



The Butterfly Project Pollinator Curriculum Guide

The Butterfly Project
A Program of the Open Space Institute
Chrissy Word, Project Coordinator
Jill Weiss, Consultant
The Butterfly Project Work Team

the new york city
ENVIRONMENTAL*fund*
HUDSON RIVER FOUNDATION

Open Space Institute



How Does Pollination Work?

Activity Summary:

In this foundation lesson students will build on their plant knowledge by investigating the process of pollination. Students will identify the reproductive parts of the plant by labeling a diagram and then identify the tools a pollinator (bee) uses to help collect pollen. Students will playact the pollination process. This is a follow up to *Function of Plants/Flower Dissection* and leads into *Sorting Out the Pollinators*.

Background Information:

All life on Earth depends on plants to provide food, shelter and oxygen. Most flowering plants (~90%) depend on animals to make the vital pollen transfer known as pollination.

Pollination

Pollination is the sexual reproduction of plants - the transfer of pollen from male to female part of plants, which leads to fertilization. Male cells (sperm), packaged within pollen grains, fuse with egg cells (usually in the ovaries of a different plant) to generate seeds. In this process sperm is transferred by some outside agent - an animal pollinator, wind or (rarely) water.

Both male and female reproductive parts of a plant are at the center of the flower. Dust-like pollen grains (vessels of the male sex cells- gametes) are produced in an anther, the swollen tip of the stamen. For a flower to be fertilized and a seed to be produced, pollen must be transferred from an anther to a stigma, the sticky tip of a style, a stalk-like extension on the top of a carpel (the stigma, style and carpel form the outer, visible parts of the female reproductive organ known as the pistil). When a pollen grain reaches the stigma, it germinates and sends a microscopic tube down inside the style, carrying the gametes to the plant's ovules within the carpel. Once fertilized, the ovules become the hard seeds from which new flowering plants will grow.

Pollinators

A pollinator is an animal that moves pollen and can effect pollination. As mentioned above, some plants rely on other means (wind and water), but these are much less precise than deliveries made by animals. Pollinating animals do the job for the reward of food, usually in the form of nectar. Plants may reproduce only certain times of year, it is fast moving pollinators, like butterflies, bees, moths and birds that move from flower to flower and guarantee the pollination process.

It is estimated there are many thousands of pollinators, ranging from tiny invertebrates to primates. In New York City, the most common are insects: bees, butterflies, moths, flies and, occasionally, beetles.

Honeybees are probably the most common image that comes to mind when thinking of pollination. Bees are built for pollen collection as they feed this high protein food to their young. They have specialized hairs on their bodies or modified legs to help carry pollen back to their nests. It is also important to note that only female bees gather pollen. All bees may visit for nectar and thus accidentally transport pollen but it's the females that have the scopa (hairy parts of non-honey bee species that catches pollen) or the corbicula (pollen basket in honey bee females) that aids in the transport of pollen.



Bumblebees are energetic pollinators. A single bee can visit 240 flowers in a single trip to collect nectar and pollen, each time picking up and leaving behind a little pollen. Only two of those 240 flowers need to be of the same species to allow the possibility of fertilization.

Many plants dole out their nectar in small amounts throughout the day encouraging bees and other nectar feeders to keep moving and not stay too long at one flower. With this sort of rationing, the amount of energy invested in nectar can be kept low: a single apple tree produces just one ounce a day.

Activity 1 – “Parts” of the Plan

Location/Setting: A place to sit; a table or clipboard to lean on.

Subject/Skills/Discipline: Science, Reading/Writing, Research, Observe/Compare.

Grade Level: 3-8 Standards: S2, S4

Time: 15 – 30 minutes for initial talk and about 40 minutes for activity.

Materials List: Flower diagram per student, bee diagram per student. Optional: Plant part and/or bee part visuals or photographs.

Objectives:

- Students will recall the parts of a flower and demonstrate by labeling diagrams.
- Learners will identify the animal (bee) structures involved in pollination.
- Educators assess what the students have learned using a KWL (What I know, What I want to know, What I learned) chart.

Procedure:

1. Announce the topic (pollination) to the class and introduce the KWL chart. Assess the students' knowledge about the topic by asking questions such as:

Have you heard of pollination before?

Allow students to continue trying to explain, write correct and related answers in the first column.

Ask: *Is that all? Do we need to know more?*

Insert these answers in the center column.

Pollination		
What I know	What I want to know	What I Learned
Flowers need pollination to reproduce. Bees and butterflies are pollinators.	How do bees and butterflies pollinate the flower? How does the flower attract the bee or butterfly?	

