

HOW PLANTS WORK EXHIBIT
PRE-VISIT ACTIVITIES

These pre-visit activities are designed to spark students' curiosity about topics and concepts they may encounter in the *How Plants Work* Exhibit, draw on their previous experiences, and reveal what they already know – or think they know – about plants. Many activities also prepare students to be keen observers.

Each activity leaves a door open for a post-visit wrap-up. In some cases, this includes updating charts, concept maps, or stories. By revisiting their earlier ideas and theories, and revising or extending them in light of new “ahas” from the exhibit, students should build a deeper understanding of concepts.

The following chart provides an overview of the Pre-Visit Activities. Please click on an activity link to gain access to the lesson plan.

ACTIVITY	OVERVIEW	TIME FRAME	BIG IDEAS	NATIONAL STANDARDS
<u>People/Plant Connections</u>	Students bring in items that reveal their thinking about people/plant connections.	1 class session	Introductory Lesson (Are Plants Important?)	NS.K-4.1 (SCIENCE AS INQUIRY) NS.5-8.1 (SCIENCE AS INQUIRY) NS.K-4.3 (LIFE SCIENCE) NS.K-4.6 (PERSONAL & SOCIAL PERSPECTIVES) NS.5-8.6 (PERSONAL & SOCIAL PERSPECTIVES) NSS-G.K-12.5 (ENVIRONMENT & SOCIETY)
<u>Private Investigator: Plants in Our Lives</u>	In a more advanced investigation, students search their homes and classrooms for evidence of people/plant connections.	2 class sessions	Introductory Lesson (Are Plants Important?)	NS.K-4.1 (SCIENCE AS INQUIRY) NS.5-8.1 (SCIENCE AS INQUIRY) NS.K-4.3 (LIFE SCIENCE) NS.K-4.6 (PERSONAL & SOCIAL PERSPECTIVES) NS.5-8.6 (PERSONAL & SOCIAL PERSPECTIVES) NSS-G.K-12.5 (ENVIRONMENT & SOCIETY)
<u>A Day in the Life...</u>	Students use a journaling activity to consider how the life of a plant differs from the life of a human being.	1-2 class session(s)	Are Plants Like Us?	NS.K-4.1 (SCIENCE AS INQUIRY) NS.5-8.1 (SCIENCE AS INQUIRY) NL-ENG.K-12.4 (COMMUNICATION SKILLS) NL-ENG.K-12.5 (COMMUNICATION STRATEGIES) NL-ENG.K-12.6 (APPLYING KNOWLEDGE)
<u>Picture This!</u>	A drawing challenge sparks students' thinking and illuminates what they know about plant structures and functions.	1 class session	A Puzzle of Plant Parts, Green Machine	NS.K-4.1 (SCIENCE AS INQUIRY) NS.5-8.1 (SCIENCE AS INQUIRY) NS.K-4.3 (LIFE SCIENCE) NS.5-8.3 (LIFE SCIENCE) NS.5-8.6 (PERSONAL & SOCIAL PERSPECTIVES) NA-VA.K-4.1 (UNDERSTANDING & APPLYING MEDIA, TECHNIQUES, & PROCESSES) NA-VA.5-8.1 (UNDERSTANDING & APPLYING MEDIA, TECHNIQUES, & PROCESSES)

				NA-VA.5-8.3 (CHOOSING & EVALUATING A RANGE OF SUBJECT MATTER, SYMBOLS, & IDEAS) NA-VA.K-4.6 (MAKING CONNECTIONS BETWEEN VISUAL ARTS & OTHER DISCIPLINES)
<u>Puzzling Out Plant Parts</u>	As students examine and compare a wide variety of plant parts, they consider what makes a fruit a fruit, a leaf a leaf, and so on, and what makes each one unique.	1 class session	A Puzzle of Plant Parts	NS.K-4.1 (SCIENCE AS INQUIRY) NS.5-8.1 (SCIENCE AS INQUIRY) NS.K-4.3 (LIFE SCIENCE) NS.5-8.3 (LIFE SCIENCE) NS.5-8.6 (PERSONAL & SOCIAL PERSPECTIVES)
<u>Fuel for Life</u>	Students share their ideas about how living things get energy for growth and survival.	1 class session	Green Machine	NS.K-4.1 (SCIENCE AS INQUIRY) NS.5-8.1 (SCIENCE AS INQUIRY) NS.K-4.3 (LIFE SCIENCE) NS.5-8.3 (LIFE SCIENCE) NS.5-8.6 (PERSONAL & SOCIAL PERSPECTIVES)
<u>Is it Easy Bein' Green?</u>	Students brainstorm challenges plants might face in meeting their needs, protecting themselves, and reproducing. Then they consider how these green organisms are built to "get by."	1 class session	Survival Against the Odds	NS.K-4.1 (SCIENCE AS INQUIRY) NS.5-8.1 (SCIENCE AS INQUIRY) NS.K-4.3 (LIFE SCIENCE) NS.5-8.3 (LIFE SCIENCE) NL-ENG.K-12.12 (APPLYING LANGUAGE SKILLS)
<u>Plant Parenthood</u>	Students create concept maps or stories to reveal their understanding of life cycles and plant reproduction.	1 or 2 class session(s)	Plant Multiplication	NS.K-4.1 (SCIENCE AS INQUIRY) NS.5-8.1 (SCIENCE AS INQUIRY) NS.K-4.3 (LIFE SCIENCE) NS.5-8.3 (LIFE SCIENCE) NL-ENG.K-12.5 (COMMUNICATION STRATEGIES) NL-ENG.K-12.6 (APPLYING KNOWLEDGE) NL-ENG.K-12.12 (APPLYING LANGUAGE SKILLS)
<u>Speaking of Flowers</u>	Students read quotes and poetry that feature flowers, and they consider what the writing reveals about why humans value them and what role they play in plants' lives.	1 class session	Plant Multiplication, A Puzzle of Plant Parts	NS.K-4.1 (SCIENCE AS INQUIRY) NS.5-8.1 (SCIENCE AS INQUIRY) NS.K-4.3 (LIFE SCIENCE) NS.5-8.3 (LIFE SCIENCE) NL-ENG.K-12.5 (COMMUNICATION STRATEGIES) NL-ENG.K-12.6 (APPLYING KNOWLEDGE) NL-ENG.K-12.12 (APPLYING LANGUAGE SKILLS)

PEOPLE/PLANT CONNECTIONS

This activity corresponds to the following Big Idea section(s):

Introductory Lesson (Are Plants Important?)

Overview

Students bring in items that reveal their thinking about people/plant connections.

Time Allotted

1 class session

Student Objectives

After completing this lesson, the student will be able to:

1. Prepare a chart of plant related items.
2. Analyze the role of plants in their everyday lives.

Materials

Markers

1 large sheet of paper (newsprint) for every few students

Items or Photos related to plants (See #2 below)

What to Do

1. Lay the groundwork by explaining that the class trip to the United States Botanic Garden is all about plants, how they work, and how they affect our lives. Ask, *how do you use plants? How are plants a part of your life?* Document students' responses and ask them to explain their thinking. Younger students are likely to mention plant foods they eat and things they look at (e.g., houseplants). Older students may suggest the oxygen plants provide or other plant-related products, such as paper. If necessary, you may want to share an example or two (e.g., students' pencils are made from wood that comes from trees.)

2. Direct students to bring in an item, photo (from a magazine, for instance), or drawing that reveals one way that people use plants. Discuss some examples to spark their thinking. You may want to bring in some extra items that students may not have considered (e.g., sugar, derived from the stems of the grass sugarcane; mint toothpaste; or a dollar bill, which is made from paper *and* features olive leaves, which represent peace).

3. Have students meet in small groups. Each student should share the item he or she brought in, have teammates guess the people/plant connection it reveals, and then explain his or her own thinking. For example, a student displaying a T-shirt might point out that we make fabric from the cotton plant.

4. Next, have each group rotate to the next group's table, observe and take notes about the items, and try to guess the people/plant connections each represents. Each time you give the signal, groups should rotate until the entire class has visited each group's display. (You may want to set up a special station with items you brought in.)



Real maple syrup comes from real maple trees!

Making Connections

5. Gather the class to discuss what they observed. Ask, *did any items surprise you? Why? Do you think any of the samples don't belong here? Why?* Give students who brought in items a chance to explain their thinking.
6. Post a piece of chart paper and have students suggest categories for the items (e.g., *plant foods, plants for beauty, clothing from plants*) and list items accordingly. Keep a list of things the class is unsure of and questions they have. Tell them they'll have a chance to learn more at the United States Botanic Garden's *How Plants Work* Exhibit. After their visit, students may revise and expand their list.

