower with a hand lens, then **draw** it on a new worksheet. Carefully **dissect** a flower with a tweezers and place each part on a strip of double-stick tape on your worksheet. When done, cover it with another piece of tape to protect it. **Identify** and **count** the parts.

What's Happening?

As the fertilized eggs grow into seeds, the outside of the pistil swells to become the **seed pod** (or **fruit**) that encases several seeds. The seed pod grows longer and fatter as the seeds ripen inside. Meanwhile, the leaves and flowers slowly wilt and fall off, one by one.

After the seeds have dried out completely, they are ready to be planted or stored. Inside each seed is a tiny **embryo**, waiting for water and warmth so it can germinate into a new plant, and another life cycle can begin.

Day 44

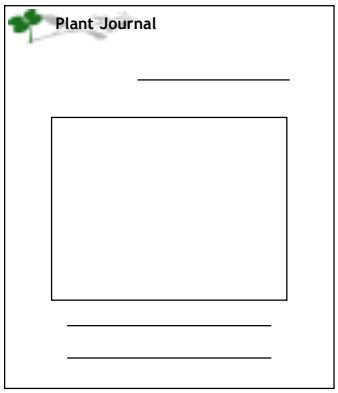


Who are the parents?

The plant where the seeds and pods grow is the mother plant. Each of the mother's eggs was fertilized by a pollen grain that came from a different plant — the father plant. The fertilized eggs develop into seeds, each of which may or may not have a different father.

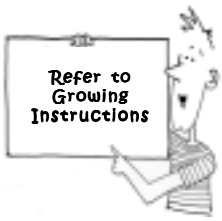
Days 25, 32, 37, and 44
Activities and Investigations

Plant Journals



- ☐ **Draw** and color your plant (K-4).
- ☐ **Measure** the height of your plant. Fill in the same number of boxes on the growth chart (K-4), or record the number (3-4).
- ☐ **Complete** the prompted sentences (K-4) and word bank matches (3-4).
- ☐ *Guess how many seeds did your plant produce?* Although it is can be emotional to see the plants die, the harvest brings to life a new generation of seeds... and **begin to the answer to the Seed Challenge!**

Action



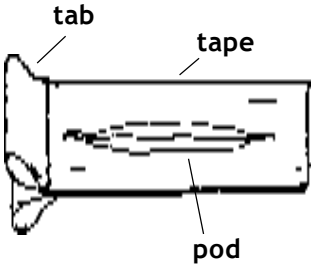
- ☐ **Days 25 and 32: Check** the nutrient solution.
- ☐ **Day 37: Stop** watering the plants 20 days after pinching off the flower buds.
- ☐ **Day 44:** One week after you stop watering, the plants will become brown and crispy. **Harvest** the seeds by gently cutting the seed pods off the plant. Carefully open the seed pods over a tray, or make a tape envelope (see below right).
- ☐ **Plant** the seeds or **store** them in a cool, dry place for another life cycle investigation!

Some Discussion Ideas...

- All the seeds harvested from one plant have the same mother. But who was the father? (Hint: Where did the pollen come from?)
- What can these seeds become?

Easy Activity: Tape Envelope

Place a seed pod between two pieces of clear tape. Fold back the ends to make two tabs. Crush the pods inside the tape envelope. Pull the tabs to open the envelope and collect the seeds.



Word Match

Directions
1. Cut the words out on the lines.
2. Match each word with its meaning.
3. Glue the words to your picture on the Plant Journal Pages.

seed	It has a baby plant inside that grows into a big plant.
seed leaves	The tiny leaves that come out of a seed.
stem	The part of a plant that holds the leaves and flowers.
leaf	The part of the plant that collects sunlight.
root	The underground part that absorbs water & minerals from soil.
growth tip	The top part of a plant where new leaves and flowers appear.
flower	The reproductive part of the plant that attracts bees and butterflies.

flower bud	An unopened flower.
pistil	The flower part that has the eggs.
stamens	The six flower parts that produce the pollen.
petals	The four flower parts that are yellow.
sepals	The four flower parts that are under the petals.
pollen	The yellow, powdery stuff on the stamens.
seed pod	It has seeds inside it.

