

POLLEN DETECTIVE



ACTIVITY BOOK



Pollen Detective Activity Book

This book features five hands-on activities designed for 8- to 12-year-olds. Each activity includes one 30- to 60-minute project and extensions. Activities can be used in any order. Also included are objectives and learning outcomes, assessment questions, ideas for a presentation or exhibit and topics for further investigation. Wonderwise learning outcomes are based on national science education standards identified by McREL (Mid-continent Research for Education and Learning), the Nebraska Educational Standards, and the National Science Education Standards developed under the direction of the National Research Council. This book incorporates concepts of inquiry-based learning and the 4-H Youth Development experiential learning model.

Each youth participant should receive a copy of the activities. Copies of this book can be downloaded from the Pollen Detective CD-ROM.

WONDERWISE Women in Science Learning Series

Wonderwise introduces you to women who have made science their career. Each kit is a comprehensive instructional package that includes a video, CD-ROM, and activity book. With these materials, leaders and youth explore the world of women scientists and discover together the fun of learning about science. For more information about Wonderwise, including free samples, Web activities, resources, science education standards and ordering information, visit our Web site:

wonderwise.unl.edu



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Learning Outcomes: Youth develop an understanding of science and technology in society and of science as a human endeavor.

INFORMATION FOR LEADERS

What You Will Need for Each Activity

Listed below are the materials and preparations you will need for each activity. Most of the materials can be purchased locally. The more difficult-to-find items, such as dissecting needles, can be purchased from Wonderwise. The symbol © indicates that an item can be ordered from the Wonderwise Web site or GPN, the Wonderwise distributor. To purchase supplies, kits, videos, or CD-ROMs contact:

GPN (Great Plains National)
 P.O. Box 80669 ▪ Lincoln, NE ▪ 68501-0669
 Phone: 1-800-228-4630 ▪ FAX: 1-800-306-2330
 e-mail: gpn@unl.edu ▪ Web site: gpn.unl.edu

Activity 1 Pollination	Activity 2 In Search Of Pollen	Activity 3 Medical Mystery	Activity 5 Pollen Tracks	
<p>For the entire group:</p> <ul style="list-style-type: none"> © 18-min video <i>Peg Bolick, Pollen Detective</i> <p>For each team of 2:</p> <ul style="list-style-type: none"> ▪ crayons, markers, or colored pencils ▪ 2 cotton balls ▪ scissors ▪ 3 colors of powdered tempera paint in small containers ▪ cotton swabs ▪ manila folder or lightweight cardboard ▪ glue and/or tape 	<p>For each team of 2:</p> <ul style="list-style-type: none"> © 1 dissecting needle © 1 magnifying lens ▪ 1 fresh flower (lily flowers work best; florists sometimes will donate day-old flowers) ▪ 1 roll of clear tape ▪ 1 piece of cardboard or thick paper 	<p>For each team of 2:</p> <ul style="list-style-type: none"> ▪ 4 colored pencils ▪ pen or highlighter marker <hr/> <p>Activity 4 Flower Engineers</p> <p>For each participant:</p> <ul style="list-style-type: none"> ▪ construction paper ▪ tissue paper ▪ scissors ▪ glue ▪ tape ▪ markers ▪ pipe cleaners ▪ additional art materials of your choice 	<p>For each team of 4:</p> <ul style="list-style-type: none"> © 4 dissecting needles © 4 plastic pipets or droppers ▪ 4 plastic spoons ▪ masking tape ▪ paper towels ▪ 2 pieces of string, each about 35 cm ▪ ¼ cup vinegar in a small plastic cup ▪ aluminum cake pan 8 x 8 inch filled ¾ full with dry sand and 4 imitation rocks (see recipe at right) 	<p>Imitation Rock Recipe/Dig Site Preparation</p> <p>To make the rocks:</p> <ul style="list-style-type: none"> © About ½ oz Indian seed beads (2 packets) in the following colors: yellow, white, orange, red, green, blue, and black ▪ 1 ½ cups flour ▪ ½ cup salt ▪ 4 tsp. Alum ▪ ¾ cup baking soda ▪ 1 cup sand with small gravel ▪ ¾ cup water ▪ 4-5 drops red, blue and yellow food coloring <p><i>In a mixing bowl, combine all ingredients and shape into small round "rocks" about the size of a marble. Bake "rocks" on a cookie sheet at the lowest possible temperature setting for 2-3 hours.</i></p> <p>To make the dig site:</p> <p><i>Once the rocks have cooled, bury four of them in each cake pan, placing them in different sections of the pan. Cover rocks with dry sand, filling each pan ¾ full.</i></p>

POLLINATION

Watch the 18-minute video on Peg Bolick, a pollen specialist who is Curator of Botany at the University of Nebraska State Museum. Then make models of a bee and a flower and act out the role a bee plays in flower pollination.



BEFORE YOU BEGIN

Teams of 3

Length:
Part I - 60 mins.,
including 18-min. video
Part II - 30 mins.

WHAT YOU NEED

For the entire group:

© 18-min video *Peg Bolick, Pollen Detective*

For each team of 2:

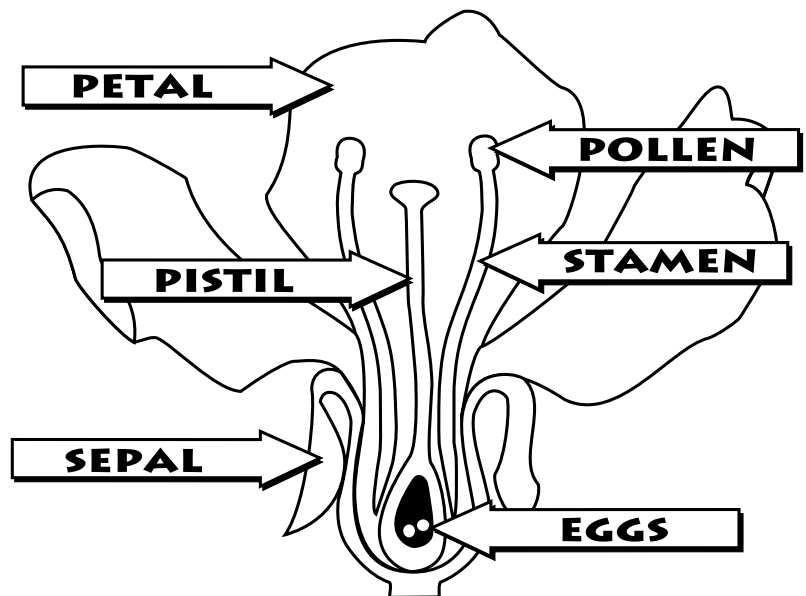
- crayons or colored pencils
- 2 cotton balls
- scissors
- 3 colors of powdered tempera paint in small containers with cotton swabs
- manila folder or lightweight cardboard
- glue and/or tape

What We Know. Everyone knows that flowers bloom in the spring. But have you noticed what else happens during that time of the year? Insects return to our yards and to the fields, forests, and deserts. They come because they are attracted to the flowers' beautiful petals and sweet smell. Insects know just where to go to get the good stuff. They go to the center of the flower where nectar is made. As the insect drinks the sweet nectar, it touches flower parts that are covered with

sticky pollen. When the nectar in the first flower dries up, the insect moves to another flower, unaware that it carries pollen from the first flower it visited. The pollen on the insect's body dries, becomes less sticky and is easily brushed off onto the next flower. The insect continues visiting one flower after another all day long. Scientists say the insects are pollinating the flowers. This process called pollination often begins in the spring and ends in the summer.