Digging Deeper

- ❖ You can extend this activity by having students interview family members, neighbors, other teachers, or peers to uncover what they know or believe about people/plant connections.
- ❖ Help students shift their thinking from how people rely on plants to how plants rely on people. Try creating a parallel list. Ask, *do you think plants need us as much as we need them?*
- ❖ *Plant Trivia Timeline*: Visit this online timeline, which begins in 8,000 B.C. and offers highlights of people/plant connections through history.

<http://www.huntington.org/BotanicalDiv/Timeline.html>

After Your Visit

Refer back to the Category Chart students created before their visit to the United States Botanic Garden. Ask, *what would you change? Why? What would you add? Why?* For further extension, have the students brainstorm items not derived from plants and how they could be re-designed to include a plant connection.

Complete the post-visit activity [Pitching Plants](#) or [Rewards of a Green Scene](#).

National Science Education Standards

- NS.K-4.1 – SCIENCE AS INQUIRY:
As a result of activities in grades K-4, all students should develop an understanding about scientific inquiry.
- NS.5-8.1 – SCIENCE AS INQUIRY:
As a result of activities in grades 5-8, all students should develop an understanding about scientific inquiry.
- NS.K-4.3 – LIFE SCIENCE:
As a result of activities in grades K-4, all students should develop an understanding of characteristics of organisms.
As a result of activities in grades K-4, all students should develop an understanding of lifecycles of organisms.
- NS.K-4.6 – PERSONAL AND SOCIAL PERSPECTIVES:
As a result of activities in grades K-4, all students should develop an understanding of types of resources.
- NS. 5-8.6 – PERSONAL AND SOCIAL PERSPECTIVES:
As a result of activities in grades 5-8, all students should develop an understanding of populations, resources, and environments.

National Geography Standards

- NSS-G.K-12.5 – ENVIRONMENT AND SOCIETY:

As a result of activities in grades K-12, all students should understand how human actions modify the physical environment.

As a result of activities in grades K-12, all students should understand the changes that occur in the meaning, use, distribution, and importance of resources.

PRIVATE INVESTIGATOR: PLANTS IN OUR LIVES

This activity corresponds to the following Big Idea section(s):

Introductory Lesson (Are Plants Important?)

Overview

In a more advanced investigation, students search their homes and classrooms for evidence of people/plant connections.

From our morning breakfast cereal to our cotton sheets, we're dependent on plants for much more than the life-sustaining food and oxygen they produce. Throughout history, plants have been the source of medicines, fibers, paper products, cosmetics, spices, building materials, fuels, and more. The many roles and depictions of plants in religion, folklore, celebrations, music, art, and poetry give us insight into the different meanings and symbolism plants have had for humans. With a resume like that, it's worth taking a closer look at how plants are woven into our lives. (A field of study called ethnobotany.)

Time Allotted

2 class sessions

Student Objectives

After completing this lesson, the student will be able to:

1. Create a list of plant related household items.
2. Analyze the role of plants in their everyday lives.
3. Create a plant-based product. (Digging Deeper activity)

Materials

How We Use Plants worksheet (1 per student with 1 enlarged version to compile student responses)

Writing utensils

House Plants PDF file (optional)

What to Do

1. Follow the link provided to preview the PDF file "House Plants" and decide if you want to share it with students once they've done their own detective work (optional).

<http://www.aspb.org/education/foundation/houseplants.pdf>

2. Invite the class to brainstorm examples of products we use that come (at least in part) from plants. Students will likely name items that plants produce and possibly mention oxygen. Challenge them to consider other categories. Did they mention building materials, personal care items (e.g., shampoo), fibers (clothing, rope), dyes, and miscellaneous items (e.g., rubber tires, paper, gum, toilet paper)? If not, you might spark their thinking by pointing out a few classroom items that fall into those categories and asking what, if any, plant connections they see.



Did you know that corn, which has been cultivated for food products for thousands of years, is also used in paints, plastics, soaps, and a host of other products?

3. Hand out copies of the How We Use Plants worksheet and ask students to become private investigators who continue the search at home for evidence of plants in household items and products. Together, discuss some examples of what students might list in the second worksheet column: *What I Know about the Plant Connection*. For instance, *The trunks of trees are ground up to make paper*. In addition to documenting their discoveries on paper, students might bring in actual items, including some of the more unusual ones they find.

Making Connections

4. Back in class, have students work in small groups to share their discoveries and, if necessary, explain their choices. Ask each group to try to categorize the items as they see fit and then report their findings to the class. Ask, *what do you notice about our combined lists? Do any items surprise you? Consider focusing on specific items and asking, what characteristics of the plant make it useful in this product?* Consider these examples:

- The juicy gel inside aloe leaves that stores water and nutrients for the plant also soothes and moisturizes skin and enhances superficial wound healing.
- Many modern medicines, such as digitalis (from foxgloves) and witch hazel, were derived from or created to simulate compounds produced by plants as protection against wind, sun damage, and herbivores.
- The cellulose fibers in tree trunks lend strength to paper.

Routinely ask students how they know what they know or what their evidence is; this is vital to being a good scientist! Keep a running list of questions students have and use them to spark further research.

Digging Deeper

- ❖ Invite the class to research and then try to create an important plant-based product. Here are some ideas with links to how-to information:

Make and use dyes from homegrown and collected plants:

[Dyeing to Find Out: Extracting Nature's Colors](#)

<http://www.kidsgardening.com/growingideas/projects/may03/pg1.html>

Make paper:

Making Paper: Experience the Fiber of Learning

<http://www.kidsgardening.com/growingideas/projects/nov02/pg1.html>

Make potpourri, salve, or other herbal products:

Turning Kids on to Herbs

<http://www.kidsgardening.com/Dig/DigDetail.taf?ID=1683&Type=Art>

Keep a running list of plant-related words and phrases we routinely use (e.g. *a family's roots; she's blossoming; he's cool as a cucumber*). Have students think about what these phrases reveal about the structure and jobs of plant parts or about how we value them. Challenge students to create their own plant analogies, similes, or metaphors.

- ❖ Interview parents, grandparents, and community seniors about the following: recollections of plant and/or food folklore; plant use in celebrations and/or religious purposes; medicinal use of plants; etc.
- ❖ My Dad, the Ethnobotanist: Have your students read and discuss this interview done by a 10-year-old girl; her father studies how people in the Amazon use plants for healing and more!

<http://www.units.muohio.edu/dragonfly/plants/plotkin.htmlx>

After Your Visit

Complete the post-visit activity Pitching Plants or Rewards of a Green Scene.

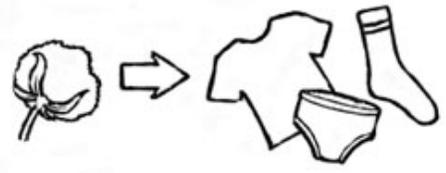
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HOW WE USE PLANTS



Name _____

Product that comes from plants	What I know about the plant connection	Questions I have

A DAY IN THE LIFE...

This activity corresponds to the following Big Idea section(s):

Are Plants Like Us?

Overview

Students use a journaling activity to consider how the life of a plant differs from the life of a human being.

Time Allotted

1-2 class session(s)

Student Objectives

After completing this lesson, the student will be able to:

1. Compare and contrast human and plant activity.
2. List the adaptations humans and plants make to their environments.

Materials

Paper (or Journal)

Writing Utensil

A copy of the fairy tale, Jack and the Beanstalk (The version where Jack plants the seeds and tends to them, not the version where he throws the seeds away and they grow un-attended – example attached)

Chart paper (or transparency sheet)

What to Do

1. Start the lesson by reading the story, Jack and the Beanstalk.
2. After reading the story, discuss the beanstalk. Ask, *how did the beanstalk get to be so big? How did Jack take care of it? Could it survive on its own? Do you think a new beanstalk will grow in its place?*
3. Prompt students to write two journal entries [*another option could be for students to write 2 separate blog entries]. Both entries will be titled “A Day in the Life...” The first entry will be told from Jack’s point of view on the day he first notices the giant Beanstalk. The second entry will be told from the Beanstalk’s point of view on that same day. Both journal entries should be detailed accounts of both Jack and the Beanstalk’s daily activities. If necessary, ask, *what do Jack and the Beanstalk do for food? Do Jack and the Beanstalk go anywhere during the day? What was the weather like on that day? What if it was windy or snowy? Do Jack and the Beanstalk see any friends or family? Etc.*

Making Connections

4. Invite students to share their journal entries. Have them compare Jack’s daily activities to the daily activities of the Beanstalk. Ask, *what activities do they share? What activities are different?* Write student responses on chart paper.
5. Have students brainstorm a chart listing their daily activities and the activities of a plant inside or outside the classroom. Would their chart look the same as the one created for Jack and the Beanstalk? Ask, *what can plants do that humans cannot?* Record student responses.
6. Tell students they will have a chance to investigate their thoughts about the life of a plant while visiting the *How Plants Work* Exhibit at the United States Botanic Garden.