(Some sample answers included above.)

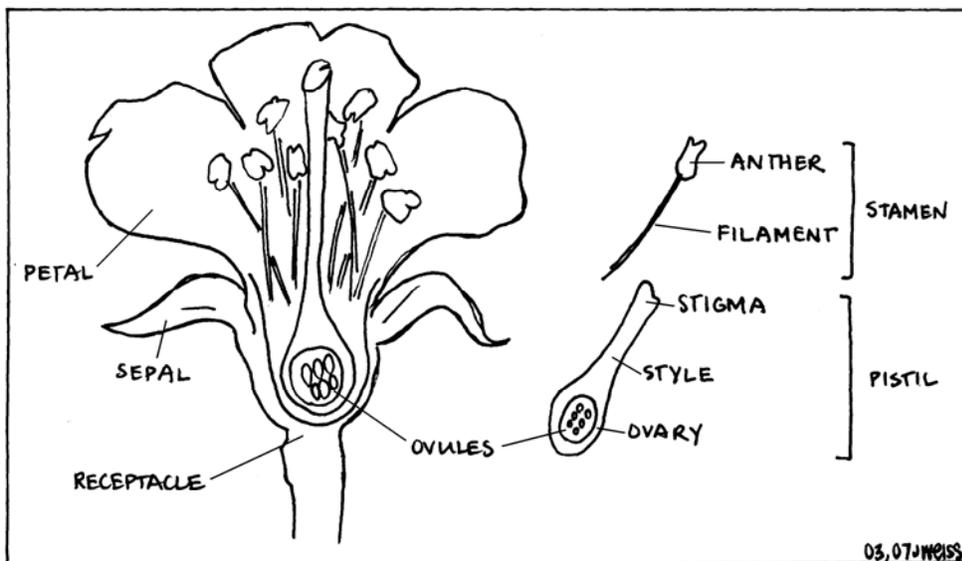
Share the definition of pollination, and some information from the background section above.

