Smarty Plants

Grades 2-7

SF Environment
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Lesson Summary
Students learn about plants and pollinators and design their own imaginary plants.

Overview
In this lesson, students will:
- Learn about pollination and plant adaptation
- Create imaginary plants that are adapted to specific pollinators

Time
75-90 minutes for lesson

Background
The next time you enjoy peaches, pistachios, peppers, vanilla, sesame seeds, or coffee, thank a bee…or maybe even a fly! Many of the fruits, vegetables, nuts and seeds we eat are made with the help of **pollinators**, or animals that spread pollen from flower to flower. In fact, animals like insects and birds help more than 90% of flowering plants grow new plants and fruits.

Pollen is the powder in the middle of flowers created by plants to help reproduce, or make new plants, which are important sources of beauty, oxygen, food, animal habitat, and medicine. Pollinators like bees, flies, butterflies, hummingbirds, moths, mosquitoes, and bats, visit flowers to eat the nectar that plants produce to attract pollinators. At the same time, they spread pollen among other flowers. When pollen from one flower gets onto another flower of the same species, the flower that receives the pollen becomes pollinated, or ready to **reproduce**. Once a flower has been pollinated, it grows the fruit and seeds it needs for reproduction. Fruit grows from flowers and around seeds in order to protect the seeds while they grow. More importantly, fruit helps a plant **disperse**, or spread, its seeds. This whole process happens because seeds, if allowed to grow, will eventually become new plants. For example, if a fruit is sweet and fleshy, an animal may eat it and spit out or excrete the seeds. This helps plants disperse their seeds in places that plants can't reach on their own. With help from animals (and even wind and water) plants send their seeds both near and far to grow new plants.

In addition to requiring **s**unlight, **w**ater, **a**ir, and **n**utrients (SWAN), most plants need to attract pollinators in order to survive. Because having pollinators is so important, plants have **adapted**, or changed, in order to fit their pollinators' needs. For example, a plant's flowers may have a specific shape, size, color, scent, amount and sweetness of nectar, and time that they bloom according to what its pollinators prefer. For instance, tube-shaped flowers with a lot of nectar attract birds with long beaks, and foul smelling flowers that look like rotting meat attract dung flies.
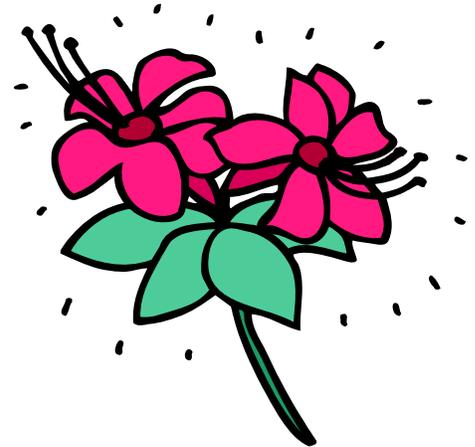
Vocabulary
- Pollinator
- Pollen
- Nectar
- Pollination
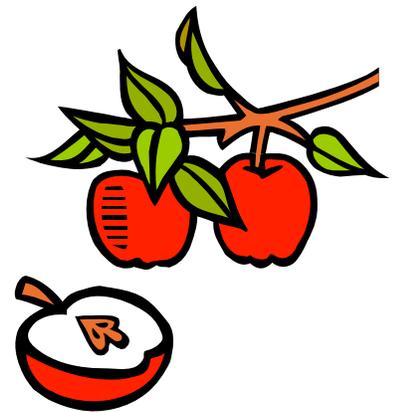- Reproduce
- Adaptation
- Disperse

Materials
- Student Fact Sheets: *The Power of Pollinators*; *How does your Garden Grow;* and *Trees Please*
- Flower and Pollinator Pictures (see back pages)
- 1 set of Pollinator Cards (see back pages)
- 14 sheets of reused, white paper, each with one blank side, sized 11x14 (or 8.5 x11)
- 7 boxes or bunches of colored pencils or crayons
- 1 pencil per student
- 1 apple cut in half horizontally across the middle to reveal its seeds
- Optional: 1 fragrant honeysuckle flower per student

Preparation

1. Read *Conservatory of Flowers Background Information for Teachers.*
2. Students read *The Power of Pollinators*, *How does your Garden Grow, and Trees Please* Fact Sheets.
3. Cut out pollinator cards (see back pages).