Part One: Making Flower Models

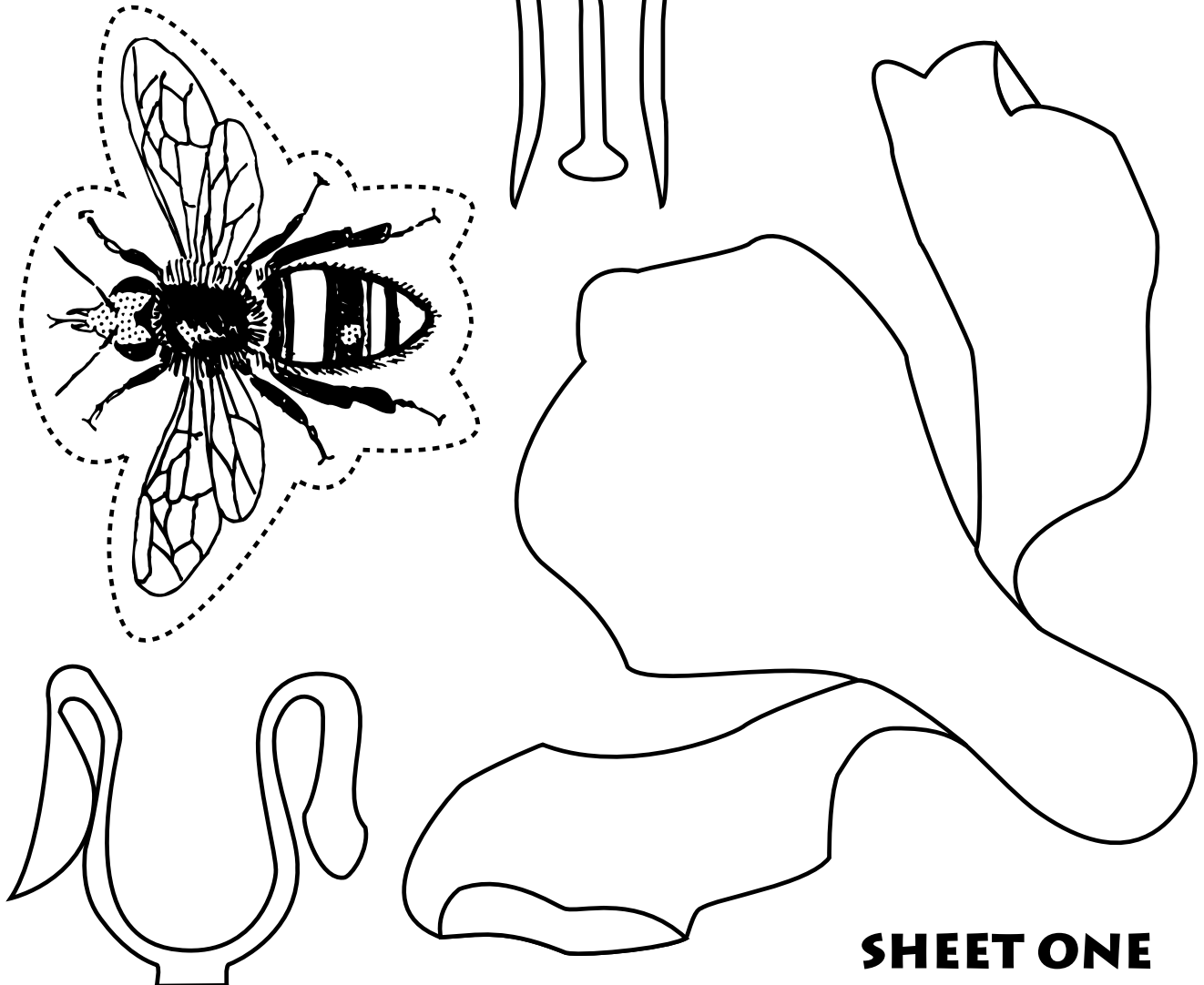
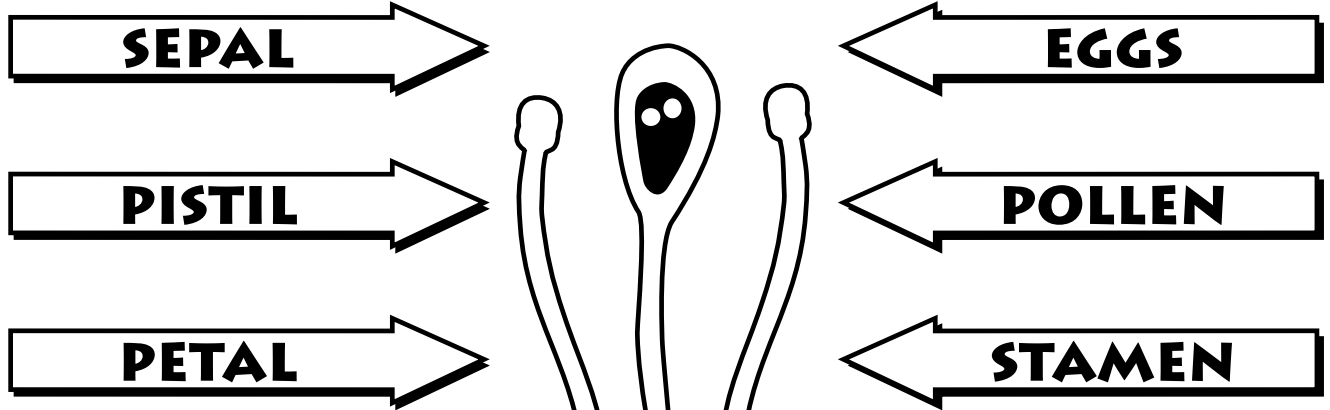
- 1 Watch the video of Peg Bolick. Then explore how bees fertilize flowers.
- 2 Use your scissors to cut out the flower parts, the bee, and the labels on Sheet one (p.4). Practice learning the flower parts by looking at the picture below and laying your cut-out parts over the flower parts and labels on Sheet two (p.5). Color the petals.
- 3 Work with the person next to you to test each other on the flower parts until you know them all. When you have learned them, each of you should glue the flower parts onto Sheet 2. Next, glue the labels in the correct place over the flower parts.
- 4 Tear two tiny pieces of cotton from your cotton ball and glue them to the tip of each stamen. You may also substitute cotton swabs for the stamens.
- 5 Use a yellow crayon to color the bee. Glue your bee to lightweight cardboard or a folder. Cut out the bee again. Use a piece of tape to attach the rest of your cotton ball to the underside of the bee.
- 6 Divide into groups of three. Ask one member of the group to go to the materials table and get the three different colors of powdered paint. Each of you will choose a different color for the stamen on your flower. What color will you use? Use a cotton swab to place a small amount of powdered paint on the cotton on the top of both stamens. The paint represents the pollen.
- 7 Organize your completed flower models next to each other on the table to create a "garden" that you will use in Part two.



POLLINATION

ACTIVITY
ONE

Part One: Making Flower Models (cont'd)