Pollination – to pollinate

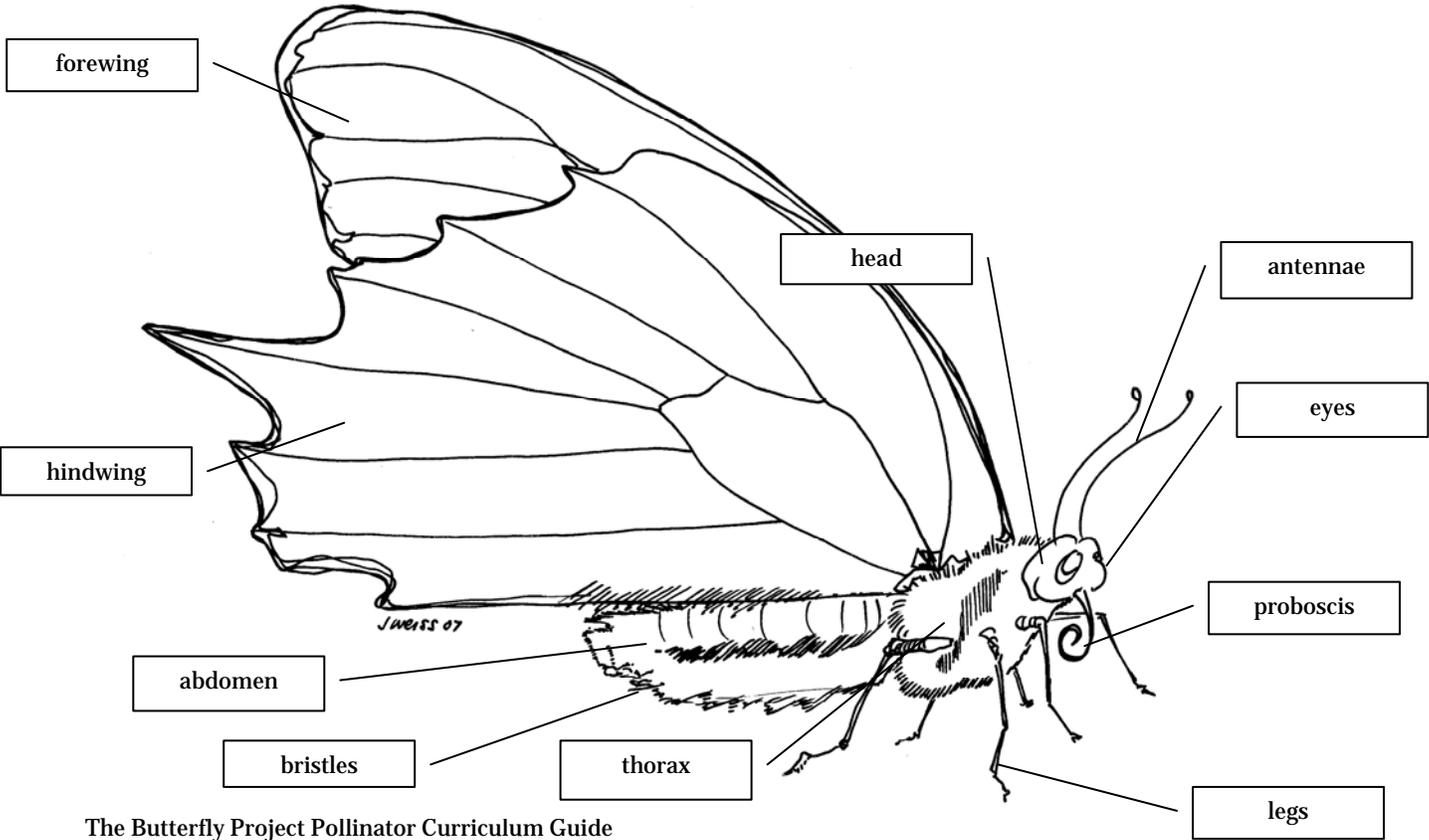
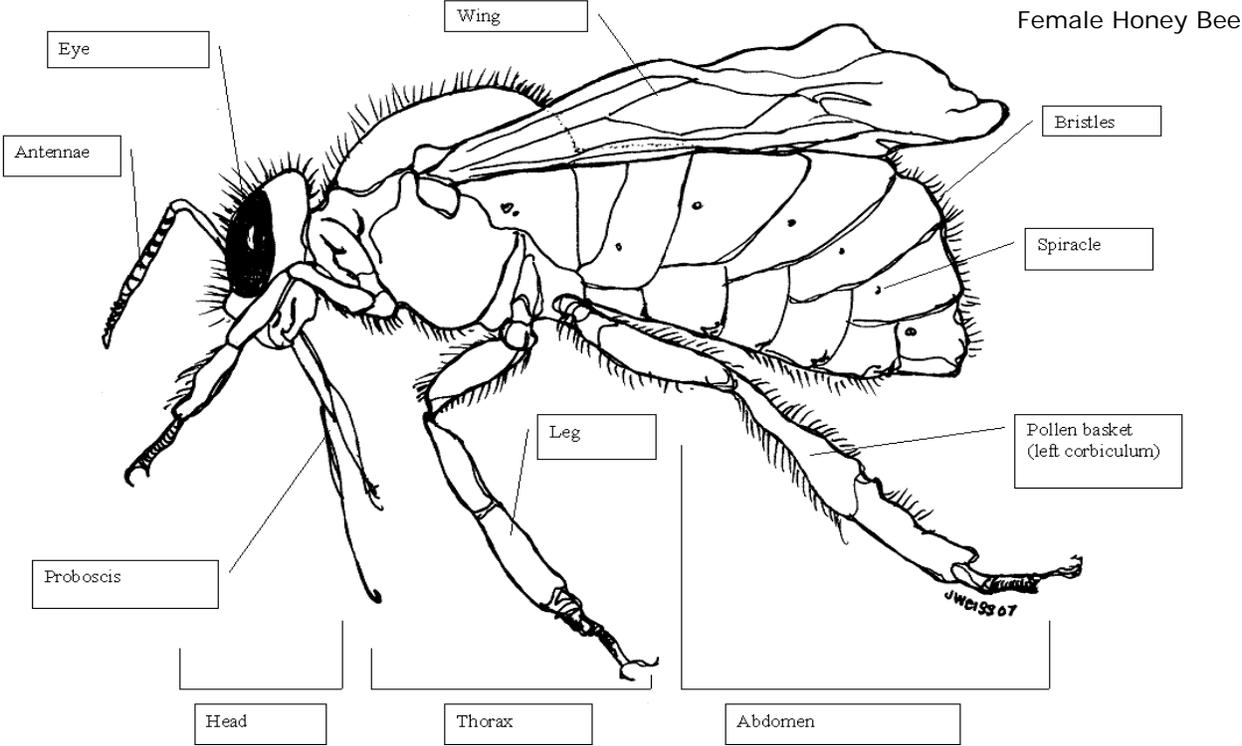
The transfer of pollen from an anther to the stigma in flowering plants.

