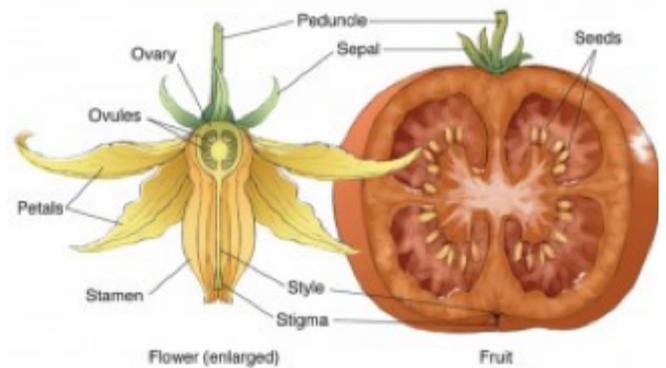


Fertilization



Alstroemeria (Peruvian Lily) is the flower of choice for dissection. It is classified as a monocot, meaning the petals are located above the ovary, and the leaves are parallel veined. There are six stamens and a three-lobed, short, thin pistil.³



1 Purpose and Content of Lesson:

This lesson will explore how flowers make seeds and develop fruit. It will begin with a review of pollination from the prior lesson and focus on fertilization and development of fruit and seeds, hence completing the plant life cycle.

Terms and Definitions:

pollen: microscopic grains formed on a part of the flower called stamens that are needed to make a seed

stamen: male flower part that contains an anther with pollen

anther: part of the stamen that holds pollen

pistil: female flower part with a stigma on top and an ovary on bottom, where seeds are formed

stigma: sticky top part of pistil where the pollen from the anthers must land in the seed making

pollen tube: tube extension of a pollen grain that leads from stigma of pistil to the ovule

ovary: part of the pistil that holds the ovules

ovule: structure in ovary that contains egg cells that develop into a seed/seeds after fertilization

fertilization: cells in pollen tube join together with the ovule to make seed

seed: plant part capable of growing into another plant

fruit: ripened ovary containing seed(s)

flowering plant life cycle: seed → seedling → young plant → adult plant with flowers → pollination & fertilization → fruit → seed

2 Next Generation Science Standards (NGSS): <http://www.nextgenscience.org/search-standards>

Disciplinary Core Ideas

LS1.A: Structure and Function

All organisms have external parts. Plants have different parts (roots, stems, leaves, flowers, fruits) that help them survive and grow. (Grades K-2)

Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. (Grades 3-5)

LS1.D: Information Processing

Plants respond to some external inputs. (Grades K-2)

3 For grades 5 and 6:

This lesson is rich in vocabulary and concepts for grades 5 and 6. Vocabulary should be reduced for younger elementary grades, and the process of fertilization can be simplified to four steps using the animation from the Great Plant Escape website: <http://extension.illinois.edu/gpe/case1/cifacts2d.html>.

Students often have difficulty distinguishing between ovules, which become seeds, and ovary, which becomes fruit, because of the similarity of the words and their unfamiliarity with the terms.

4

Lesson Objective:

Learners will explain how fertilization occurs to form seeds and how the ovary develops into fruit containing seed(s) and will then label a diagram with flower terminology.

5

**Lesson Procedure—
THE LEARNING CYCLE: The Five Es****ENGAGE**

What do you know about flowers and what they do for the plant?

Review key terms and processes from the pollination lesson. Identify misconceptions and offer correct conceptions; check for understanding. After students share thoughts, inform them that the real work of the flower — to make seeds — cannot be seen with the naked eye.

*“Today we are going to learn about inner parts of flowers and how they make seeds by dissecting a flower called *Alstroemeria*.”*

Prior to the flower dissection lab, students should view the microscopy slideshow at: <http://www.microscopy-uk.org.uk/mag/indexmag.html?http://www.microscopy-uk.org.uk/mag/artoct08/bj-peru.html>

EXPLAIN

Show PowerPoint presentation titled FERTILIZATION showing flowers and their parts. Discuss with students what they will see and when they will get their flower. Explain the process of fertilization as a series of steps. Students will view an animation from the Great Plant Escape website that shows a simplified 4-step fertilization sequence on slide 5.

EXPLORE

Key Questions: *What are the main parts of a flower and what is the job of each? What do the flower parts of *Alstroemeria* look like? Why do flowers die soon after blooming?* (Their job is done.)

Dissection Materials: Distribute the following to each student: Paper plate with one flower, one toothpick, and a hand lens. Students will need to draw and label in their science notebooks. Directions for the lab are outlined in the PowerPoint presentation.

1. Observe the flower.
 - What is the most notable feature? (petals)
 - What do you notice about the petals and sepals and their number and pattern? (There are three patterned petals and three solid colored sepals.)

- Does this flower get pollinated by the wind or an animal? (Animal; petals are colorful to attract pollinators)
- Is it a perfect flower (having both stamen and pistil) or imperfect flower (only stamens or only pistil)?
- Draw your petal and sepal pattern in your notebook. Gently pull off the petals and sepals and put them on your plate.