Digging Deeper

- ❖ Have students choose a plant in a nearby garden or outdoor area. Have them observe the plant for several weeks, keeping a journal from the perspective of the plant. Students should note changes they can see to measure (e.g. height, width) as well as changes they must infer. Have students share their observations and predict what will happen to the plant in the future.
- ❖ *Plant Trivia Timeline*: Visit this online timeline, which begins in 8,000 B.C. and offers highlights of people/plant connections through history.
<http://www.huntington.org/BotanicalDiv/Timeline.html>

After Your Visit

Refer back to the Beanstalk and plant journal entries students created before their visit to the United States Botanic Garden. Ask, *what would you change? Why? What would you add? Why?*

Complete the post-visit activity [Invent a Plant](#) or [Catch Them in the Act! How Neighborhood Plants Get By](#).

National Science Education Standards

- NS.K-4.3 – LIFE SCIENCE:
As a result of activities in grades K-4, all students should develop an understanding of characteristics of organisms.
As a result of activities in grades K-4, all students should develop an understanding of lifecycles of organisms.
- NS.5-8.3 – LIFE SCIENCE:
As a result of activities in grades 5-8, all students should develop an understanding of structure and function in living systems.
As a result of activities in grades K-4, all students should develop an understanding of diversity and adaptations of organisms.

Standards for the English Language Arts

- NL-ENG.K-12.4 – COMMUNICATION SKILLS
Students adjust their use of spoken, written, and visual language (e.g., conventions, style, vocabulary) to communicate effectively with a variety of audiences and for different purposes.
- NL-ENG.K-12.5 – COMMUNICATION STRATEGIES
Students employ a wide range of strategies as they write and use different writing process elements appropriately to communicate with different audiences for a variety of purposes.
- NL-ENG.K-12.6 – APPLYING KNOWLEDGE
Students apply knowledge of language structure, language conventions (e.g. spelling and punctuation), media techniques, figurative language, and genre to create, critique, and discuss print and non-print texts.

Jack and the Beanstalk

As told by Andrew Lang

Jack Sells the Cow

Once upon a time there was a poor widow who lived in a little cottage with her only son Jack. Jack was a giddy, thoughtless boy, but very kind hearted and affectionate. There had been a hard winter, and after it the poor woman had suffered from fever and ague. Jack did no work as yet, and by degrees they grew dreadfully poor.

The widow saw that there was no means of keeping Jack and herself from starvation but by selling her cow; so one morning she said to her son, "I am too weak to go myself, Jack, so you must take the cow to market for me, and sell her."

Jack liked going to market to sell the cow very much; but as he was on the way, he met a butcher who had some beautiful beans in his hand. Jack stopped to look at them, and the butcher told the boy that they were of great value and persuaded the silly lad to sell the cow for these beans.

When he brought them home to his mother instead of the money she expected for her nice cow, she was very vexed and shed many tears, scolding Jack for his folly. He was very sorry, and mother and son went to bed very sadly that night; their last hope seemed gone.

At daybreak Jack rose and went out into the garden. "At least," he thought, "I will sow the wonderful beans. Mother says that they are just common scarlet runners, and nothing else; but I may as well sow them." So he took a piece of stick, and made some holes in the ground, and put in the beans.

That day they had very little dinner, and went sadly to bed, knowing that for the next day there would be none, and Jack, unable to sleep from grief and vexation, got up at day-dawn and went out into the garden.

What was his amazement to find that the beans had grown up in the night, and climbed up and up until they covered the high cliff that sheltered the cottage and disappeared above it! The stalks had twined and twisted themselves together until they formed quite a ladder.

"It would be easy to climb it," thought Jack. And, having thought of the experiment, he at once resolved to carry it out, for Jack was a good climber. However, after his late mistake about the cow, he thought he had better consult his mother first.

Wonderful Growth of the Beanstalk

So Jack called his mother, and they both gazed in silent wonder at the beanstalk, which was not only of great height, but was thick enough to bear Jack's weight. "I wonder where it ends," said Jack to his mother. "I think I will climb up and see."

His mother wished him not to venture up this strange ladder, but Jack coaxed her to give her consent to the attempt, for he was certain there must be something wonderful in the beanstalk; so at last she yielded to his wishes.

Jack instantly began to climb, and went up and up on the ladder-like beanstalk until everything he had left behind him -- the cottage, the village, and even the tall church tower -- looked quite little, and still he could not see the top of the beanstalk.

Jack felt a little tired, and thought for a moment that he would go back again; but he was a very persevering boy, and he knew that the way to succeed in anything is not to give up. So after resting for a moment he went on. After climbing higher and higher, until he grew afraid to look down for fear he should be giddy, Jack at last reached the top of the beanstalk, and found himself in a beautiful country, finely wooded, with beautiful meadows covered with sheep. A crystal stream ran through the pastures; not far from the place where he had got off the beanstalk stood a fine, strong castle.

Jack wondered very much that he had never heard of or seen this castle before; but when he reflected on the subject, he saw that it was as much separated from the village by the perpendicular rock on which it stood as if it were in another land.

While Jack was standing looking at the castle, a very strange looking woman came out of the wood, and advanced towards him. She wore a pointed cap of quilted red satin turned up with ermine. Her hair streamed loose over her shoulders, and she walked with a staff. Jack took off his cap and made her a bow.

"If you please, ma'am," said he, "is this your house?"

"No," said the old lady. "Listen, and I will tell you the story of that castle:"

Once upon a time there was a noble knight, who lived in this castle, which is on the borders of fairyland. He had a fair and beloved wife and several lovely children; and as his neighbors, the little people, were very friendly towards him, they bestowed on him many excellent and precious gifts.

Rumor whispered of these treasures; and a monstrous giant, who lived at no great distance, and who was a very wicked being, resolved to obtain possession of them.

So he bribed a false servant to let him inside the castle, when the knight was in bed and asleep, and he killed him as he lay. Then he went to the part of the castle which was the nursery, and also killed all the poor little ones he found there.

Happily for her, the lady was not to be found. She had gone with her infant son, who was only two or three months old, to visit her old nurse, who lived in the valley; and she had been detained all night there by a storm.

The next morning, as soon as it was light, one of the servants at the castle, who had managed to escape, came to tell the poor lady of the sad fate of her husband and her pretty babes. She could scarcely believe him at first, and was eager at once to go back and share the fate of her dear ones. But the old nurse, with many tears, besought her to remember that she had still a child, and that it was her duty to preserve her life for the sake of the poor innocent.

The lady yielded to this reasoning, and consented to remain at her nurse's house as the best place of concealment; for the servant told her that the giant had vowed, if he could find her, he would kill both her and her baby.

Years rolled on. The old nurse died, leaving her cottage and the few articles of furniture it contained to her poor lady, who dwelt in it, working as a peasant for her daily bread. Her spinning wheel and the milk of a cow, which she had purchased with the little money she had with her, sufficed for the scanty subsistence of herself and her little son. There was a nice little garden attached to the cottage, in which they cultivated peas, beans, and cabbages, and the lady was not ashamed to go out at harvest time, and glean in the fields to supply her little son's wants.

Jack, that poor lady is your mother. This castle was once your father's, and must again be yours.

Jack uttered a cry of surprise. "My mother! Oh, madam, what ought I to do? My poor father! My dear mother!"

"Your duty requires you to win it back for your mother. But the task is a very difficult one, and full of peril, Jack. Have you courage to undertake it?"

"I fear nothing when I am doing right," said Jack.

"Then," said the lady in the red cap, "you are one of those who slay giants. You must get into the castle,

and if possible possess yourself of a hen that lays golden eggs, and a harp that talks. Remember, all the giant possesses is really yours."

As she ceased speaking, the lady of the red hat suddenly disappeared, and of course Jack knew she was a fairy.

Jack determined at once to attempt the adventure; so he advanced, and blew the horn which hung at the castle portal. The door was opened in a minute or two by a frightful giantess, with one great eye in the middle of her forehead. As soon as Jack saw her he turned to run away, but she caught him, and dragged him into the castle.