Let's try to figure out how pollination works.

2. Give each student their own flower diagram and ask him or her to study the diagram.



3. Give each student copies of the bee and butterfly diagrams. Have them study these diagrams.



Extensions:

You may wish to use the images on page 7 as flashcards to help reinforce the part names and functions.

Activity 2 – Pollen on the Move

Location/Setting: Indoors or Outdoors; space to spread out. Wind may blow cornstarch away.

Subject/Skills/Discipline: Science, Communication, Teamwork, Critical Thinking.

Grade Level: 3-6 Standards: S2, S4

Time: At least 30 minutes; depending on age and size of class.

Materials List: Flower diagram per student, bee diagram per student, dish of cornstarch per half of students, cotton swabs per half of students. Optional: Plant part cards, point cards.

Objectives:

- Acting as bees and flowers, students will simulate the pollination process using cornstarch as pollen and cotton swabs a pistils.
- Educators assess what the students have learned using a KWL chart.

Procedure:

1. Divide the students into two groups: the pollinators (bees and butterflies) and the flowering plants. Give each member of the plant group a cotton swab and a small container of cornstarch (will act as pollen).
2. Instruct each member of the pollinator group to visit a member of the plant group and dip a finger into the pollen. At this point, ask the class to name the part of the plant that the pollinators touched (the stamen, which consists of the anther and the filament) to get the pollen on their fingers. Have them determine whether it is a male or female part.
3. Ask the students what parts of the pollinators' bodies (represented by their finger) touched the stamens.
Ask what they were looking for when they got to the plant (nectar and/or pollen) and what appendage they used to get it (proboscis or other body part such as mouthparts or scopa).
4. Have each member of the plant group hold up his or her cotton swab. Explain that the pollinators have just visited one plant and will now move on to another plant of the same species. Instruct the pollinators to visit a different member of the plant group and rub some of the pollen they are carrying on to that plant's stigma (represented by the swab). Ask the students what part of the flower the swab represents (stigma) and whether it is a male or female part (female).
5. Have each group meet separately to discuss its specific role as a pollinator partner and how it

benefited from the pollination process. Have each group select a spokesperson that will take notes and report the findings to the class.

There are several ways to make this activity a little more challenging. Here is one idea:

- Replace the “pollen” reward with cards, each worth one point
- When the “bee/butterfly” arrives at the flower they must identify the plant or pollinator part shown on a card (see page 7 for images). “Bees/butterflies” could answer by whispering or writing the correct word.
- Upon receiving the correct answer, the “flower” gives the “bee/butterfly” a point card.
- How many points can the bee team score?
- Ask the students how the flower team could be tested.

This may be expanded further to identify other insect/plant relationships, such as monarch caterpillar and milkweed leaf.

Assessment:

- Return props to their places and students to their seats. Ask a volunteer or volunteers to recount the activity.
- Complete the KWL chart.

Pollination		
What I know	What I want to know	What I Learned
Flowers need pollination to reproduce.	How do bees or butterflies pollinate the flower?	Only the anther of the flower has pollen.
Bees and butterflies are pollinators.	How does the flower attract the bee or butterfly?	Animals like bees visit the flower to get food.

- Give each student their own flower diagram and ask him or her to label the parts of the flower. Give each student copies of the bee and butterfly diagrams. Have them label the diagrams.

Extensions:

- Larger groups/Younger students: If you have a group of 16 or more consider dividing the group in half. Have one group rest and complete a reflection page for the day. Younger students could color the flower and bee drawings during this period. Remember, rest and reflection is an important part of learning too!
- Make game more challenging by using part cards: pollinator may only get pollen if they can identify part when shown card, etc.
- Students can read about pollination and agriculture.
- Have students visit Butterfly Project’s website at ?
- Have students Bee Watchers site at <http://greatpollinatorproject.org>. Learn more in lesson 8.
- Learn about NYC Beekeepers!
- Try *Sorting Out the Pollinators* to learn more about special pollinator features.

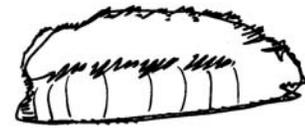
Written by Jill Weiss.

Edited By Chrissy Word and Elizabeth Johnson. Illustrations by Jill Weiss.