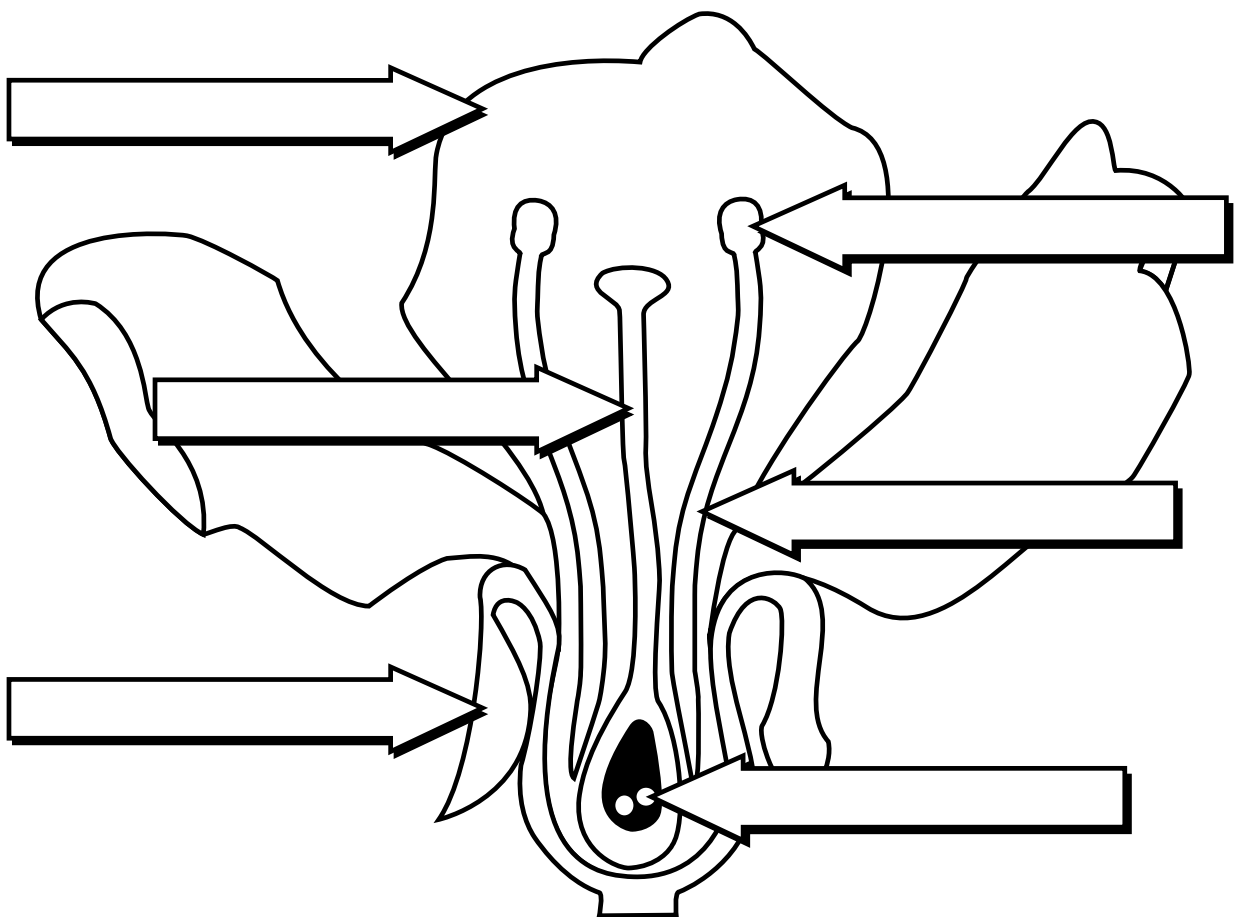


SHEET ONE

POLLINATION

ACTIVITY
ONE

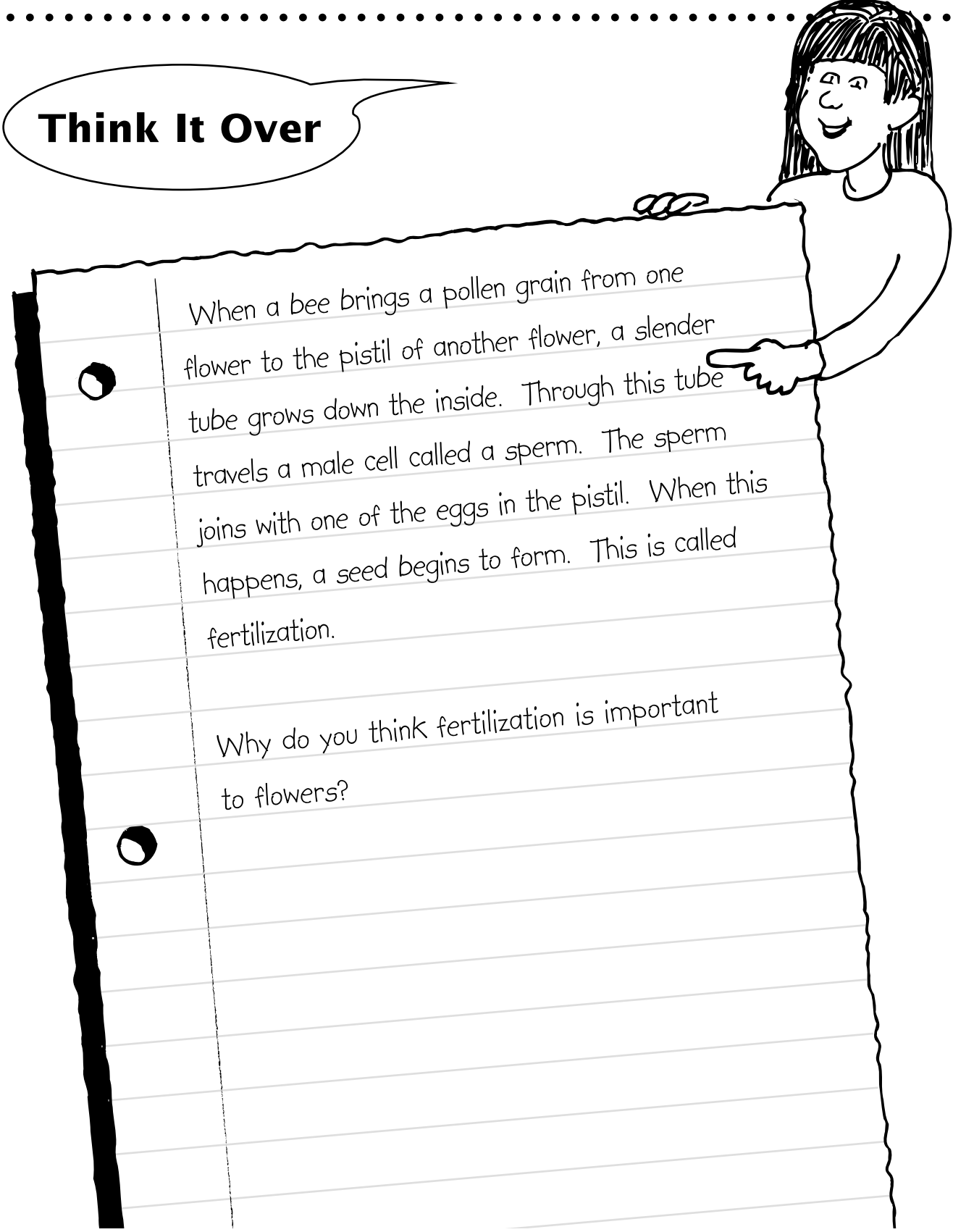
Part One: Making Flower Models (cont'd)



SHEET TWO

POLLINATION

Think It Over



When a bee brings a pollen grain from one flower to the pistil of another flower, a slender tube grows down the inside. Through this tube travels a male cell called a sperm. The sperm joins with one of the eggs in the pistil. When this happens, a seed begins to form. This is called fertilization.

Why do you think fertilization is important to flowers?

Part Two: Pollination Role Play

There are three roles to play in the Pollination Role Play. The first person will play the role of the GARDENER and read the instructions. The second person will be the STORYTELLER and will read the story. The third person will play the BEE. The bee will listen and follow the instructions given by the gardener. Decide now who will play each part. After you have gone through it once, trade parts and continue playing until everyone has had a chance to act the part of the bee.

Storyteller: Bees have been pollinating flowers for millions of years. But what is pollination and how does it happen? Let's find out.

Gardener: (Says to bee.) Pick up your bee and hold it over one of the flowers.

Storyteller: During pollination the bee flies from flower to flower to collect nectar and pollen. As the bee stretches its tongue into the flower to reach the nectar, its underside gets covered with pollen.

Gardener: (Says to bee.) Rub the tops of the stamens (where you put the powdered paint) with the cotton on the underside of the bee.

Storyteller: Now the bee goes away to another flower but some of the pollen from the first flower remains on its body. Do you see "pollen" on your bee?

Gardener: (Says to bee.) Move your bee to the next flower. Rub the top of this flower with the cotton underside of your bee.

Storyteller: Some of the pollen from the first flower gets rubbed onto the pistil of the second flower. The bee continues moving from flower to flower, picking up new pollen and leaving pollen from the last flower.

Gardener: (Says to bee.) Look at your bee's underside. Did it collect any pollen? If not, go back and touch the stamens of each of the flowers again.

Storyteller: The bee has helped the flowers share their pollen. The pollen from all three flowers is now mixed.



POLLINATION

ACTIVITY
ONE

Think It Over



1. How does the flower attract the bee?

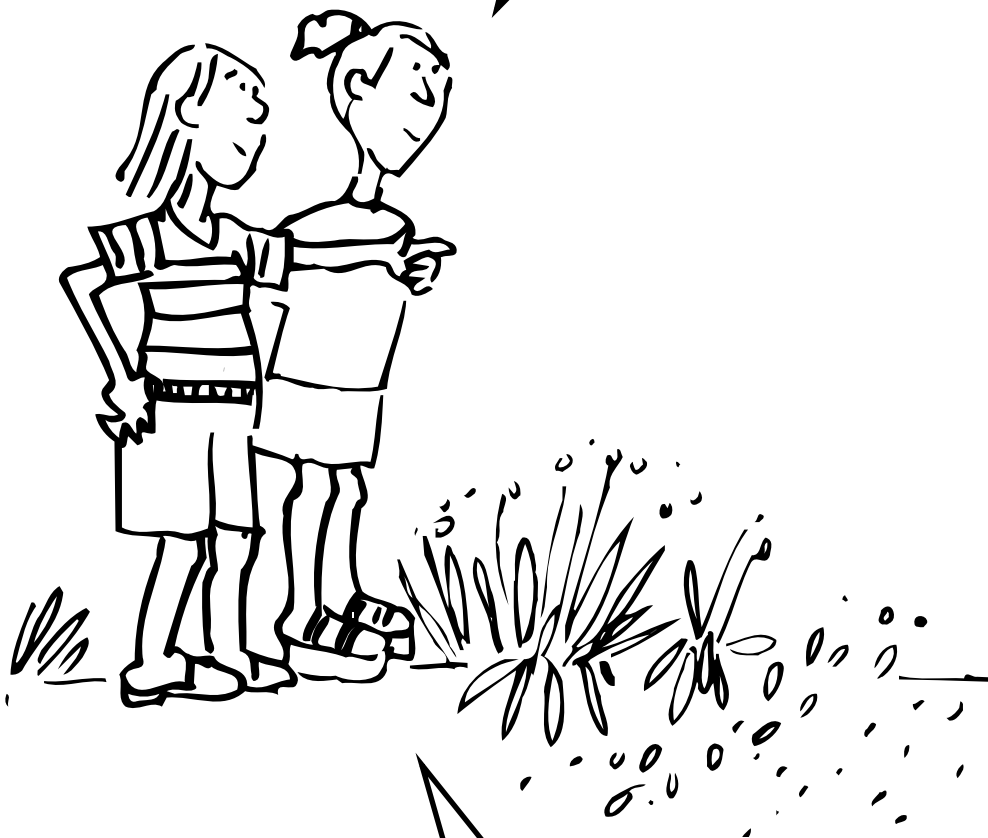
2. Why does the bee go from flower to flower?

3. As the bee travels from flower to flower, it accidentally carries something with it from the last flower. What is it?

IN SEARCH OF POLLEN

ACTIVITY
TWO

Plant scientists called botanists learn about flowers by dissecting them — that means you take a flower apart. Your mission is to dissect a flower to find where the pollen is. Along the way you will learn about other flower parts.



What We Know. Cover your sneeze, please! Have you ever had someone tell you to do this? Think about the last time you sneezed. Did you have a cold or were you just having a sneeze attack? Something in the air probably made you sneeze. It could have been good old common house dust or it could have been pollen. Most likely it was pollen.

What is pollen? Where is it found?

Pollen is the yellowish powder you can see on the legs of a honeybee. Each grain of pollen is so tiny (ragweed pollen is 20 micrometers in size) you need to use a microscope to see individual grains. Pollen is part of a flower. It helps plants reproduce and make seeds.

Before You Begin

Teams of 2

Length:
Part I — 30 mins.
Part II — 30 mins.

What You Need

For each team of 2:

- ⊙ 1 dissecting needle
- ⊙ 1 magnifying lens
- 1 fresh flower (lily flowers work best; florists sometimes will donate day-old flowers)
- 1 roll of clear tape
- 1 piece of cardboard or thick paper

IN SEARCH OF POLLEN

ACTIVITY
TWO

Part One: Learn Your Parts

1 Look at the flower diagram on the next page. Match the flower parts shown on the diagram with those on the real flower. Use your magnifying lens to look carefully at your flower.