Pre-Questions and Activities

1. What did you eat for dinner last night? Take answers.
2. Focus on someone's answer that pertained to a fruit or vegetable and ask: Where did that [insert fruit or vegetable here] come from? (*A plant.*)
3. What about chocolate – who likes chocolate?
4. Do you know what it's made from? (*The cacoa bean which grows on the cacao tree – it's a seed.*)
5. Why are plants important? (*They provide us with food, beauty, fresh air, and habitat or shelter and food for other animals.*)
6. We all need plants in order to survive. What different things do plants need to survive? (*SWAN= sunlight, water, air, and nutrients.*) Write this on the board and leave it up during the entire lesson.
7. The different parts of a plant help it get the things it needs to survive. What are the different parts of a plant? (*Roots, stem, leaves, flower, fruit.*) Write this on the board and leave it up during the entire lesson.
8. Who would like to come to the board and draw an apple tree, making sure to include the parts we just named?
9. Once it is drawn, ask: Who would like to label its parts? Make sure they include: roots, stem, leaves, flower, and fruit. Leave this diagram on the board for the duration of this lesson. **Note:** Fruit grows from flowers, so normally a full-grown apple isn't on the tree at the same time as a flower.
10. Each plant part has a job. What do the roots do? (*Support the plant and take in water and nutrients from the soil.*)
11. What does the stem do? (*Supports the plant and allows transfer of nutrients from the roots to the leaves.*)
12. What do the leaves do? (*Absorb sunlight to make food for the plant.*)
13. Before we get to the flower, let's talk about the fruit – who likes to eat apples? Can you eat the whole apple? (*No- you can't eat the seeds!*)
14. Where are the seeds found? (*Inside the fruit.*) Tell a student to add seeds inside the picture of fruit on the board. Hold up the apple halves and tell students they will now observe the seeds. Pass around the apple halves. Invite students to notice the seeds.
15. Why do you think plants make seeds? (*To grow new plants.*)
16. Now let's talk about the flower…who has ever touched or rubbed their finger on a flower and seen the orange or yellow powder that comes off? That's pollen! That's the special powder that flowers make to carry the recipe for what the baby plants they make should look and be like. In order for a plant to grow seeds and fruit, it must be pollinated, or receive pollen from another plant that is similar to it. When a plant's flower is pollinated it is ready to grow the seeds that will one day become baby plants.

17. What does it mean to produce something? (*To make it.*)
18. What does it mean when you put "re" on the front of a word like redo or reread? (*To do again.*)
19. So, what does re-produce mean? (*To make something again.*)
20. When humans reproduce, what do we make? (*Baby human beings.*)
21. When plants reproduce, what do they make? (*New plants.*)
22. What do these new plants look like? (*Their "parent" plant.*)
23. When a plant is pollinated it is ready to reproduce, or grow seeds to make baby plants. That is why pollination is so important. Without pollination, we would not have many new plants, or most fruits, vegetables, seeds, and nuts at all!
24. For example, what are some of your favorite foods? Take answers. Make connections about how pollinators help grow the foods a few students mention: vanilla ice cream is made with pollinated vanilla orchid beans, etc.
25. What insects and animals do you see a lot around flowers? (*Bees, butterflies, hummingbirds.*)
26. Why do you think these animals and insects like to visit flowers when they're hungry? (*To eat the flowers' nectar which is a source of food.*)
27. These animals and insects are pollinators. Now that you know what pollen is, what do you think it means to be a pollinator? Before you take answers, write the word "pollen" on the board. Write the word pollinator on the board. Underline the "pollin" portion of the word. Then take answers. (*Something that pollinates flowers, or spreads pollen from flower to flower.*)
28. Right. "Pollin" (pollen) is the root word for pollinator. And "-ator" (underline the "ator" portion of the word) means something or someone that has to do with the root word it's attached to. In this instance, the root word is "pollen." So, a pollin-ator is something that spreads pollen from flower to flower.
29. Now that we know a pollinator is an animal or insect that spreads pollen from flower to flower so the plant can reproduce, what do you think is the flower's job? What do you think the flower is trying *really* hard to do? (*The flower's job is to attract pollinators, like bees, hummingbirds, butterflies, bats, and flies.*)
30. Why does the flower want to attract them? (*So that they can spread the flower's pollen to other similar flowers.*)
31. What are some things flowers do to attract pollinators? (*Provide nectar, or a sweet liquid, inside; have bright colors; have sweet smells.*) Pass around the honeysuckle, if you have it.
32. Have you ever smelled a sweet flower or tasted the sweet liquid inside a flower? Take answers. If you have enough honeysuckle for each student, pass it out for students to smell and taste by sipping the bottom of the blossom. If you just have one honeysuckle blossom, pass it around for students to sniff and