Pollinator Part Cards; Flower Part Cards

Use these part cards as flash cards or to make activity 2 more challenging

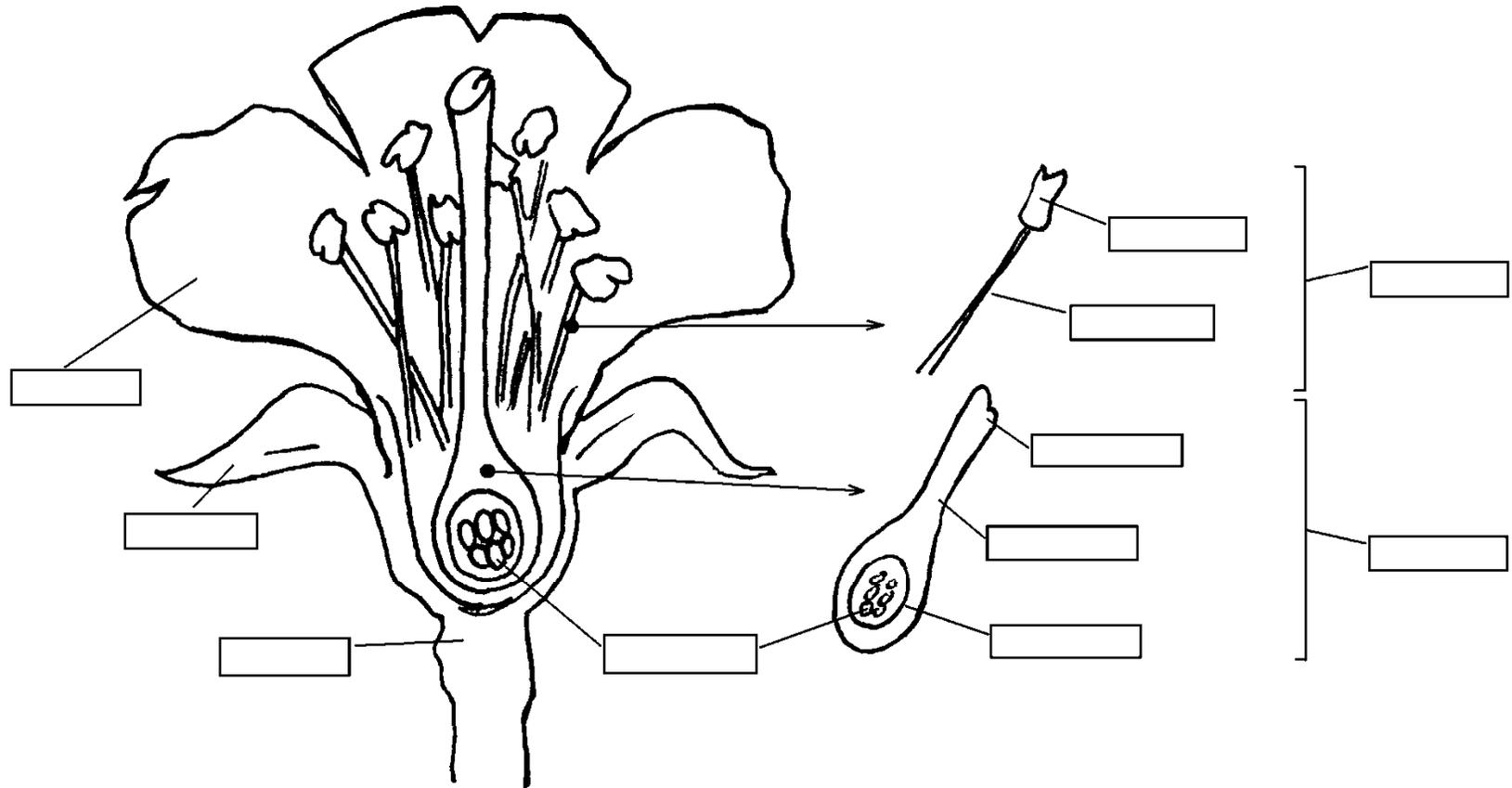
1. antennae	2. proboscis	3. leg	4. bristles	5. wing	6. abdomen	7. eye	8. ovary	9. anther	10. stamen	11. pistil	12. petal
-------------	--------------	--------	-------------	---------	------------	--------	----------	-----------	------------	------------	-----------

<p>1.</p> 	<p>2.</p> 	<p>3.</p> 	<p>4.</p> 
<p>5.</p> 	<p>6.</p> 	<p>7.</p> 	<p>8.</p> 
<p>9.</p> 	<p>10.</p> 	<p>11.</p> 	<p>12.</p> 

How Does Pollination Work?