2 Draw and label a picture of your flower in the space below.

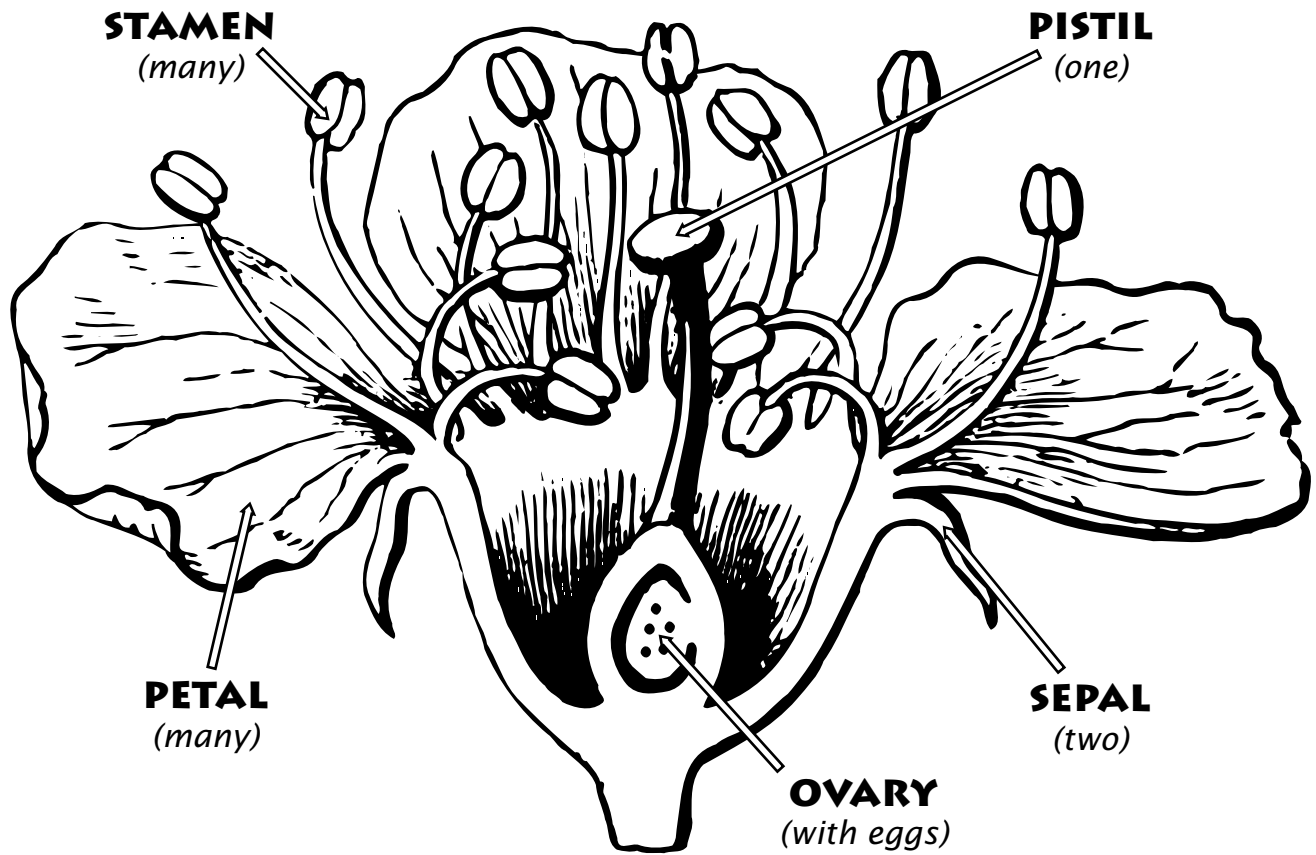
3 In the space below make a list of the flower parts you recognized on your flower.

Good job.

IN SEARCH OF POLLEN

ACTIVITY
TWO

Part One: Learn Your Parts (cont'd)



CHERRY FLOWER

IN SEARCH OF POLLEN

ACTIVITY
TWO

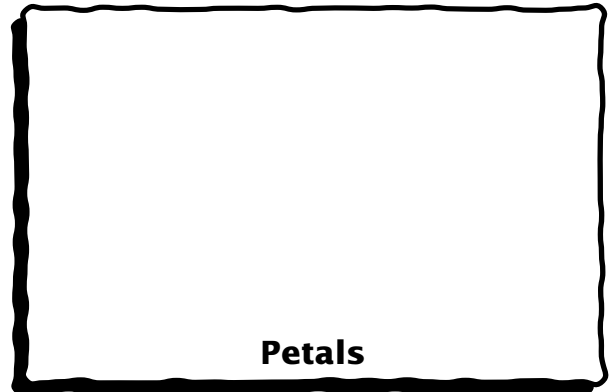
Think It Over



Part Two: Dissecting a Flower

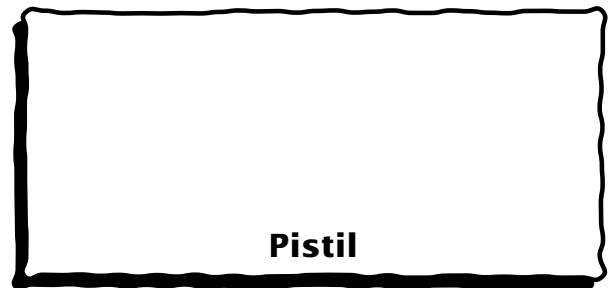
1 The first thing you will notice about your flower are the attractive petals. These are usually large and brightly colored. Choose two of the best-looking petals. Using your dissecting needle, carefully remove them from the flower by scraping at the base to free them. Tape them inside the rectangle labeled **Petals**.

Do you see any pollen on the petals?



2 At the center of the flower is the pistil. If you cannot find the pistil, look again at the picture to see where it is located. Carefully remove the pistil and tape it in the rectangle labeled **Pistil**.

Do you see any pollen on the pistil?



3 You will also find many stamens inside the flower. Gently pull off one stamen from the base. Look carefully at the top with a hand lens.

Do you see any pollen on the top?

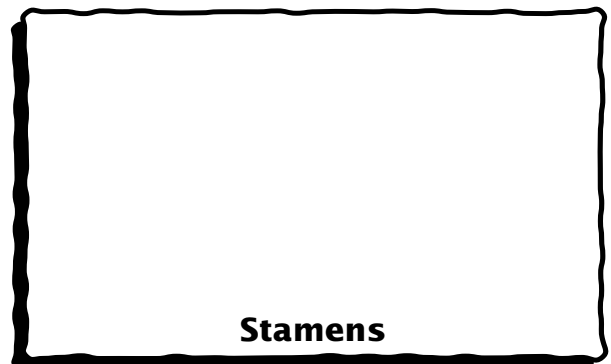
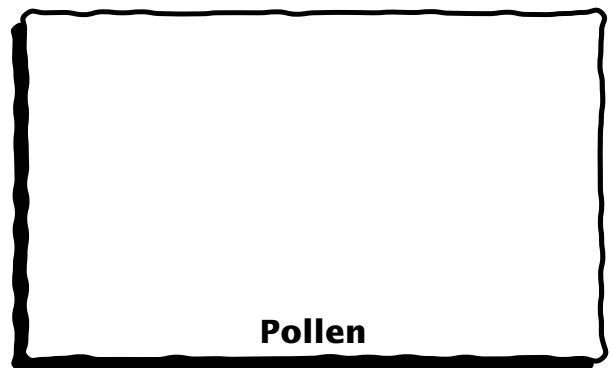
Shake the stamen or use your dissecting needle to scrape the top of it while holding it over the rectangle labeled **Pollen**.

Do you see any pollen?

Place a piece of tape over the pollen.

Now, tape at least 2 stamens to the square labeled **Stamens**.

Great work! You are almost finished. Take a close look at your book. Did you carefully secure the plant parts in the correct places? Compare your book with another person's to check your work.



IN SEARCH OF POLLEN

ACTIVITY
TWO

Think It Over



Was your search for pollen successful? If not, find someone who did find pollen and answer the following questions:
Describe where you found the pollen.

Why is pollen important to the flower?

MEDICAL MYSTERY

ACTIVITY
THREE

Work with a partner to try to solve a medical mystery. One of you will be a detective on the medical case, the other will be the main character in the story.



Before You Begin

Teams of 2

Length:
Part I - 30-45 mins.
Part II - 30 mins.

What You Need

For each team of 2:

- 4 colored pencils
- pen or highlighter marker

What We Know. Doctors estimate that 35 million Americans have allergies. Does this include you or someone in your family? What is allergy? Allergy is a reaction made by the body against things that do not usually hurt us. For example, your body may “mistake” dust for an invader. You breathe it in and suddenly your body reacts by making you sneeze. Your eyes may turn red and water. If you are allergic to the dust, you may develop stuffiness in the nose, a sore throat, and even a cold.

For people who suffer from hayfever (an allergy to pollens from grasses, trees, and weeds)

certain times of the year are miserable. Other people may be allergic to things they have around them all the time, like pets, dust, or certain foods and medicines.

People with allergies sometimes also have asthma. During an episode with asthma, a person will experience difficulty breathing because muscles that control their air passages tighten. Asthma is a disease that can be brought on by many things, like pollen, stress, and exercise. Like most diseases, asthma can be treated with medicine.

Part One: Gathering the Facts

Read the story about a girl named Tasha who is ill. Your goal is to determine why she is ill and what caused her illness. Use a pen or highlighter marker to underline anything that sounds like a good clue.

Tasha's Story

It was well into the night when Tasha became restless in her sleep. She tossed and turned as she began struggling to breathe. Was she awake or asleep? Tasha could hear herself trying to breathe. If only I could breathe, she thought to herself. It seemed like there was a heavy weight resting on her chest.

Tasha slowly moved herself out of bed and down the stairs to her parents' room. Her parents woke with a start but were glad that she had come to see them. As her mother hugged her, tears filled Tasha's eyes and she continued to make noise with every breath. Together they talked about the other times Tasha woke up, gasping for breath, and tried to figure out just when those times were.