then ask one student to come to the front and pretend they are a pollinator. Ask them to sip the nectar from the bottom, and describe what it tastes like.

33. These are examples of adaptations. Adaptations are natural changes that a living thing like a plant or animal will do to survive in nature. For example a really long time ago, some plants created or evolved to create flowers and nectar so that they could attract pollinators. This ensured that they would be pollinated and make new baby plants.

34. Can you think of some other ways plants adapt, or change, in order to invite their pollinators? (*They may have*):
- *A place for an insect to land. The flowers bees pollinate have broad flowers so the bees can stand and walk on them.*
- *Bright or specific colors to attract animals that like or can only see those certain colors.*
- *Smells to attract pollinators—some are sweet and some are rotten or smelly.*
- *Colors or shapes that look like or mimic something else. For example, the plants pollinated by dung flies, which eat rotting meat, look like raw meat to trick the flies into landing on them.*
- *Specific timing of when the flower opens. For instance, nocturnal moths and bats visit flowers at night, so the flowers they pollinate have evolved to only open at night.*

* Make sure to name and describe adaptations students miss.

Procedure – Part 1

Keep plant parts diagram on the board for students to reference in Procedures-Part 2

1. Tell students that now they are going to see and list examples of ways that plants adapt. Not only do plants have adaptations to help them get pollinated—but they also have different adaptations for different pollinators! In other words, not all flowers get pollinated by all pollinators.

2. Show students the pictures of pollinators and the flowers they pollinate.

3. Ask: Which adaptations do you notice on the flowers? How does this adaptation attract the pollinator?
- Write a column for each pollinator and list answers accordingly on the board. **Note:** If students understand the concept easily, you may also tell them the information asterisked below. For instance:

    Dung Fly
    - Red and Brown (the color of raw meat, which is what they search out and eat)
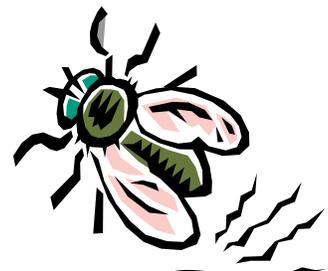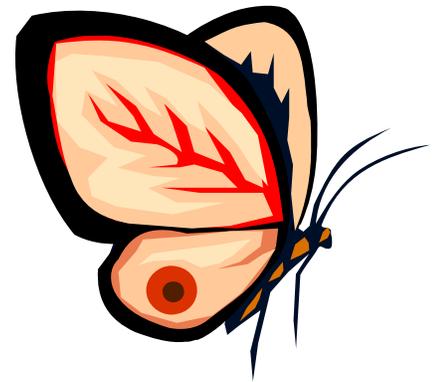
- *Stinky, rotting smell (the smell of decomposing raw meat)

Hummingbird
- Yellow or red color to attract hummingbird
- Long tube-like shape to fit its long beak
- *Not necessarily a strong fragrance (because they don't have a good sense of smell)
- *Lots of nectar that hummingbirds depend on for food and energy

Bee
- Broad flowers that act as landing platforms
- Bright colors to attract bees
- *Bees can't see red
- *Sweet fragrances
- *Lots of nectar to give them lots of energy

Moth
- Flowers open at night since moths are nocturnal (awake at night)
- Pale colors because strong colors aren't visible in the dark and pale colors reflect the moonlight
- Sweet, strong odors to guide the moth in the dark
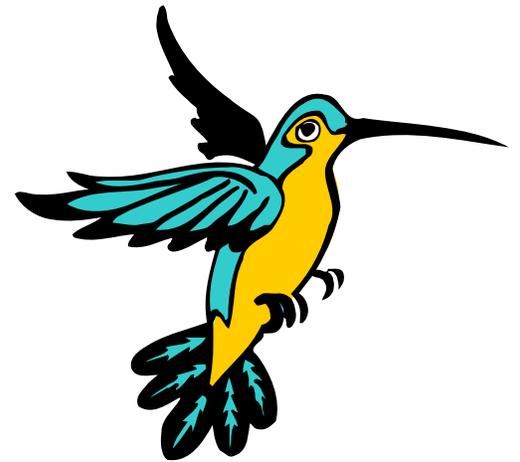
4. Make sure students understand what you have just explained and take a few minutes to answer questions if needed.