"Ho, ho!" she laughed terribly. "You didn't expect to see *me* here, that is clear! No, I shan't let you go again. I am weary of my life. I am so overworked, and I don't see why I should not have a page as well as other ladies. And you shall be my boy. You shall clean the knives, and black the boots, and make the fires, and help me generally when the giant is out. When he is at home I must hide you, for he has eaten up all my pages hitherto, and you would be a dainty morsel, my little lad."

While she spoke she dragged Jack right into the castle. The poor boy was very much frightened; as I am sure you and I would have been in his place. But he remembered that fear disgraces a man, so he struggled to be brave and make the best of things.

"I am quite ready to help you, and do all I can to serve you, madam," he said, "only I beg you will be good enough to hide me from your husband, for I should not like to be eaten at all."

"That's a good boy," said the giantess, nodding her head; "it is lucky for you that you did not scream out when you saw me, as the other boys who have been here did, for if you had done so my husband would have awakened and have eaten you, as he did them, for breakfast. Come here, child; go into my wardrobe. He never ventures to open *that*. You will be safe there."

And she opened a huge wardrobe which stood in the great hall, and shut him into it. But the keyhole was so large that it admitted plenty of air, and he could see everything that took place through it. By and by he heard a heavy tramp on the stairs, like the lumbering along of a great cannon, and then a voice like thunder cried out.

*Fe, fa, fi-fo-fum,
I smell the breath of an Englishman.
Let him be alive or let him be dead,
I'll grind his bones to make my bread.*

"Wife," cried the giant, "there is a man in the castle. Let me have him for breakfast."

"You are grown old and stupid," cried the lady in her loud tones. "It is only a nice fresh steak off an elephant that I have cooked for you which you smell. There, sit down and make a good breakfast."

And she placed a huge dish before him of savory steaming meat, which greatly pleased him and made him forget his idea of an Englishman being in the castle. When he had breakfasted he went out for a walk; and then the giantess opened the door, and made Jack come out to help her. He helped her all day. She fed him well, and when evening came put him back in the wardrobe.

The Hen That Lays Golden Eggs

The giant came in to supper. Jack watched him through the keyhole, and was amazed to see him pick a wolf's bone and put half a fowl at a time into his capacious mouth.

When the supper was ended he bade his wife bring him his hen that laid the golden eggs.

"It lays as well as it did when it belonged to that paltry knight," he said. "Indeed, I think the eggs are heavier than ever."

The giantess went away, and soon returned with a little brown hen, which she placed on the table before her husband.

"And now, my dear," she said, "I am going for a walk, if you don't want me any longer."

"Go," said the giant. "I shall be glad to have a nap by and by."

Then he took up the brown hen and said to her, "Lay!" And she instantly laid a golden egg.

"Lay!" said the giant again. And she laid another.

"Lay!" he repeated the third time. And again a golden egg lay on the table.

Now Jack was sure this hen was that of which the fairy had spoken.

By and by the giant put the hen down on the floor, and soon after went fast asleep, snoring so loud that it sounded like thunder.

Directly Jack perceived that the giant was fast asleep, he pushed open the door of the wardrobe and crept out. Very softly he stole across the room, and, picking up the hen, made haste to quit the apartment. He knew the way to the kitchen, the door of which he found was left ajar. He opened it, shut and locked it after him, and flew back to the beanstalk, which he descended as fast as his feet would move.

When his mother saw him enter the house she wept for joy, for she had feared that the fairies had carried him away, or that the giant had found him. But Jack put the brown hen down before her, and told her how he had been in the giant's castle, and all his adventures. She was very glad to see the hen, which would make them rich once more.

The Money Bags

Jack made another journey up the beanstalk to the giant's castle one day while his mother had gone to market. But first he dyed his hair and disguised himself. The old woman did not know him again and dragged him in as she had done before to help her to do the work; but she heard her husband coming, and hid him in the wardrobe, not thinking that it was the same boy who had stolen the hen. She bade him stay quite still there, or the giant would eat him.

Then the giant came in saying:

*Fe, fa, fi-fo-fum,
I smell the breath of an Englishman.
Let him be alive or let him be dead,
I'll grind his bones to make my bread.*

"Nonsense!" said the wife, "it is only a roasted bullock that I thought would be a tit-bit for your supper; sit down and I will bring it up at once."

The giant sat down, and soon his wife brought up a roasted bullock on a large dish, and they began their supper. Jack was amazed to see them pick the bones of the bullock as if it had been a lark.

As soon as they had finished their meal, the giantess rose and said, "Now, my dear, with your leave I am going up to my room to finish the story I am reading. If you want me call for me."

"First," answered the giant, "bring me my money bags, that I may count my golden pieces before I sleep."

The giantess obeyed. She went and soon returned with two large bags over her shoulders, which she put down by her husband.

"There," she said; "that is all that is left of the knight's money. When you have spent it you must go and take another baron's castle."

"That he shan't, if I can help it," thought Jack.

The giant, when his wife was gone, took out heaps and heaps of golden pieces, and counted them, and put them in piles, until he was tired of the amusement. Then he swept them all back into their bags, and leaning back in his chair fell fast asleep, snoring so loud that no other sound was audible.

Jack stole softly out of the wardrobe, and taking up the bags of money (which were his very own, because the giant had stolen them from his father), he ran off, and with great difficulty descending the beanstalk, laid the bags of gold on his mother's table. She had just returned from town, and was crying at not finding Jack.

"There, mother, I have brought you the gold that my father lost."

"Oh, Jack! You are a very good boy, but I wish you would not risk your precious life in the giant's castle. Tell me how you came to go there again." And Jack told her all about it.

Jack's mother was very glad to get the money, but she did not like him to run any risk for her. But after a time Jack made up his mind to go again to the giant's castle.

So he climbed the beanstalk once more, and blew the horn at the giant's gate. The giantess soon opened the door. She was very stupid, and did not know him again, but she stopped a minute before she took him in. She feared another robbery; but Jack's fresh face looked so innocent that she could not resist him, and so she bade him come in, and again hid him away in the wardrobe.

By and by the giant came home, and as soon as he had crossed the threshold he roared out:

*Fe, fa, fi-fo-fum,
I smell the breath of an Englishman.
Let him be alive or let him be dead,
I'll grind his bones to make my bread.*

"You stupid old giant," said his wife, "you only smell a nice sheep, which I have grilled for your dinner."

And the giant sat down, and his wife brought up a whole sheep for his dinner. When he had eaten it all up, he said, "Now bring me my harp, and I will have a little music while you take your walk."

The giantess obeyed, and returned with a beautiful harp. The framework was all sparkling with diamonds and rubies, and the strings were all of gold.

"This is one of the nicest things I took from the knight," said the giant. "I am very fond of music, and my harp is a faithful servant."

So he drew the harp towards him, and said, "Play!" And the harp played a very soft, sad air.

"Play something merrier!" said the giant. And the harp played a merry tune.

"Now play me a lullaby," roared the giant, and the harp played a sweet lullaby, to the sound of which its master fell asleep.

Then Jack stole softly out of the wardrobe, and went into the huge kitchen to see if the giantess had gone out. He found no one there, so he went to the door and opened it softly, for he thought he could not do so with the harp in his hand.

Then he entered the giant's room and seized the harp and ran away with it; but as he jumped over the

threshold the harp called out, "Master! Master!" And the giant woke up. With a tremendous roar he sprang from his seat, and in two strides had reached the door.

But Jack was very nimble. He fled like lightning with the harp, talking to it as he went (for he saw it was a fairy), and telling it he was the son of its old master, the knight.

Still the giant came on so fast that he was quite close to poor Jack, and had stretched out his great hand to catch him. But, luckily, just at the moment he stepped upon a loose stone, stumbled, and fell flat on the ground, where he lay at his full length.

This accident gave Jack time to get on the beanstalk and hasten down it; but just as he reached their own garden he beheld the giant descending after him.

"Mother! mother!" cried Jack, "make haste and give me the ax."

His mother ran to him with a hatchet in her hand, and Jack with one tremendous blow cut through all the stems except one.

"Now, mother, stand out of the way!" said he. Jack's mother shrank back, and it was well she did so, for just as the giant took hold of the last branch of the beanstalk, Jack cut the stem quite through and darted from the spot.

Down came the giant with a terrible crash, and as he fell on his head, he broke his neck, and lay dead at the feet of the woman he had so much injured.

Before Jack and his mother had recovered from their alarm and agitation, a beautiful lady stood before them.

"Jack," said she, "you have acted like a brave knight's son, and deserve to have your inheritance restored to you. Dig a grave and bury the giant, and then go and kill the giantess."