Word Bank

Directions

Use the following phrases to complete the sentence on your *Plant Journal* pages:

"*Today, I _____ my plant.*"

removed the extra plants to make room for

harvested seeds from

watered

pollinated the flowers on

planted seeds of

stopped watering

pinched the buds off

fertilized

Seed Sponge Germination

Directions

1. Cut the pattern (Figure A) out of a thin household sponge.
2. Cut the seed leaves in half, lengthwise to form two seed leaves (Figure B).
3. Thoroughly wet the sponge and roll it into a ball, with the root inside the seed leaves.
4. Wrap it tightly with a piece of string and let it dry for a few days (Figure C).
5. Once dry, remove the string, and wrap the "seed" with one layer of tissue to simulate a seed coat. Secure the tissue with a tiny piece of tape.
6. Toss the "seed" into a large bowl of water, and watch it "germinate"!

Figure A

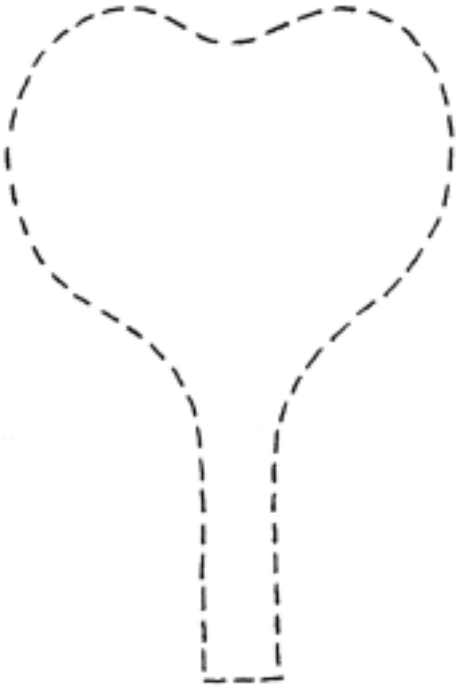


Figure B

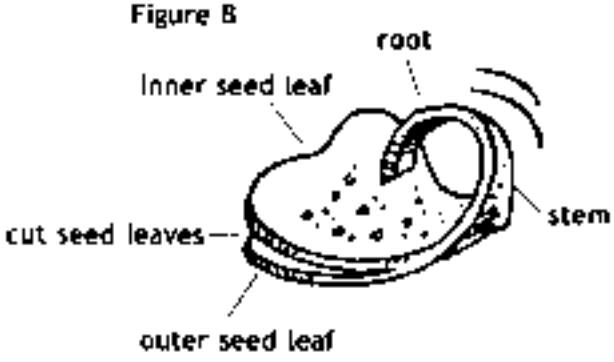
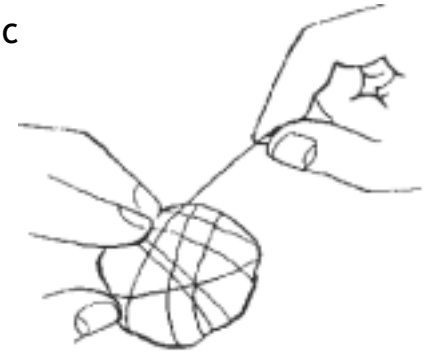