Procedure – Part 2
1. Tell students they are now going to create their own special plant called a "Smarty Plant."
2. Divide the class into 7 groups.
3. Explain that students will have fifteen minutes to create an imaginary plant based on what they just learned, and the following instructions:
   - Each group will receive a pollinator card that shows which insect or animal pollinates their plant.
   - Each group must work together to create and draw an imaginary plant that follows real life guidelines for its needs and parts.
   - In addition to giving it real parts, students should design their plant's adaptations to its pollinator. At least one of its adaptations should be an adaptation they just learned about. Each plant should also have one imaginary adaptation.
   - Students will draw and name their imaginary plant.
   - On another sheet of reused paper, students will also write a description of their plant (using full sentences), answering the following questions that you write on the board.
     - What is your plant's name? **Note:** Names should mimic other plant names and not be names like: Barney or Ruby.
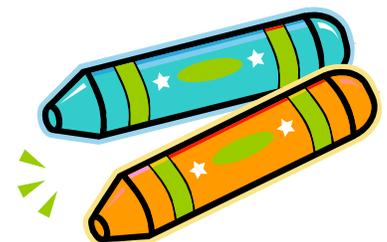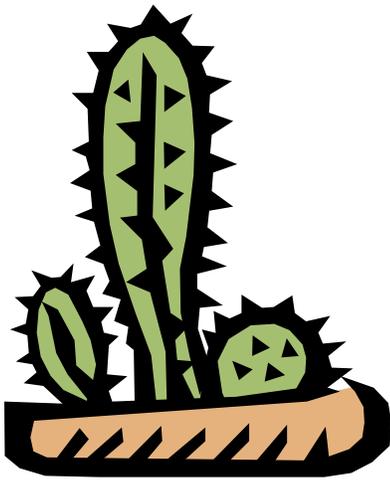
- o What animal or insect pollinates your plant?
- o What real adaptation does your plant have to help its pollinator do its job?
- o What imaginary adaptation does your plant have to help its pollinator do its job?
- o *For grades 5-7: What ecosystem can it be found in?
- o Where in the world does your plant grow? What is one other interesting thing about your plant?

4. After fifteen minutes, allow each group about three minutes to present its "Smarty Plant" to the class. Have students tell the rest of the class about their plant, read their written description aloud, and answer any questions the class may have.

Discussion

1. Now let's review: Why are pollinators important? (*They help plants grow the fruits and seeds that grow new plants, including the plants we eat for food.*)
2. How might a plant adapt to a desert environment, where there is little water? (*By holding onto water, like a cactus, or having a smooth surface that drips the moisture it collects down to the sand around its roots.*)
3. What are some other examples of environmental situations or factors that plants have to adapt to? (*Climate including wind and temperature, predators, too much water or too little water, shade, nutrient-poor soil.*)
4. How might a plant adapt to an environment where there are tall trees blocking the sunlight? (*By growing like a vine up the trunk of trees to reach sunlight.*)
5. How might a plant defend itself against animals that want to eat it? (*By growing thorns or spikes.*)