Tasha recalled that last spring was the first time she had become sick like this. She remembered that on the day before the school picnic in March, she had spent all afternoon helping her teacher set up a scavenger hunt in the maple tree grove. That night she also woke struggling for each breath.

Tasha's parents reminded her about the second time she had become ill and woke up in the night. It was during June, when Tasha had insisted that her mother let her try out the new lawn mower. The next day Tasha missed a barbecue and fun with Grandma and Grandpa because she was sick again. Tasha was sick for over a week that time.

Here it was September already and Tasha had been back to school for over a week. Today must be September 17th, Tasha thought, because tomorrow was the day her sixth grade class was going on a field trip to the museum. Tasha tried to think about all the things she had done during the day today. She remembered that she and her friend had gone to the playground to pick flowers that were growing under the ragweed. She also remembered that in early September she had raked the leaves in the yard after school.

As Tasha considered all of the different times she had been sick, she became even more upset. That night her parents took her to the hospital emergency room to see their family doctor, Dr. Q. Tasha and her parents were determined to understand why this was happening.

Part One: Gathering the Facts (cont'd)

Read Dr. Q's Investigation. Again, underline or highlight any information that you think may help you solve the mystery.

Dr. Q's Investigation

Tasha has now reached the hospital, where she is immediately treated for asthma. The doctor explains that asthma is caused when the muscles that control the air passages constrict or tighten and make breathing difficult. Swelling also occurs inside the air passages and interferes with breathing. This is usually brought on by an allergic reaction. The doctor asks her to return to his office the next day for some allergy testing.

The next morning Dr. Q calls Dr. Peg Bolick, the pollen specialist. Dr. Q needs to know what kind of plant pollens are

in the air. Dr. Bolick takes a pollen count each morning from the top of her building at the University of Nebraska. Then she shares the pollen information with specialists like Dr. Q. The doctor uses the information to help him decide what may be causing the illnesses of some of his patients.

When Tasha arrives at his office, Dr. Q places a small amount of different pollen extracts on Tasha's skin. She reacts positively to several of them. Tasha is highly allergic to one of the pollens she is tested for and, according to Dr. Bolick, this pollen has a high count for this time of year.



Part One: Gathering the Facts (cont'd)

The Interview

Role play a pollen detective interviewing Tasha. With your partner, decide who will be the detective and who will play Tasha. Write your name next to your role below:

Detective: _____ **Tasha:** _____

The detective begins the interview by asking Tasha the following questions. The detective records what Tasha says in the space provided.

1. Detective: “Tasha, let’s think back to the beginning of your story. How did you feel when you first woke up that night?”

Tasha’s reply:

2. Detective: “Tasha, in the last six months have you ever felt like this before? If so, please tell me when. Be as specific as you can.”

Tasha’s reply:

3. Detective: “Tasha, where had you been on the days you got sick?”

Tasha’s reply:

4. Detective: “Tasha, do you think that the places you went or the things you were doing had anything to do with the fact that you got sick? Please explain.”

Tasha’s reply:

5. Detective: “Tasha, the last time you were sick was in September. What kind of plants were you around at that time?”

Tasha’s reply:

6. Detective: “Tasha, what do you think is making you sick during certain times of the year?”

Tasha’s reply:

Good work! You completed the interview.

Think It Over



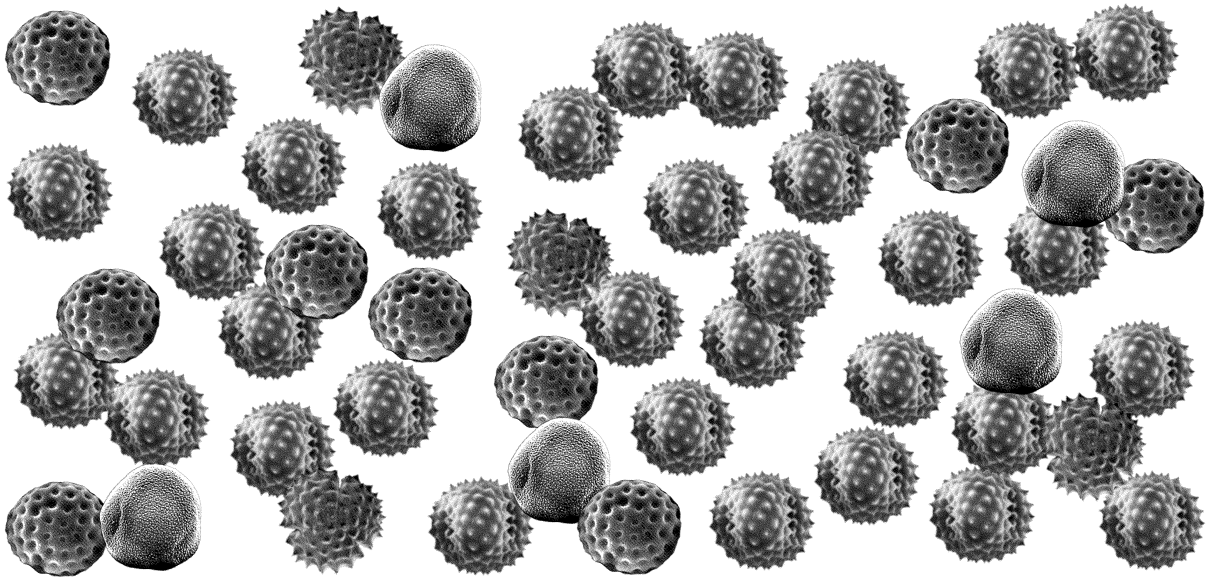
What do you think might be causing Tasha's illness? Write down your thoughts. Then try to state your conclusion in a single sentence. A scientist would call this idea a hypothesis.

Part Two: Producing the Evidence

A pollen detective needs evidence to make a case. Dr. Q's lab is the place to check the evidence and solve the mystery.

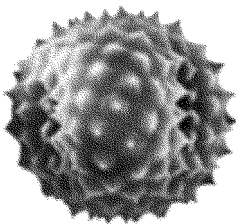
The Pollen Sample

Which pollen made Tasha sick in September? Look at the Pollen Sample below.

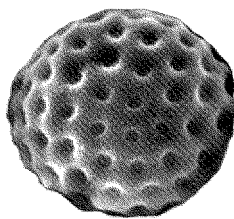


Use the Pollen Key to identify and count each type of pollen. Record how many of each type you count in the box under each pollen grain.

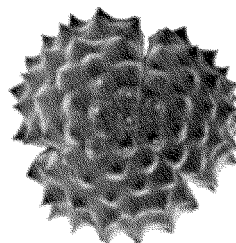
Pollen Key



Ragweed



Pigweed



Cocklebur



Grass

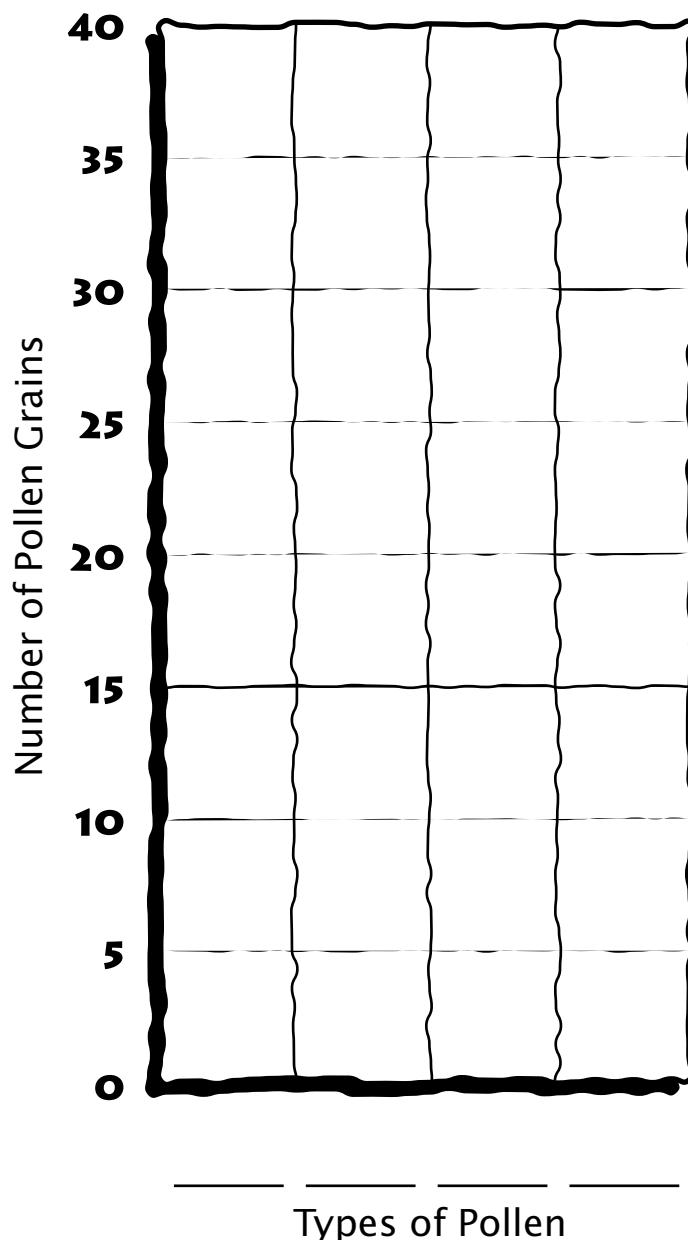
Remember to count and record how many of each pollen type you found.