Figure C

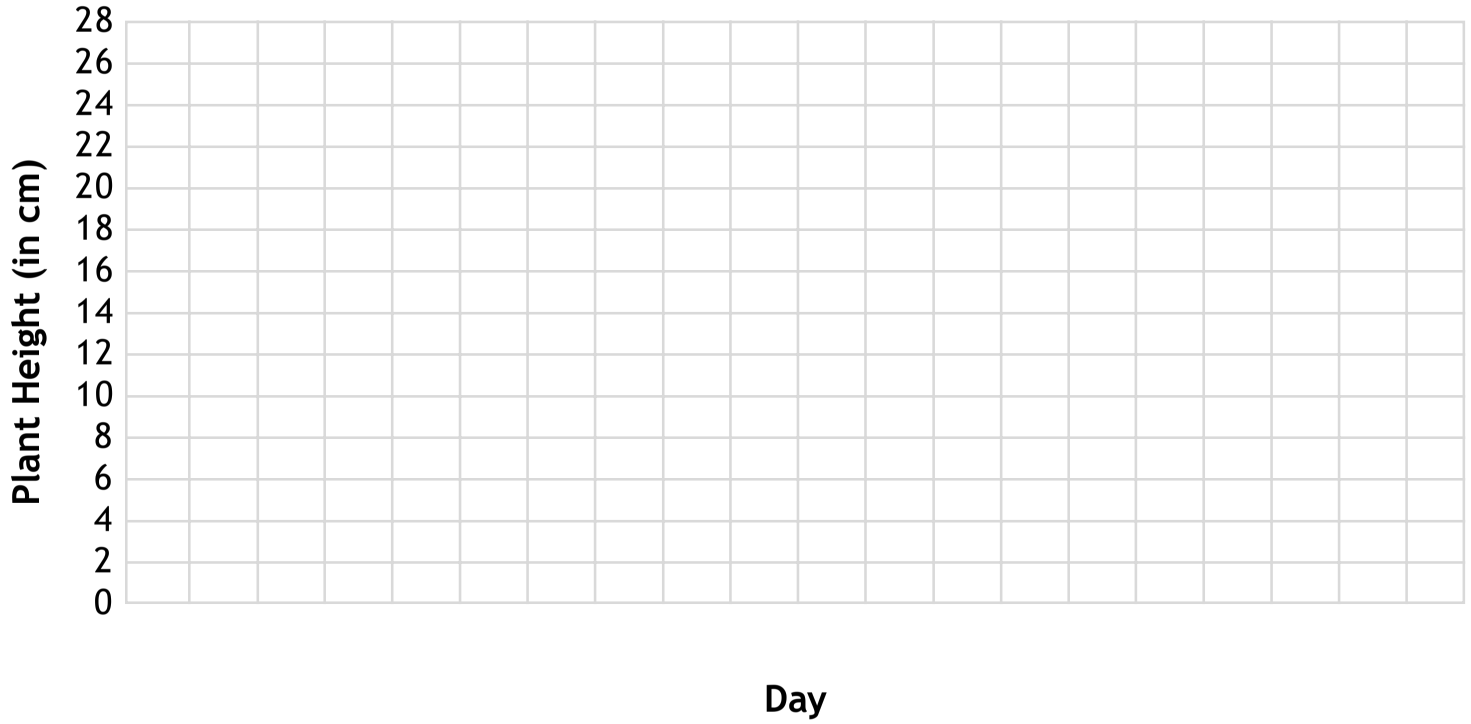


Life Cycle Graph

Planting Date (Day 0)

Name: _____

Graph Title: _____



Culminating Activities

1 Create a Life Cycle Log (Grades K-4)

Have students make a cover for their Life Cycle Log with a picture, poem, or drawing about their plants. Put all their *Plant Journal* pages in order with the cover on top, then punch them with a 3-hole punch. Tie them together with yarn or string. Do they remember how their plants grew? Share them with each other and talk about the differences and similarities.

2 Life Cycle Pictures

Cut & Color (Grades K-2)

Instead of drawing plants on their *Plant Journal* pages, have younger students cut and color pictures. Make one copy per student of the *Stages in the Life Cycle of Wisconsin Fast Plants™* pages and *Word Match* pages and cut them apart. Let students color the picture that looks most like their plant on each observation day, and choose the words that go with the picture. Have them paste the picture and words on their *Plant Journal* pages.