"But," said Jack, "I could not kill anyone unless I was fighting with him; and I could not draw my sword upon a woman. Moreover, the giantess was very kind to me."

The fairy smiled on Jack. "I am very much pleased with your generous feeling," she said. "Nevertheless, return to the castle, and act as you will find needful."

Jack asked the fairy if she would show him the way to the castle, as the beanstalk was now down. She told him that she would drive him there in her chariot, which was drawn by two peacocks. Jack thanked her, and sat down in the chariot with her. The fairy drove him a long distance round, until they reached a village which lay at the bottom of the hill. Here they found a number of miserable-looking men assembled. The fairy stopped her carriage and addressed them.

"My friends," said she, "the cruel giant who oppressed you and ate up all your flocks and herds is dead, and this young gentleman was the means of your being delivered from him, and is the son of your kind old master, the knight."

The men gave a loud cheer at these words, and pressed forward to say that they would serve Jack as faithfully as they had served his father. The fairy bade them follow her to the castle, and they marched thither in a body, and Jack blew the horn and demanded admittance.

The old giantess saw them coming from the turret loop hole. She was very much frightened, for she guessed that something had happened to her husband; and as she came downstairs very fast she caught her foot in her dress, and fell from the top to the bottom and broke her neck.

When the people outside found that the door was not opened to them, they took crowbars and forced the portal. Nobody was to be seen, but on leaving the hall they found the body of the giantess at the foot of

the stairs.

Thus Jack took possession of the castle. The fairy went and brought his mother to him, with the hen and the harp. He had the giantess buried, and endeavored as much as lay in his power to do right to those whom the giant had robbed. Before her departure for fairyland, the fairy explained to Jack that she had sent the butcher to meet him with the beans, in order to try what sort of lad he was.

"If you had looked at the gigantic beanstalk and only stupidly wondered about it," she said, "I should have left you where misfortune had placed you, only restoring her cow to your mother. But you showed an inquiring mind, and great courage and enterprise, therefore you deserve to rise; and when you mounted the beanstalk you climbed the Ladder of Fortune."

She then took her leave of Jack and his mother.

- Source: Andrew Lang, *The Red Fairy Book* (London: Longmans, Green, and Company, 1890), pp. 133-145.
- Retrieved on 3/10/08 from <http://www.pitt.edu/~dash/type0328jack.html>

PICTURE THIS!

This activity corresponds to the following Big Idea section(s):

A Puzzle of Plant Parts, Green Machine

Overview

A drawing challenge sparks students' thinking and illuminates what they know about plant structures and functions.

Time Allotted

1 class session

Student Objectives

After completing this lesson, the student will be able to:

1. Draw a plant both above and below soil.
2. Label structures and functions associated with their plant drawings.
3. Compare and contrast their work with other students.
4. Compose a list of questions for further inquiry.

Materials

Drawing paper for each student

Larger construction or chart paper

Markers (or other drawing materials)

"Sticky notes" (or cutout paper shapes & glue)

What to Do

1. To get students thinking about plants, and to prepare them for a trip to the United States Botanic Garden, do one of the following:

- Take a walk on school grounds, having students pay particular attention to the plant world around them.
- Show students pictures of plants from various locations around the world. Have each student discuss his or her favorite.
- Take a virtual tour of a garden or flower shop. Try the [Flower Forest, Barbados](http://www.barbados.org/sightseeing/flowerforest/photogallery.htm) web site for some beautiful photos of tropical flowers.
<http://www.barbados.org/sightseeing/flowerforest/photogallery.htm>
- Read the story [Jack's Garden](#) by Henry Cole (for less advanced students) or an excerpt from [The Secret Garden](#) by Frances Hodgson Burnett (for more advanced students). (See [Suggested Reading List](#) link on the USBG website for book information)

2. Tell students to close their eyes and envision being in a garden, on a walk in the neighborhood, or in another place where plants grow. They should imagine a plant they see and "look" carefully at it and all its parts. Tell them to imagine each part of the plant, including the roots beneath the soil.

3. With eyes open, students should draw their plants from memory and then glue their portrayals onto pieces of larger construction paper. Challenge them to write what they know about the role of each plant part on cutout paper shapes or sticky notes, glue them on the paper, and draw arrows from their drawing

to the descriptions. Prompt students with questions like these: *What is it? What does it do for the plant? How is it connected to other parts? How does it help us?* You might also ask students to note whether and how a particular part might look and “act” differently on different plants.

4. At the bottom of the page, ask students to write a list titled *Questions I Have About Plant Parts*.

Making Connections

4. Hang the posters around the room and give students time to view them. Ask, *what did you notice as you compared the posters? Focus on each plant part in turn and ask, which statements about this plant part did you agree with? Which did you disagree with or do you have questions about? How would you summarize our ideas about its “job”?*

5. Compile students’ plant questions as a reference while visiting the United States Botanic Garden’s *How Plants Work* Exhibit.

Digging Deeper

❖ Challenge students to create similes for different plant parts using this pattern: A _____ is like a _____. (e.g. “A stem is like a straw”) Give them a chance to enrich or revise these similes after their visit to the United States Botanic Garden!

After Your Visit

Once your students have explored the United States Botanic Garden’s *How Plants Work* Exhibit and they are back in class, ask them to revise their posters or create new ones that incorporate their new understanding.

Complete the post-visit activity [Plant Parts Feast](#), [Invent a Plant](#), or [Growing Tips](#).

National Science Education Standards

- NS.K-4.1 – SCIENCE AS INQUIRY:
As a result of activities in grades K-4, all students should develop an understanding about scientific inquiry.
- NS.5-8.1 – SCIENCE AS INQUIRY:
As a result of activities in grades 5-8, all students should develop an understanding about scientific inquiry.
- NS.K-4.3 – LIFE SCIENCE:
As a result of activities in grades K-4, all students should develop an understanding of characteristics of organisms.
As a result of activities in grades K-4, all students should develop an understanding of lifecycles of organisms.
As a result of activities in grades K-4, all students should develop an understanding of organisms and environments.
- NS.5-8.3 – LIFE SCIENCE:
As a result of activities in grades 5-8, all students should develop an understanding of structure and function in living systems.
As a result of activities in grades 5-8, all students should develop an understanding of diversity and adaptations of organisms.
- NS. 5-8.6 – PERSONAL AND SOCIAL PERSPECTIVES:
As a result of activities in grades 5-8, all students should develop an understanding of populations, resources, and environments.

National Standards for Arts Education

- **NA-VA.K-4.1 – UNDERSTANDING & APPLYING MEDIA, TECHNIQUES, & PROCESSES**
Students use different media, techniques, and processes to communicate ideas, experiences, and stories.
Students use art materials and tools in a safe and responsible manner.
- **NA-VA.5-8.1 – UNDERSTANDING & APPLYING MEDIA, TECHNIQUES, & PROCESSES**
Students intentionally take advantage of the qualities and characteristics of art media, techniques, and processes to enhance communication of their experiences and ideas.
- **NA-VA.5-8.3 – CHOOSING & EVALUATING A RANGE OF SUBJECT MATTER, SYMBOLS, & IDEAS**
Students use subjects, themes, and symbols that demonstrate knowledge of contexts, values, and aesthetics that communicate intended meaning in artworks.
- **NA-VA.K-4.6 – MAKING CONNECTIONS BETWEEN VISUAL ARTS AND OTHER DISCIPLINES**
Students identify connections between the visual arts and other disciplines in the curriculum.

PUZZLING OUT PLANT PARTS

This activity corresponds to the following Big Idea section(s):

A Puzzle of Plant Parts

Overview

As students examine and compare a wide variety of plant parts, they consider what makes a fruit a fruit, a leaf a leaf, and so on, and what makes each one unique.

You can customize this activity to fit with your available time and students' abilities. In the approach we describe, each small group has a different plant part to explore. You might also choose to set up a different station for each part and have students rotate through them, or have the whole class focus on just one plant part (leaves and fruits are very accessible for younger students).

Time Allotted

1 class session

Student Objectives

After completing this lesson, the student will be able to:

1. List words or phrases to describe plant parts.
2. Compare and contrast plant structures.
3. Group plant parts according to observable characteristics.
4. Compose a list of questions for further inquiry.

Materials

Hand magnifying lenses (1 per student or pair of students)

Puzzle of Plant Parts worksheet (1 per group – provided at end of lesson plan)

A diversity of plant parts (Bring in or have students collect a variety of examples of each type of plant part you're exploring. Draw from indoor and outdoor plants as well as items from the refrigerator and grocery store.)