Part Two: Producing the Evidence (cont'd)

Graphing

Using the pollen counts you recorded on the last page, make a bar graph to show how many grains of each pollen you found. Use a different color of pencil for each type of pollen. Make up a title for your graph.

Graph Title: _____



Part Two: Producing the Evidence (cont'd)

Summarizing Results

1 Which pollen type has the lowest number? _____

Which pollen type has the highest number? _____

2 Which pollen do you think caused Tasha's asthma in September? _____

3 Read Doctor Q's Final Report to find out what the doctor discovered.

Doctor Q's Final Report

Date: **September 20, 1994**

Patient: **Tasha**

Doctor: **Dr. Q**

Report

Tasha had an episode of asthma on September 17. She was brought to the hospital by her parents, treated and sent home after her recovery. Later the next day, several allergy tests were run in our lab.

Tasha should be aware of the early warning signs that signal the onset of an asthma episode. Some of them are:

- | | | |
|--|--|--|
| <input type="checkbox"/> Funny feeling in the chest | <input type="checkbox"/> Feeling weak | <input type="checkbox"/> Heart beating faster |
| <input type="checkbox"/> Feeling spacey | <input type="checkbox"/> Coughing | <input type="checkbox"/> Itchy, watery eyes |
| <input type="checkbox"/> Getting upset | <input type="checkbox"/> Sneezing | <input type="checkbox"/> Mouth feeling dry |

Tasha should also remember that if she feels an episode coming on she should do the following: Stay calm, call Mom or Dad, think, drink water, and rest.

Lab Results

Tasha's lab results show her to be very sensitive to ragweed pollen. We think that ragweed pollen is the pollen that triggered Tasha's last asthma episode.

MEDICAL MYSTERY

ACTIVITY
THREE

Think It Over

How did graphing the pollen counts help you
and Dr. Q solve the mystery?

FLOWER ENGINEERS

ACTIVITY
FOUR

Flowers are designed to attract insects, and the designs are as different as the insects they attract. Be a flower engineer and design and build a model of a flower that will attract a honeybee, a flower beetle, a hawkmoth, or a butterfly.



Before You Begin

Work as individuals

Length:
Part I - 30-45 mins.
Part II - 30 mins.

What You Need

For each participant:

- construction paper
- tissue paper
- scissors
- glue
- tape
- markers
- pipe cleaners
- additional art materials of your choice

What We Know. If flowers could talk, they would be saying: "Look at me, I am open for business!" But what kind of business are flowers in? Why do they advertise themselves with beautiful shapes, colored petals, and sweet-smelling nectar?

Because flowers cannot move, they use their shapes, colors, and smells to attract insects. The insects help flowers get in touch with other flowers of the same kind. Insects are hungry for nectar, the sweet-smelling liquid inside the flower. As the insect takes nectar from deep within the flower, it gets covered with pollen. The insect then moves from

flower to flower and is unaware that it is spreading pollen along the way. Insects that move pollen from flower to flower are called pollinators.

This turns out to be a pretty good deal for both the insect and the flower. The insect needs the nectar from the flower for energy, and so goes from flower to flower collecting it. Meanwhile, the flower needs pollen from another flower and gets it from the insect.

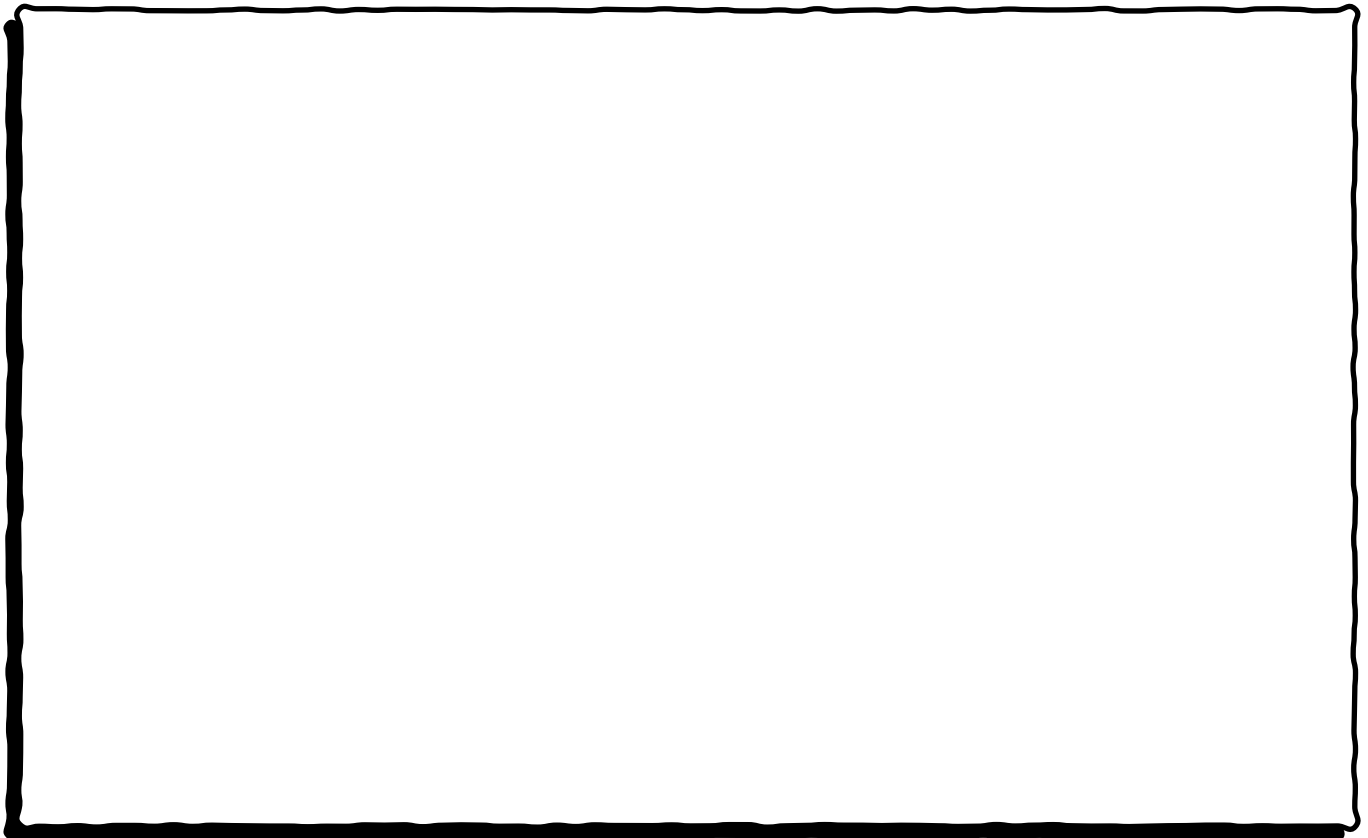
Do the insects go to just any flower? No. Certain insects are attracted to certain flower shapes and colors.

Part One: Flower Building Project

Build a flower to attract a particular pollinator.

- 1** Look at the Pollinator Chart on page 26. Which pollinator interests you the most? Find out what flower color and shape your pollinator is attracted to. Keep the name of your pollinator a secret. Later you will survey your classmates to see if they can match your flower to an insect pollinator.
- 2** Decide which flower you will build. To help organize your plan, draw your flower below. Decide on the number and color of petals. How many stamens will you include and where will you put them?
- 3** Label the following structures on your drawing: stamens, pistil, petals, leaves, sepals.

Flower Drawing Space



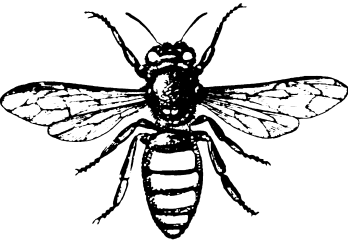
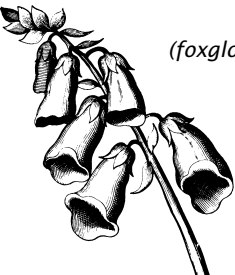
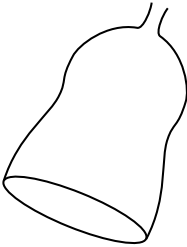
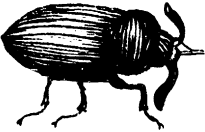
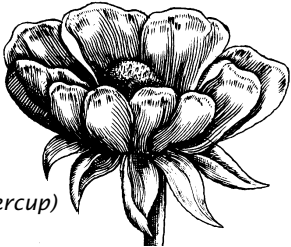
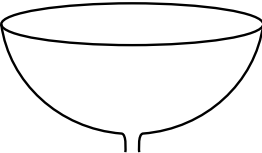
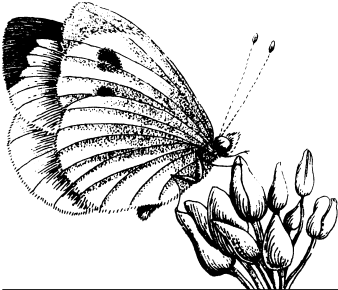
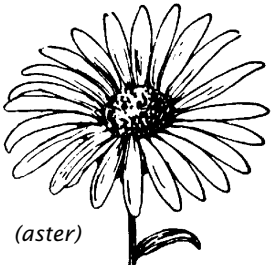
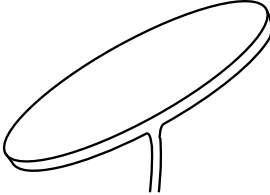
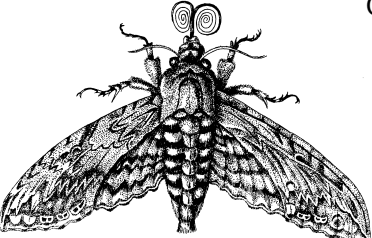
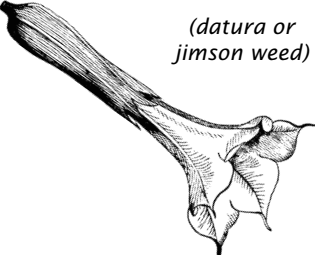
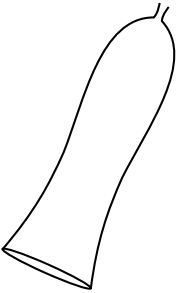
- 4** Gather materials. Build your flower.