Extensions

- Take students on a field trip to the San Francisco Conservatory of Flowers or botanical garden in your area.
- Visit or plant a pollinator garden.
- Study "nectar guides" and have students design their own.
- Learn about plant reproduction and flower parts, and dissect flowers.
- Dissect a fruit or vegetable, and then sprout and plant its seed, and record its growth.
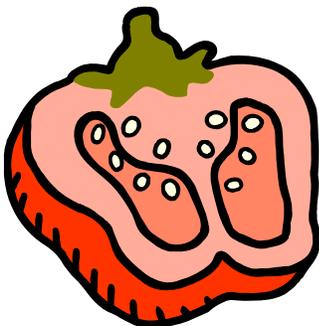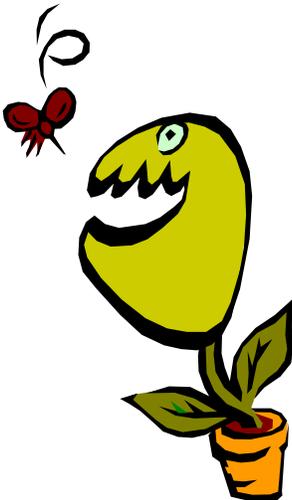
Smarty Plants   CA Standards Grade 2-7

Grade 2

Science	
♦2a	Plants and animals have predictable life cycles: Students know that organisms reproduce offspring of their own kind and that the offspring resemble their parents and one another.
♦2f	Students know flowers and fruits are associated with reproduction in plants.
Language Arts ♦ LS1.2	Ask for clarification and explanation of stories and ideas.

Abbreviations
Language Arts: R=Reading; W=Writing; LC= Language Conventions; LS=Listening/Speaking
Math: N=Number Sense; A=Algebra; MG=Measurement/Geometry; S=Statistics/Data Analysis; MR=Mathematical Reasoning

Grade 3

Science	
♦ 3a	Adaptations in physical structure or behavior may improve an organism's chance for survival. As a basis for understanding this concept: Students know plants and animals have structures that serve different functions in growth, survival, and reproduction.
Language Arts ♦ LS2.3	Students make descriptive presentations that use concrete sensory details to set forth and support unified impressions of people, places, things, or experiences.

Abbreviations
Language Arts: R=Reading; W=Writing; LC= Language Conventions; LS=Listening/Speaking
Math: N=Number Sense; A=Algebra; MG=Measurement/Geometry; S=Statistics/Data Analysis; MR=Mathematical Reasoning

Grade 4

Science	
♦ 2c	All organisms need energy and matter to live and grow: Students know many plants depend on animals for pollination and seed dispersal, and animals depend on plants for food and shelter.
Language Arts ♦ R1.3	Use knowledge of root words to determine the meaning of unknown words within a passage.
♦ LS1.1	Ask thoughtful questions and respond to relevant questions with appropriate elaboration in oral settings.

Grade 7

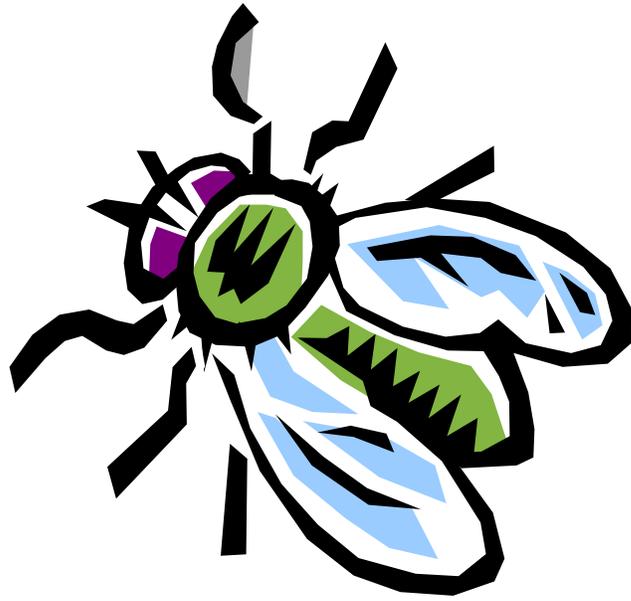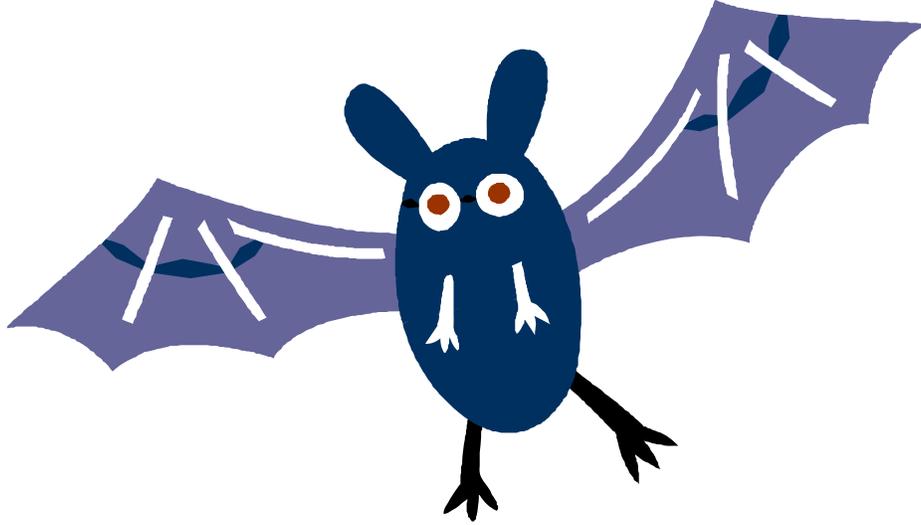| Science	
♦	The anatomy and physiology of plants and animals illustrate the complementary nature of structure and function. As a basis for understanding this concept: • Students know the structures and processes by which flowering plants generate pollen, ovules, seeds, and fruit