Teacher Tips and Sample Questions handout (provided at end of lesson plan)

Tools for dissecting plant parts (e.g. plastic knife)

What to Do

1. Have each group of students use their senses (except for taste) and magnifying lenses to keenly observe each sample of a specific plant part (e.g., leaves). They should write a list of descriptive words or phrases for each item on the Puzzle of Plant Parts worksheet. You can let students tackle this alone or use some of the prompts found in the Teacher Tips and Sample Questions handout. Encourage students to stretch their thinking and vocabulary with new descriptive words (e.g., *fuzzy, jagged, lime green, ribbed, or heart-shaped*).

2. Next, ask each group to circle descriptive words or phrases that showed up for *all* the samples in a given category. For example, the phrase *has seeds inside* might apply to all fruit samples. Ask, *What do your charts tell you about how all ____ are alike? How are they different? Why do you think each one is unique?*

3. Explain that botanists often group plants according to what they can observe, such as flower or leaf types. Challenge students to subdivide their plant parts into categories based on their observations (for instance, *leaves with smooth margins* or *leaves with jagged/toothed margins*). Next have groups view one

another's subdivisions (without labels) and try to guess on which characteristics the categories are based.

Making Connections

4. As a class, discuss the commonalities of each category (e.g., stems are stiff). *What can this characteristic tell us about its function in a plant?* Also discuss how samples differ, and elicit students' ideas about why this might be so. If students aren't sure or have questions, create a list titled *Questions We Have about Plant Parts*. They can add a second column – *Things We Learned* – once they've been through the *How Plants Work* Exhibit at the United States Botanic Garden.

Digging Deeper

- ❖ Challenge students to create similes describing the different plant parts (or particular aspects) they examined. For instance, *A leaf's veins are like a network of rivers.*
- ❖ Have students press samples of a variety of plant parts and annotate each sample with a description of the plant it came from and the environment it grew in. (This may require further research.) These can be mounted in journals, on a classroom poster, or in herbaria (pressed collections). Click to this Web page for a comprehensive lesson on pressing plants and making herbaria.
<http://www.kidsgardening.com/growingideas/projects/june03/pg1.html>

After Your Visit

Complete the post-visit activity [Plant Parts Feast](#).

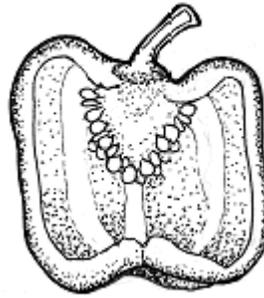
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As a result of activities in grades K-4, all students should develop abilities necessary to do scientific inquiry.
- NS.5-8.1 – SCIENCE AS INQUIRY:
As a result of activities in grades 5-8, all students should develop an understanding about scientific inquiry.
As a result of activities in grades 5-8, all students should develop abilities necessary to do scientific inquiry.
- NS.K-4.3 – LIFE SCIENCE:
As a result of activities in grades K-4, all students should develop an understanding of characteristics of organisms.
- NS.5-8.3 – LIFE SCIENCE:
As a result of activities in grades 5-8, all students should develop an understanding of structure and function in living systems.
As a result of activities in grades 5-8, all students should develop an understanding of diversity and adaptations of organisms.
- NS. 5-8.6 – PERSONAL AND SOCIAL PERSPECTIVES:
As a result of activities in grades 5-8, all students should develop an understanding of populations, resources, and environments.

A PUZZLE OF PLANT PARTS

Group _____

Plant Part We Explored _____



Sample	Description
1	
2	
3	
4	
5	

Teacher Tips and Sample Questions

Leaves: Consider adding some leafy vegetables, such as lettuce or collards, to your collection of tree leaves and other food factories. Ask, *What do you notice about leaf edges? How does each sample feel? Do you notice any patterns on the fronts or backs?* Encourage students to use crayons or pencils to do a leaf rubbing on paper. If they point out veins, ask, *What do these patterns remind you of (e.g., human veins, rivers)? What does this tell you about what they might do for the plant? Which leaf feels like it could best survive an insect attack? Why?*



Seeds: Consider contributing some scented seeds (e.g., fennel or cumin) and those with adaptations for traveling still attached (e.g., milkweed). You may also want to have some presoaked so students can split them in half and examine what's inside (large beans, like limas, offer the best view). Once students describe what seeds have in common (e.g., *hard coats, baby plant inside, food source for people and animals, they come from fruits*), pose related questions that could inspire investigations. For instance, ask, *Do you think the size of the seed will affect the size of the plant? How could we find out?*



Fruits: Give students a chance to observe whole fruits before cutting them in half so they can see the "guts." Ask, *How does each sample feel? How do their sizes and weights compare? How would you describe the flesh? Are seeds arranged the same way in all fruits?* If students note that all fruits surround (and/or protect) seeds, ask, *Do you think there's a connection between the number of seeds and the size or weight of fruit? Ask, How could we investigate that question?*



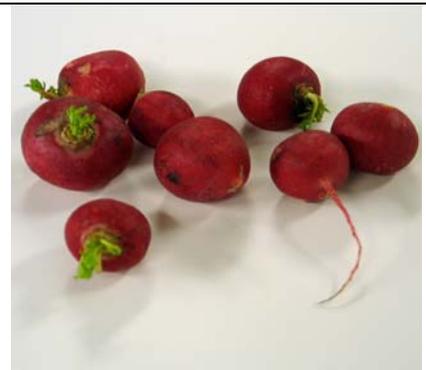
Flowers: If flowers are blooming outside, try to bring in a wide range of forms and colors. Otherwise, check with local florists and nurseries for samples. Encourage students to explore flowers first from the outside. Next, have them gently pull apart half of each flower for an inside view. Ask them to describe what they see rather than try to name the parts as they ponder what these unsurpassed advertisers have in common and how they differ.



Stems: Try to bring in woody stems (from shrubs or trees), fleshy stems, and stems from plants we eat (e.g., asparagus). Encourage students to break open stems so they can examine the insides. You can also set up a jar of water with a strong dose of food coloring and then leave a celery and carrot in it overnight. (Celery is actually a leaf petiole, but it acts like a stem.) By cutting the ends and exploring where the color travels, students should be able to make inferences about the role of stems. When students examine woody stems from trees and shrubs, they should find evidence of past, and possibly future, leaf buds or branches.



Roots: Provide a variety of root types, including taproots (e.g. carrots) and fibrous roots (e.g. grasses). When students observe the 2 types of roots, they should investigate the root's structure, function, and use. Ask, *why are the roots designed differently? What purpose does each type of root serve for the plant? What type of root would you find in a pine tree? Why?* Taproots grow straight down (with lateral roots branching off them), go after deep water/minerals, and provide a stable anchor. Fibrous roots have many thin, branched roots that cover a wide surface area and tend to occupy a large volume of shallow soil. The main functions of roots for a plant are: anchorage, absorption (water & minerals), conduction (water & food), and storage (water & food).



FUEL FOR LIFE

This activity corresponds to the following Big Idea section(s):

Green Machine

Overview

Students share their ideas about how living things get energy for growth and survival.

Time Allotted

1 class session

Student Objectives:

After completing this lesson, the student will be able to:

1. List potential food sources for plants and animals.
2. Create a food chain for plants and a food chain for animals.
3. Compare and contrast plant and animal energy sources.
4. Analyze the role of the sun in plant energy development.
5. Compose a list of questions for further inquiry.

Materials

Chart paper (or transparency sheet) [2 pieces]

Marker

What to Do

1. Write *living things* on the chart paper and ask students to toss out some examples. If they have broad suggestions, such as a *plant* or *an animal*, ask them to be more specific (e.g., a rose bush, my cat) and list their responses on the chart.
2. Create a second column titled *What does it do?* Ask students to post answers for each living thing in the first column. For instance, they might suggest that a dog runs, barks, eats, and nuzzles, or that a rose bush grows and makes flowers.
3. Add a third column, *Where does it get the energy to do these things?* Students will probably have a variety of responses, particularly related to plants. For instance, they may suggest that plants get their energy from the sun or food from the soil. (You may need to prime younger kids with a question about where they get energy to run, play, and grow.)



Plants and animals have different ways of meeting their basic needs.

Making Connections

4. When the subject of food comes up, ask, *Can you explain what food is for plants and animals?* Many youngsters think that a plant's food is the water and minerals it takes in from the soil or fertilizer container. They may not yet understand that plants use the sun's energy, along with water and carbon dioxide, to make sugars and starches that provide food energy for all living things. (Living things break down these foods to extract energy to grow.) Document student responses.