FLOWER ENGINEERS

ACTIVITY
FOUR

Part One: Flower Building Project (cont'd)

POLLINATOR CHART


Pollinator	Petal Color	Flower Shape	General Shape	How Pollen Is Gathered
HONEYBEE 	Blue, Yellow, Pink or Red	Bell or Funnel-shaped  (foxglove)		Honeybee walks around on flower. Pollen sticks to hair. Nectar is sipped to make honey.
FLOWER BEETLE 	Usually dull colors (Gray or White)	Flat or Bowl-shaped  (buttercup)		Beetle eats pollen grains or drinks nectar. Pollen sticks to abdominal hairs.
BUTTERFLY 	Blue, Yellow, Red or Pink	Upright shaped  (aster)		Butterfly uses its long tongue to sip nectar. Pollen sticks to its hairs or legs.
HAWKMOTH 	White or Green	Deep Tube-shaped  (datura or jimson weed)		Hawkmoth inserts long tongue into nectar-filled tube and sips nectar. Pollen sticks to hairs.

Use the information you see on this chart when designing and building your flower.

FLOWER ENGINEERS

ACTIVITY
FOUR

Think It Over



Which part of your flower do you think would be most attractive to your pollinator?

FLOWER ENGINEERS

Part Two: Flower Shape Survey

Conduct a survey to see how many students can match the correct pollinator to your flower. Use the chart below to record your data.

- 1 Ask five people the question: What pollinates my flower?
- 2 Record each person's name and response in the table below.

	Answers
Person #1	
Person #2	
Person #3	
Person #4	
Person #5	
	TOTAL:

- 3 Tell why you think you did a good job designing and building your flower:

FLOWER ENGINEERS

ACTIVITY
FOUR

Think It Over

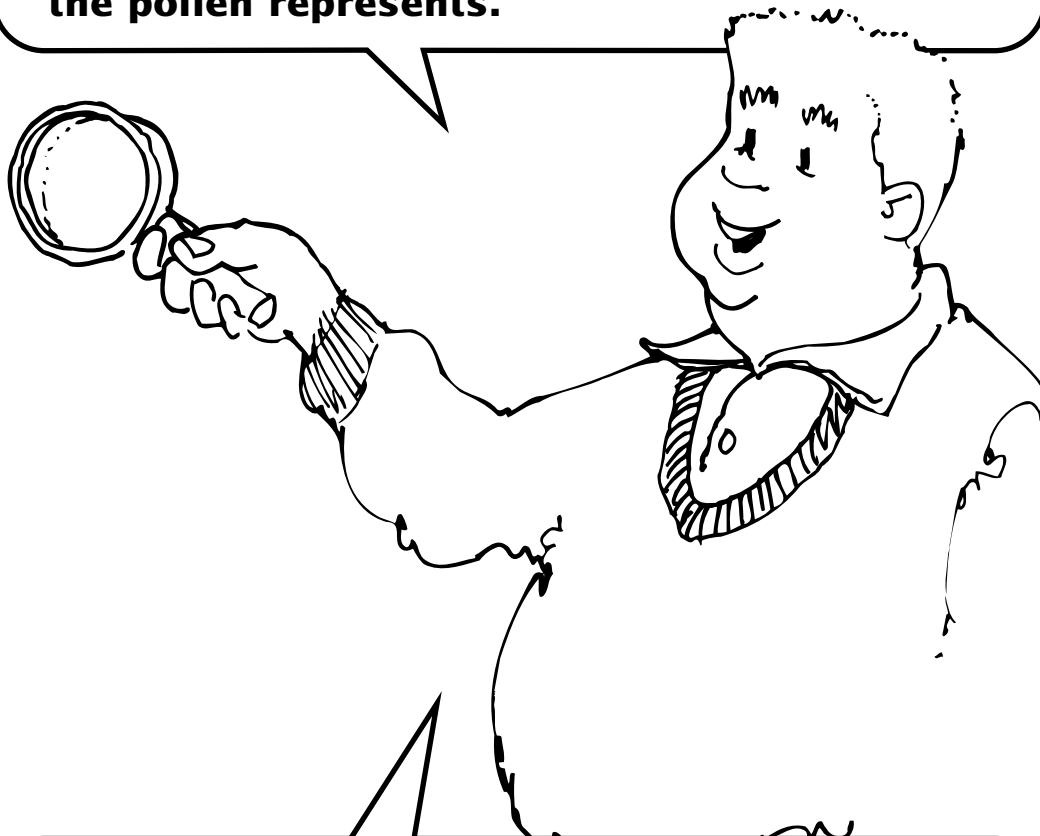
From the results of your survey, tell what you might do next time to improve your flower design.



POLLEN TRACKS

ACTIVITY
FIVE

A pollen detective's most challenging and fun job is "digging" for pollen fossils. Go on a dig for imitation rock samples containing "pollen" from ancient plants. Then extract the pollen from the rocks and determine which plants the pollen represents.



What We Know. The excitement of discovery is an everyday affair for scientists called paleobotanists. These scientists search for fossil plants that are thousands, even millions, of years old. Paleobotanists dig for fossils hoping to find new answers to old questions about the plant life of long ago. But how do paleobotanists know where to dig for their clues? They dig in sedimentary rocks. These rocks formed when layer upon layer of

sand, dirt and mud were buried and pressed down, turning into rock. The scientist looks for plants or plant parts that may be trapped in the rock layers. Scientists have found fossil leaves, stems, and pollen. Sometimes flowers are found, but they are very rare. A fossil of one of the first flowers was found in Nebraska. It is millions of years old. How do scientists find fossilized pollen in rocks? Go on a dig and find out.

Before You Begin

Teams of 4

Length:
Part I - 60 mins.
Part II - 30 mins.

What You Need

For each team of 4:

- ⊙ 4 dissecting needles
- ⊙ 4 plastic pipets or droppers
- 4 plastic spoons
- masking tape
- paper towels
- 2 pieces of string, each about 35 cm
- ¼ cup vinegar in a small plastic cup
- aluminum cake pan 8 x 8 inch filled ¾ full with dry sand and 4 imitation rocks (see recipe at right)

Imitation Rock Recipe/Dig Site Preparation

To make the rocks:

- ⊙ About ½ oz Indian seed beads (2 packets) in the following colors: yellow, white, orange, red, green, blue, and black
- 1 ½ cups flour
- ½ cup salt
- 4 tsp. Alum
- ¾ cup baking soda
- 1 cup sand with small gravel
- ¾ cup water
- 4-5 drops red, blue and yellow food coloring

In a mixing bowl, combine all ingredients and shape into small round "rocks" about the size of a marble. Bake "rocks" on a cookie sheet at the lowest possible temperature setting for 2-3 hours.

To make the dig site:

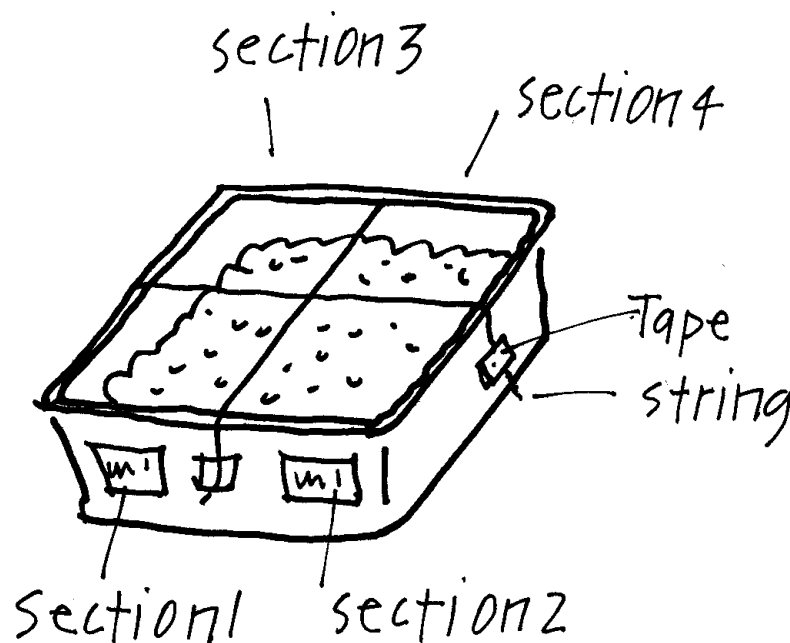
Once the rocks have cooled, bury four of them in each cake pan, placing them in different sections of the pan. Cover rocks with dry sand, filling each pan ¾ full.

Part One: The Dig

When paleobotanists go to a dig site they take along special tools, maps and recording instruments. It is very important that they record not only what they find, but exactly where they find it. Now you are the scientist. The steps in your dig include marking your site, digging for rocks, extracting pollen from the rocks, and identifying the pollen. Follow the steps carefully!