Worksheet 1 :: Flower Diagram

Word bank: stamen, ovary, sepal, anther, petal, style, receptacle, stigma, filament, pistil, ovules.

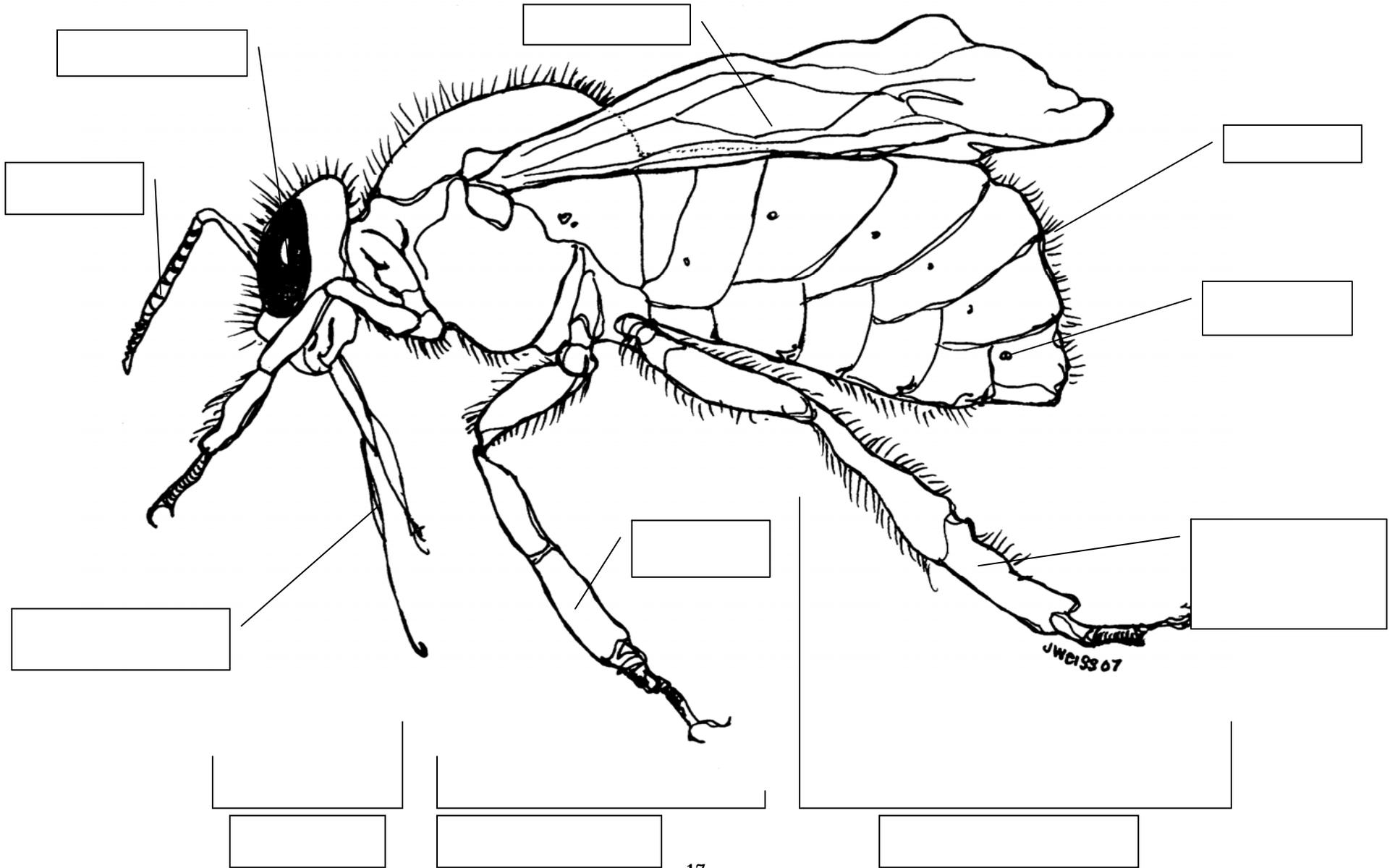


JWEISS07, 08

How Does Pollination Work?

Worksheet 2 :: Female Honey Bee Diagram

Word bank: spiracle, head, thorax, eye, pollen basket (left corbiculum), bristles, antennae, abdomen, proboscis, leg



How Does Pollination Work?

Worksheet 3 :: Butterfly Diagram

Word bank: head, thorax, compound eye, forewing, bristles, antennae, abdomen, proboscis, legs, hindwing.