5. Work with students to create a food chain diagram for plants and a food chain diagram for humans. Ask, *where do plants get their energy? Where do humans?* Compare the two food chain diagrams and discuss how plants make their own energy. Suggested prompts for discussion include: *How is it possible for plants to make their own energy? Could it have something to do with a plant's green coloring? Can humans make their own energy? What makes plants special?*

6. Take a moment to introduce the topic of photosynthesis. Students will have the opportunity to further investigate this topic when they visit the *How Plants Work* Exhibit at the United States Botanic Garden.

Digging Deeper

- ❖ Discuss the role of farmers in the life cycle of a plant. How does the farmer help the plants that he or she tends?
- ❖ See the post-visit activity [Growing Tips](#).

After Your Visit

Have the class review and update their chart once they have explored the *How Plants Work* Exhibit at the United States Botanic Garden.

Complete the post-visit activity [Tread on Me! Grasses Measure Up](#).

National Science Education Standards

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- NS.5-8.1 – SCIENCE AS INQUIRY:
As a result of activities in grades 5-8, all students should develop an understanding about scientific inquiry.
- NS.K-4.3 – LIFE SCIENCE:
As a result of activities in grades K-4, all students should develop an understanding of the lifecycles of organisms.
- NS.5-8.3 – LIFE SCIENCE:
As a result of activities in grades 5-8, all students should develop an understanding of populations and ecosystems.
- NS.5-8.6 – PERSONAL AND SOCIAL PERSPECTIVES:
As a result of activities in grades 5-8, all students should develop an understanding of populations, resources, and environments.

IS IT EASY BEIN' GREEN?

This activity corresponds to the following Big Idea section(s):

Surviving Against the Odds

Overview

Students brainstorm challenges plants might face in meeting their needs, protecting themselves, and reproducing. Then they consider how these green organisms are built to “get by.”

Students will come to appreciate that plants, while apparently sedentary, are hardly passive organisms. Rather, they have an amazing array of strategies and adaptations that enable them to respond to the world, meet their own needs, and survive under some tough circumstances! This activity will help spark students' curiosity and reveal their thinking about plant survival.

Time Allotted

1 class session (Teacher should bring in and/or plant seeds for growth in advance.)

Student Objectives:

After completing this lesson, the student will be able to:

1. List plant and animal adaptations necessary for survival.
2. Explain the survival challenges met by plants.
3. Construct a theory on plant survival based on actual plant observation.
4. Compose a list of questions for further inquiry.

Materials

Piece of paper (1 sheet per small group)

Houseplant or growing bulb, such as an amaryllis (Bring in a week prior to conducting the lesson and make sure the plant is bending towards a light source.)

If you don't have a houseplant readily available, plant corn, radish, or runner bean seeds in a small container of potting mix. These should readily show a similar phototropic response. You can also bring in a cactus or other plant with protective spines or thorns and/or buy fresh scented herbs from the grocery store.

****Leave all the items on a classroom windowsill****



Corn seedlings grow towards the light.

Photo courtesy of Roger Hangarter



Thorns protect a rose plant.



Spines adorn this cactus.

What to Do

1. Ask, *What are some of the things you need to survive?* Accept all student answers as valid as you probe deeper. For instance, if youngsters suggest they need food, ask, *How do you go about getting food when you're hungry?* (Students might say, *I go to the refrigerator.*) If the following ideas don't emerge, ask, *how do we protect ourselves from the cold, heat, biting insects, and other challenges?* If appropriate, ask, *how do people find mates?*
2. Next, have students form small groups, close their eyes, and imagine being a green plant growing firmly in one spot. Ask, *what challenges to survival might you face?* Give groups 5 minutes to grapple with the question, jot down thoughts, and report to the rest of the class. [An additional way to approach this section is to have members of the class act out what it would be like to be a stationary green plant.]
3. Ask groups to share ideas and write their responses on a piece of paper. Probe for elaboration and ask questions to extend their thinking. For instance, ask *what could harm you?* (Possible answers include *insects and other animals that eat plants, a lack of water.*) Next, have them ponder how they might meet these challenges. Ask, for instance, *How are you -- the plant -- designed (adapted) to get enough sunlight . . . make sure pollinators find you . . . survive a harsh winter?*

Making Connections

4. If students haven't already commented on the windowsill plants, point them out. Ask, *what do you notice about the plants that might relate to our discussion? What's your theory about why they look or respond as they do?* Keep a list of students' questions and things they're unsure of. This can help focus students' attention at the *How Plants Work* Exhibit at the United States Botanic Garden and inspire activities back in class.

Digging Deeper

- ❖ Ask each student group to create the first part of a story or poem based on the statement "It isn't easy bein' green." Suggest that students look for inspiration on the list they created of challenges plants face. The second part of this writing assignment will come after the students visit the *How Plants Work* Exhibit at the United States Botanic Garden.
- ❖ Plants in Motion: This Web site has incredible time-lapse clips of plant movements. Go to this page on tropisms with your class and click on selected clips. (Your computer will need a QuickTime plug-in to view the clips.)

<http://plantsinmotion.bio.indiana.edu/plantmotion/starthere.html>

After Your Visit

Once the student groups visit the *How Plants Work* Exhibit at the United States Botanic Garden, they should complete their writing project starting with this word: "But . . ." This second part should reveal what students have learned about how plants *do* meet the challenges they face.

Complete the post-visit activity [Invent a Plant](#) or [Catch Them in the Act! How Neighborhood Plants Get By](#).

National Science Education Standards

- NS.K-4.1 – SCIENCE AS INQUIRY:
As a result of activities in grades K-4, all students should develop an understanding about scientific inquiry.
As a result of activities in grades K-4, all students should develop abilities necessary to do scientific inquiry.
- NS.5-8.1 – SCIENCE AS INQUIRY:
As a result of activities in grades 5-8, all students should develop an understanding about

scientific inquiry.

As a result of activities in grades K-4, all students should develop abilities necessary to do scientific inquiry.

- **NS.K-4.3 – LIFE SCIENCE:**

As a result of activities in grades K-4, all students should develop an understanding of characteristics of organisms.

As a result of activities in grades K-4, all students should develop an understanding of organisms and environments.

- **NS.5-8.3 – LIFE SCIENCE:**

As a result of activities in grades 5-8, all students should develop an understanding of structure and function in living systems.

As a result of activities in grades 5-8, all students should develop an understanding of diversity and adaptations of organisms.

Standards for the English Language Arts

- **NL-ENG.K-12.12 – APPLYING LANGUAGE SKILLS**

Students use spoken, written, and visual language to accomplish their own purposes (e.g., for learning, enjoyment, persuasion, and the exchange of information).

PLANT PARENTHOOD

This activity corresponds to the following Big Idea section(s):

Plant Multiplication

Overview

Students create concept maps or stories to reveal their understanding of plant life cycles and reproduction.

Time Allotted

1 class session

Student Objectives:

After completing this lesson, the student will be able to:

1. Develop a theory about how plants multiply.
2. Create a concept map and/or story using knowledge of plant reproductive strategies.

Materials

Seeds (provided by students from their kitchens and/or teacher)

Paper

Pencils, pens or crayons

What to Do

1. Ask students, *who knows how to make many plants from one plant? Who has done so?* Ask respondents to elaborate on how they went about it. What had to happen? Chances are they'll describe how they planted seeds, potato pieces, or houseplant cuttings. If you have younger students, try the approach described in number 2, below. For older students, proceed to number 3.

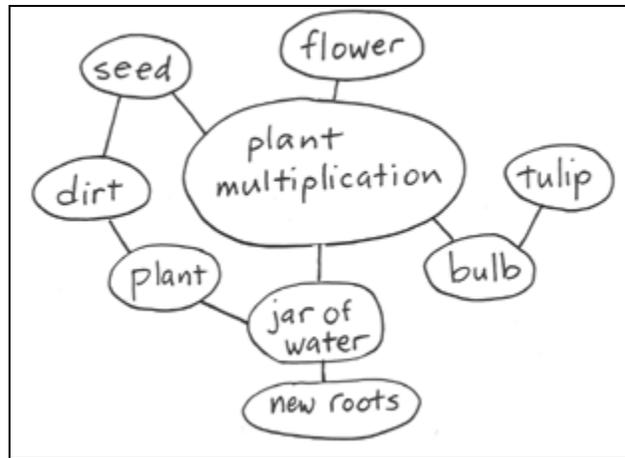
2. Ask youngsters to find as many seeds in their kitchens as possible. Have them bring in a sample of each and sort them on their desks however they see fit. Next, have them choose one and draw a picture of how they think it was formed. Invite each student to explain his or her thinking.