Sequence of Events (Grades 3-4)

Make one copy per student group of the *Stages in the Life Cycle of Wisconsin Fast Plants™* pages — but cover up the words. Have students cut out each picture, and place them in the order that they occur during the life cycle.

3 Graphing (Grades 3-4)

Make one copy per student of the *Life Cycle Graph*. Have students plot the height of their plants on each observation day, then connect the points. Do their graphs show a pattern? Try plotting other observations too, such as the number of leaves or flowers each day.

4 Word Match (Grades 3-4)

Make one copy per student group of the *Word Match* pages. Cut out the words and their definitions, then have students match them.

Glossary

Carbon dioxide .... A gas from the air that is used by plants for photosynthesis; also known as CO_2.
Chlorophyll..... Green pigment in plants; see *photosynthesis*.
Egg ..... Female gamete.
Embryo..... Young plant in a seed before germination.
Fertilization ..... Union of egg and pollen to produce a new embryo.
Flower ..... Reproductive part of a plant.
Flower bud..... Flower that has not yet opened.
Fruit ..... What the pistil becomes after fertilization; seed pod.
Germination ..... Beginning of growth by a seed.
Growth tip ..... Tip of the plant where new leaves, stems, and flower buds form.
Internode ..... Part of the stem between the nodes.
Leaf..... Green part of the plant that collects light and CO_2 for photosynthesis; green color comes from chlorophyll.
Nectar..... Sugar-rich food in flowers that insects and birds eat.
Nectary ..... Tiny structure found deep within a flower that produces nectar.
Node..... Where the leaves and flowers attach to the stem.
Petal..... Flower part that is usually colored yellow in WFP.
Photosynthesis .... The process of converting CO_2 and water (in the presence of light and chlorophyll) into carbohydrates (sugar) and oxygen (that we breathe).
Pistil..... Female reproductive part of a flower.
Pollen ..... Produced by stamens; contains the male gametes.
Pollinate ..... Transfer pollen from one flower to another.
Root..... Underground part of the plant that absorbs and conducts water and minerals; anchors the plant in soil.
Root hair..... Tiny outgrowths of the root that absorb water and minerals from the soil.
Seed ..... Part of a plant that will grow into a new plant under the right conditions.
Seed coat..... Outermost part of a seed.
Seed leaves ..... First :leaves" to germinate; also called **cotyledons**.
Seed pod ..... Contains the seeds.
Seedling ..... Young plant that grows from a seed.
Sepal ..... Green part of the flower that encloses the flower bud.
Stamen..... Male reproductive part of a flower.
Stem..... Aboveground part of the plant that bears the leaves and flowers.
Stomata ..... Pores in leaves that allow plants to uptake CO_2 and to expel oxygen and water.
Thin..... Remove extra plants.

Wisconsin Fast Plants™ Manuals and Resources

Exploring with Wisconsin Fast Plants™
Catalog Number: 15-8951

Exploring is an elementary/middle school teacher resource manual. This fully indexed version includes:

- A multitude of activities throughout the plant life cycle
- A bonus section on "Variation, Heredity, and Evolution"
- Objective statements about how the activities address the National Science Standards

Exploring is targeted to elementary grades, but its breadth and depth attracts high school teachers and college educators for pre-service training.

Bottle Biology
Catalog Number: 15-8959

Bottle Biology is designed for grades 2-12. Developed by the Wisconsin Fast Plants Program, this innovative book is a perfect companion to *Exploring*.

Bottle Biology is chock full of ideas for using plastic soda bottles and other recyclable materials to teach students about science and the environment. The low-cost projects promote science as a tool that anyone can use to explore the world. Each chapter contains background information, activities, teaching tips, and instructions.

Spiraling through Life with Fast Plants
Catalog Number: 15-8951A

Spiraling is an exciting, new, inquiry-based manual with over 25 explorations in germination, growth and development, flowering, pollination, fertilization, and embryo development. Geared for middle and high school, the activities can easily be adapted for K-6. The hand-drawn illustrations bring each topic to life.