Marking the Site

- 1** Gather your materials: cake pan, strings, masking tape, spoons, paper towels.
- 2** Lay the string over the cake pan so that it divides your dig site into four even and identical sections. Tape the string ends to the sides of the pan to hold the string tight.
- 3** Use masking tape to label each section of your container with a team member's name. This is the section where you will dig.



.....

Part One: The Dig (cont'd)

4 Below is a drawing that represents your team's dig site. Label it with the same names you used on the actual site.

Section 1 Name _____	Section 2 Name _____
Section 3 Name _____	Section 4 Name _____

Digging for Rocks

Use a plastic spoon to dig in your section. Look for rocks that are about the size of a marble. Pick the rocks out of the sand and place them on a pile of paper towels. As you find each rock, record or draw where you found it on the sheet above.

Part One: The Dig (cont'd)

Extracting the Pollen

Now you have to get inside the rocks to get the pollen out. Paleobotanists use very strong chemicals that break down the rock but do not change the pollen inside. How will you do it? Follow the directions below and find out.

1 Use the pipet to place 15-20 drops of vinegar (a weak acid) on the surface of your rock. Watch what happens. Continue to add drops of vinegar as needed.

2 Use the dissecting needle to completely take apart your rock. What do you see inside? You should find colored beads. Carefully remove and place the beads on a dry paper towel. Keep working until you have examined the entire rock. The beads you found represent the fossil "pollen."



Identifying the Pollen

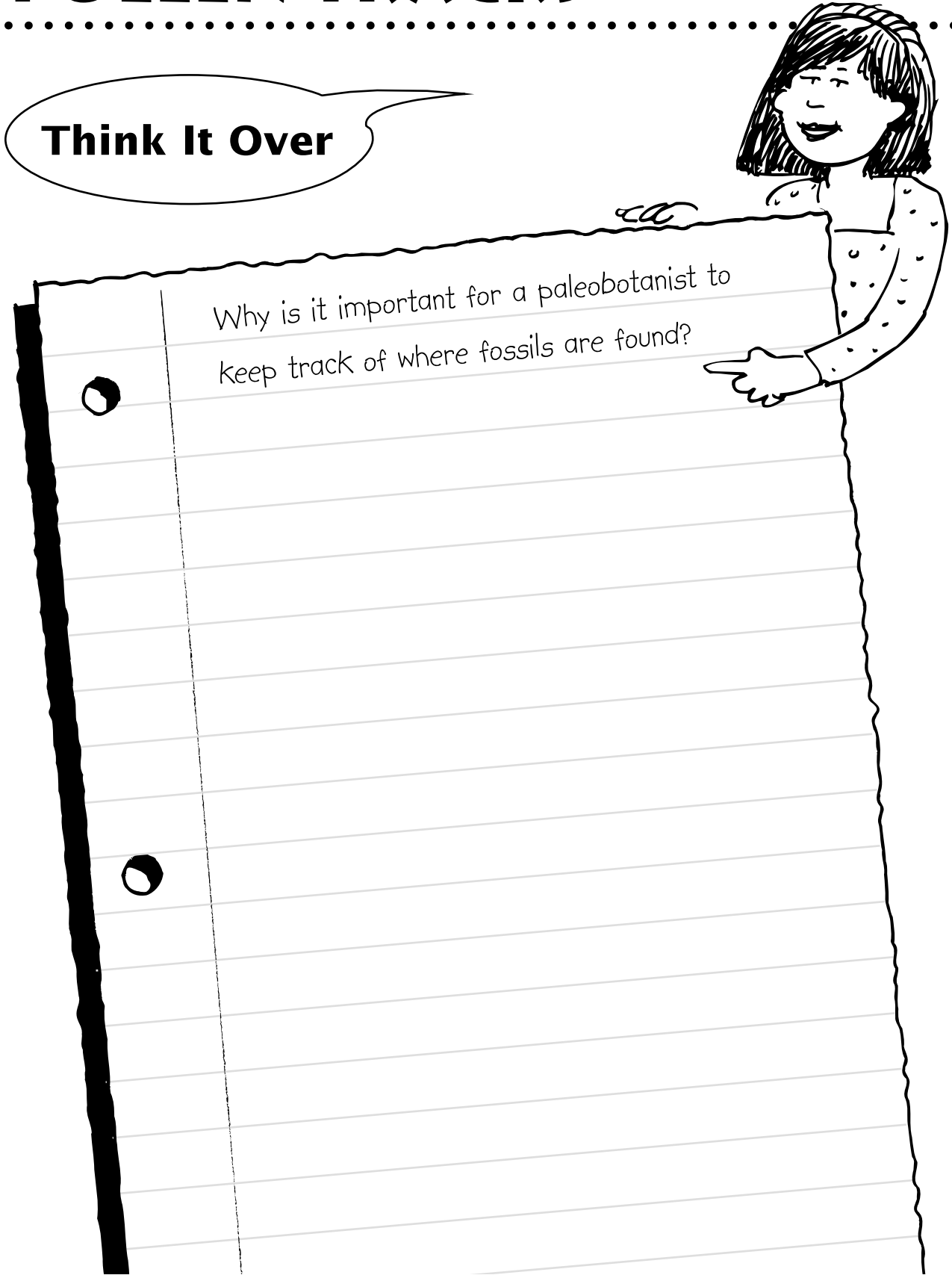
Your task as a paleobotanist is to find out what kind of "pollen" you have found. Use the key below to identify the "pollen" you found in your rock. Make tally marks to record the number of each kind of "pollen" you found.

POLLEN IDENTIFICATION TABLE							
Bead Color	Red	Green	Blue	Black	Yellow	Orange	White
Number of beads							
Plant Type	Ragweed	Grass	Sunflower	Pine tree	Cottonwood tree	Cattail	Birch tree

POLLEN TRACKS

ACTIVITY
FIVE

Think It Over



Why is it important for a paleobotanist to keep track of where fossils are found?

Part Two: Dig Site Report

Once a paleobotanist finishes a dig, she must record the data and share the results with other scientists. Now it is time for you to report the data from your dig.

- 1 Use your data from the Pollen Identification Table on p. 33. Find your section number from the dig site on the table below and record the number of pollen grains you found for each plant.
- 2 Take turns reading off your numbers to the rest of the group. Each of you should copy all the others' data on your own table.
- 3 Now, add the numbers going across the table for each plant and record a total number.

DIG SITE REPORT					
Type of pollen found	Section 1	Section 2	Section 3	Section 4	TOTAL
Ragweed					
Grass					
Sunflower					
Pine tree					
Cottonwood tree					
Cattail					
Birch tree					

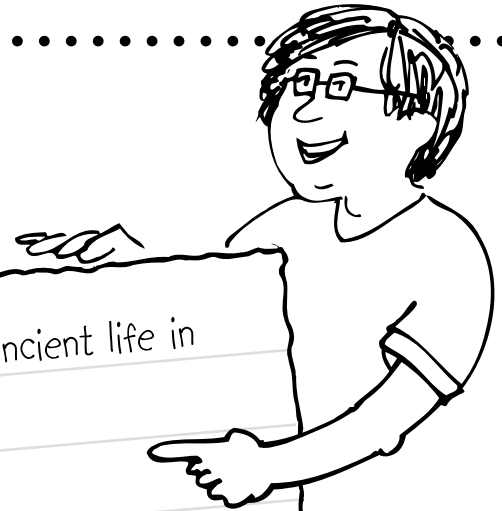
- 4 What are the three most common plants that once lived at your dig site?

Great job working as a paleobotanist!

POLLEN TRACKS

ACTIVITY
FIVE

Think It Over



What did your dig tell you about ancient life in that site?

PULLING IT ALL TOGETHER

**Create a story
about a scientist
who works with
pollen.**

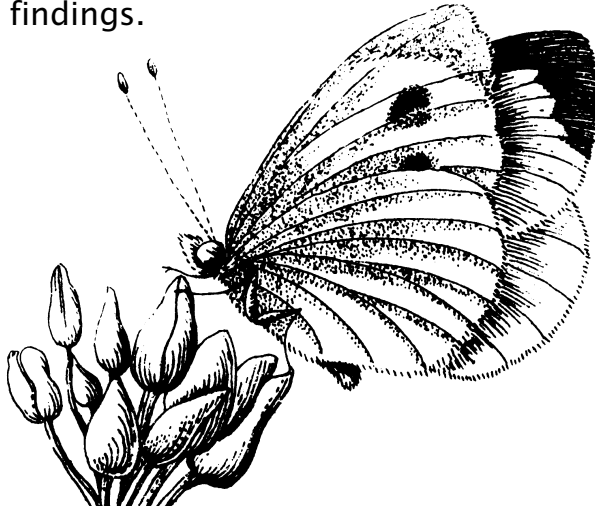


NEW WONDERS

Here are some ideas you might like to use for projects or exhibits.



1. Take photographs or draw pictures of a flower garden or a natural area. Pay attention to the insects that are pollinating. Use an insect field guide to identify them. Which insects are found on which plants? Make a poster to show your findings.



2. Invite an allergy specialist to speak with your group.

3. Get permission, and then plant a butterfly garden at home, school, or a public place. Start with plants like coreopsis, marigolds, and zinnias.

4. Design a survey that will help you find out how many kids in your group have allergies or asthma. Find out what kinds of plants or other substances they are allergic to. Make a poster that displays your data and results.

5. Investigate what plants lived in your state long ago. Design an ancient plant poster.