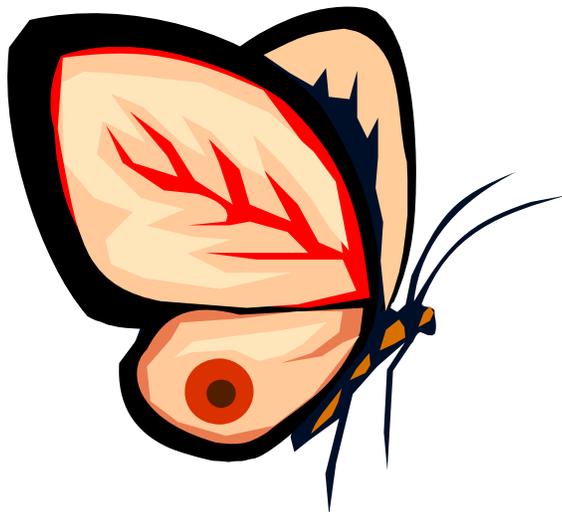# Smarty Plants Activity Cards

FLY

BEE

Smarty Plants Activity Cards

BAT

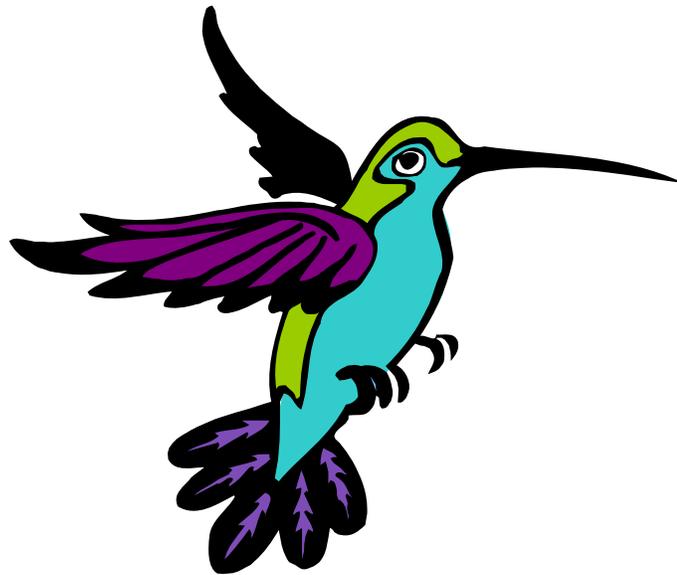MOTH

Smarty Plants Activity Cards

BUTTERFLY

BUTTERFLY

Smarty Plants Activity Cards

HUMMINGBIRD

HUMMINGBIRD

The hummingbird has a long, skinny beak.

The bee likes bright colors and sweet smells.

The bee lands and walks on flowers
while it drinks nectar.

The dung fly is attracted to flowers that look and smell like stinky, rotting animal flesh.

The hummingbird hovers as it drinks nectar.

The butterfly uses its long, straw-like tongue to sip nectar from deep within flowers.

The butterfly likes bright colors and sweet smells.

The moth is active at night,
so it does not see bright colors.

The moth does not see well at night,
so it relies on sweet smells to find flowers.