3. Tell students to imagine a plant fixed in one spot. [Or for students that have trouble visualizing, refer to a plant in the classroom.] Ask, *how are new plants created without human help? Think about what has to happen during a plant's life cycle so a new plant can be created.* Keep them together as a class or break them into small groups to discuss. Give students time to consider the question.



Making Connections

4. After students have discussed how stationary plants reproduce, assign one of the following:
 - Create a concept map. Begin with the phrase *plant multiplication* (or *plant reproduction*) in a circle in the center of a piece of chart paper. Have students think about the phrase and other words or concepts it brings to mind. For instance, someone might write the word *seed* outside the circle. As students add thoughts, have them begin to think about how they could connect these words and phrases to illustrate their thinking. Young students can simply draw lines to show the connections and hierarchies. Older students can use "linking" words to describe relationships (e.g., *flowers create seeds*).



- Write a story or how-to booklet. The topic is plant multiplication (that is, how plants reproduce). Have students in each group pool their knowledge on the topic and weave it into a story or descriptive procedural steps.

5. Circulate during this activity and pose questions to prompt students' thinking. For example, if they talk about plants making seeds, ask them to explain how that happens. If they mention plants being created from parts of other plants, ask how the process compares to new plants being created from seeds. If they stick primarily to flowering plants, you might find out how they think other types of green things, such as ferns and mosses, create new plants. Routinely ask students to explain the thinking behind their responses. At this point, accept all answers.

6. When students review their products after they visit the *How Plants Work* Exhibit at the United States Botanic Gardens, they can correct earlier misconceptions. Keep track of things students weren't sure about and questions they had. Use these to inspire detective work at the United States Botanic Garden. Let students know they'll have a chance to revise their products and add new information after the fieldtrip.

Digging Deeper

- ❖ Have groups post and discuss their maps or read their stories/how-to booklets.

After Your Visit

Allow students to make corrections/addendums to their booklets/stories/concept maps.

Complete the post-activity [Flowers Up Close](#) or [Plant Elders: Seedless but Savvy](#).

National Science Education Standards

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As a result of activities in grades K-4, all students should develop an understanding about scientific inquiry.
- NS.5-8.1 – SCIENCE AS INQUIRY:
As a result of activities in grades 5-8, all students should develop an understanding about scientific inquiry.
- NS.K-4.3 – LIFE SCIENCE:
As a result of activities in grades K-4, all students should develop an understanding of characteristics of organisms.
As a result of activities in grades K-4, all students should develop an understanding the life cycles

of organisms.

- **NS.5-8.3 – LIFE SCIENCE:**

As a result of activities in grades 5-8, all students should develop an understanding of structure and function in living systems.

As a result of activities in grades 5-8, all students should develop an understanding of reproduction and heredity.

Standards for the English Language Arts

- **NL-ENG.K-12.5 – COMMUNICATION STRATEGIES**

Students employ a wide range of strategies as they write and use different writing process elements appropriately to communicate with different audiences for a variety of purposes.

- **NL-ENG.K-12.6 – APPLYING KNOWLEDGE**

Students apply knowledge of language structure, language conventions (e.g. spelling and punctuation), media techniques, figurative language, and genre to create, critique, and discuss print and non-print texts.

- **NL-ENG.K-12.12 – APPLYING LANGUAGE SKILLS**

Students use spoken, written, and visual language to accomplish their own purposes (e.g., for learning, enjoyment, persuasion, and the exchange of information).

SPEAKING OF FLOWERS

This activity corresponds to the following Big Idea section(s):

Plant Multiplication, A Puzzle of Plant Parts

Overview

Students read quotes and poetry that feature flowers, and they consider what the writing reveals about why humans value them and what role they play in plants' lives.

Some students at this stage may believe that the primary job of flowers is to please humans. They may have an idea that bees (or other insects) visit flowers, but may not fully grasp that the sole purpose of flowers is to ensure pollination and that every characteristic is "designed" for that purpose. This activity will spark their thinking and reveal what they do know.

Time Allotted

1 class session

Student Objectives:

After completing this lesson, the student will be able to:

1. Investigate the role of flowers through peer interviews and selected readings.
2. Create a cinquain poem about flowers.
3. Create a KWL chart in conjunction with the teacher and their classmates.

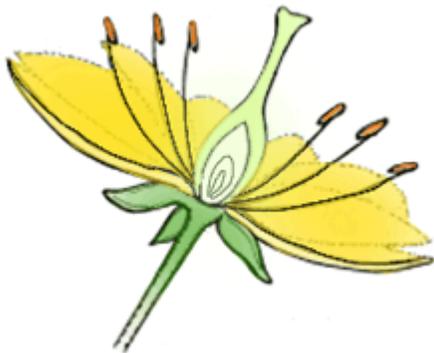
Materials

Writing materials

The Reason for a Flower by Ruth Heller (book)

Chart paper/Transparency sheet/Blackboard (for KWL chart)

Speaking of Flowers handout (if you plan to do the Digging Deeper activity)



Mallow



Daylily

What to Do

1. Write this phrase on the board: *The reasons for flowers*. Pair students up and ask them to interview each other and write down their partners' thoughts on the topic.

2. Next, ask partners to discuss and review the words, phrases, and descriptions that came out of the interviews. Have each pair use their interview responses to create a cinquain poem. A cinquain is a 5-line, non-rhyming poem that follows this pattern:

- Line 1: 1 word (2 syllables) defining the subject (in this case, flowers)
- Line 2: 2 descriptive adjectives (4 syllables total)
- Line 3: 3 active verbs (6 syllables total)
- Line 4: 8 syllables in a phrase or sentence that reflects a feeling
- Line 5: 1 word (2 syllables) that summarizes or stands for the subject word in the first line

3. Have pairs share their poems with the class and then post them on the wall or a bulletin board. Give students time to read all the poems and, as a class, discuss what they reveal about the reasons for flowers.

Making Connections

4. Follow up the class discussion and sharing of cinquains by reading *The Reason for a Flower*. Have students compare its concepts with their ideas.

5. Create a KWL chart (what the class **K**nows, what they **W**ant to know and what they've **L**earned) detailing the following: things the class knows about flowers and their roles and things they'd like to know. Bring these lists to the *How Plants Work* Exhibit at the United States Botanic Garden. After visiting, students will have a chance to revise the chart and fill in the Learn column.

Digging Deeper

- ❖ Pass out selected writings from the Speaking of Flowers sheet to individuals or teams of students, or put them on an overhead. Tell the class to imagine they are on a mission from a bloomless planet to discover what they can about the earthly things called *flowers*. Challenge them to read the quotes and underline words, phrases, or lines that offer clues about which flower characteristics humans' value. Next, have them circle words or phrases that give them clues about the importance of flowers to plants. They should write other observations and questions in the margins.

As students share their responses, ask, *What would you and your fellow space travelers conclude about flowers if you only had these writings to look at? What would you assume about what flowers do for plants? What questions might you still have?*

If students suggest that some of the qualities that attract humans (fragrance or bright colors, for instance) also serve to attract bees (or other pollinators), ask them to elaborate. Ask, for instance, *Why do they need to attract bees? What do bees get out of the deal?*



Pollinator: Bee



Pollinator: Butterfly



Pollinator: Hummingbird

After Your Visit

Revisit the KWL chart.

Permit students to revise their cinquain poems.

Complete the post-activity Pursuing Pollination Partners, Fruit for Thought I: Getting to the Core or Fruit for Thought II: Flower to Fruit.

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As a result of activities in grades K-4, all students should develop an understanding the life cycles of organisms.
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SPEAKING OF FLOWERS

(Wise and poetic words)

Fragrance always clings to the hand that gives you a rose.

– a Chinese proverb

Bread feeds the body indeed, but the flowers also feed the soul.

– The Koran

Flowers never emit so sweet and strong a fragrance as before a storm.

– Jean Paul Richter

Just living is not enough . . .

One must have sunshine, freedom, and a little flower.

– Hans Christian Andersen

When you have only two pennies left in the world, buy a loaf of bread with one, and a lily with the other.

– Chinese proverb

Who paints the flower does not paint the flower's fragrance.

– Proverb

withered

Fall blossoms

drop in the downpour

– Michael Garofalo

Flowers always make people better, happier, and more helpful; they are sunshine, food, and medicine for the soul.

– Luther Burbank

People from a planet without flowers would think we must be mad with joy the whole time to have such things about us.

– Iris Murdoch

'Tis the last rose of summer

Left blooming alone:

All her lovely companions

Are faded and gone.

– Thomas Moore