2. Observe the stamen (with anthers and filament) and the small, thin, pistil.
 - Do you see pollen? (Probably not. The pollen is very tiny on this flower and your anthers are covered with an anther cap so pollen isn't released until the flower is ready.)
 - How is your pistil different from the diagrams we have seen?
 - How many stamens are there? ____
 - Draw the stamens and pistil in your notebook and label them.
 - Gently pull out each of the stamens. Only a pistil and ovary (the bottom bulb-like structure) remain.
3. Dissect the ovary.
 - With your toothpick, make a vertical slice down the middle of the ovary and open it like a book. Place the two halves of the ovary on your plate.
 - What do you notice about the way ovules are arranged? (in a pattern)
 - What needs to happen so ovules grow into seeds? (pollen tube cells must fertilize them).
 - Draw your dissected ovary with ovules in your notebook and label them. Use your hand lens to see the arrangement of ovules. Then view a few on the end of your toothpick.
4. Fertilization

How does Fertilization occur? Let's review the steps. See PowerPoint slide 10 and view the Fertilization animation. Review the steps. The teacher can play Round Robin. As the animation plays, students can read, one student at a time, one step at a time, all around the room until everyone has a turn. Then stop animation. Have them do it from memory around the room. Permit students who are stuck to call on a peer for support.

1. Pollen lands on stigma. This is called Pollination.
2. Pollen tube grows down the style of the pistil and into the ovary
3. Pollen + ovules → Fertilization
4. Fertilized ovules → seed(s)
5. Ovary containing seeds swells and ripens into a fruit

EXPAND

Fruits: Students will see the image of the tomato and the tomato flower to notice the ovules in one, the seeds in the other. The flower's ovary has a pattern of ovules that is duplicated in the tomato fruit. The ripened ovary is the fruit. The fruit contains the seeds. The sepals become the leaves on the top of the tomato.

You may have to help pollinate your cucumbers and tomatoes in the Tower Garden*.

- *What will happen after you place or shake the pollen on the pistils?* (fertilization)
- *If you get cucumbers and tomatoes, what part of the FLOWER are they?* (ovaries)
- *Do those fruits have seeds or ovules inside? How do you know?* (Ovules were fertilized and that is why fruit developed.)

A follow-up lesson could be on seed dispersal.

EVALUATE

(See appendices for flower-labeling diagrams.) I prefer having students draw and label their own flower as an assessment because it uncovers misconceptions and corrects conceptions they have learned. I have them draw a flower and label it using five vocabulary words. I have a word wall of new science terminology in the classroom so they can refer to that or provide a word box. Then I list the four steps of fertilization mixed up for them to sequence.

This assessment will provide the teacher with information about what was learned in terms of recognition rather than mastery. Mastery of content will not occur without rehearsal of information and additional related experiences over time. See attached assessment.

6

Web Resources and Materials

¹Tomato flower to fruit: <http://www.buncombemastergardener.org/flicking-tomato-flower-tomato-fertilization/>

Alstroemeria: <https://en.wikipedia.org/wiki/Alstroemeria>

Grades 6-8 flower investigation, vocabulary, discussion questions, full lesson plan: Discovery Education <http://www.discoveryeducation.com/teachers/free-lesson-plans/plant-pollination.cfm>

Flowers: How seeds are made (process, vocabulary) Great Plant Escape <http://extension.illinois.edu/gpe/case1/c1facts2d.html>

Pollination: Diagram, facts, video: Biology of Plants <http://www.mbgnet.net/bioplants/pollination.html>

Flower Dissection: https://www.desertmuseum.org/center/edu/docs/k-5_DesertGardeners_flowerDissection.pdf

A Close-up view of the “Peruvian Lily” Microscopy slideshow: Alstroemeria psittacina <http://www.microscopy-uk.org.uk/mag/indexmag.html?http://www.microscopy-uk.org.uk/mag/artoct08/bj-peru.html>

*Excellent site on seed dispersal that can be used in a follow-up lesson: http://www2.bgfl.org/bgfl2/custom/resourcesftp/clientftp/ks2/science/plants_pt2/dispersal.htm

Materials: One per student:

- Toothpick
- Paper plate
- Flower called Alstroemeria (One bunch has many blooms; available at most supermarkets.)

Those with pollen allergies should look on with a partner. Check with parents about student allergies prior to doing a flower dissection lab. Alstroemeria, which can be purchased inexpensively in a supermarket, has less free pollen than most flowers since a green anther cap covers the pollen. Because of pollen allergies, avoid using any flowers that scatter pollen grains. At the end of the lab, have students wash their hands.

ASSESSMENT

Name _____

1. What is the special job of the flower?

2. Draw a flower (without petals) and label five parts using terms from the list below.

You may add more parts and labels if you like.

stamen, anther, pistil, stigma, pollen, pollen tubes, pollination, ovules, ovary

3. These five steps of fertilization are out of order. Please number them in the correct sequence.

_____ Pollen + ovules = Fertilization

_____ Pollen tube grows down the style of the pistil and into the ovary.

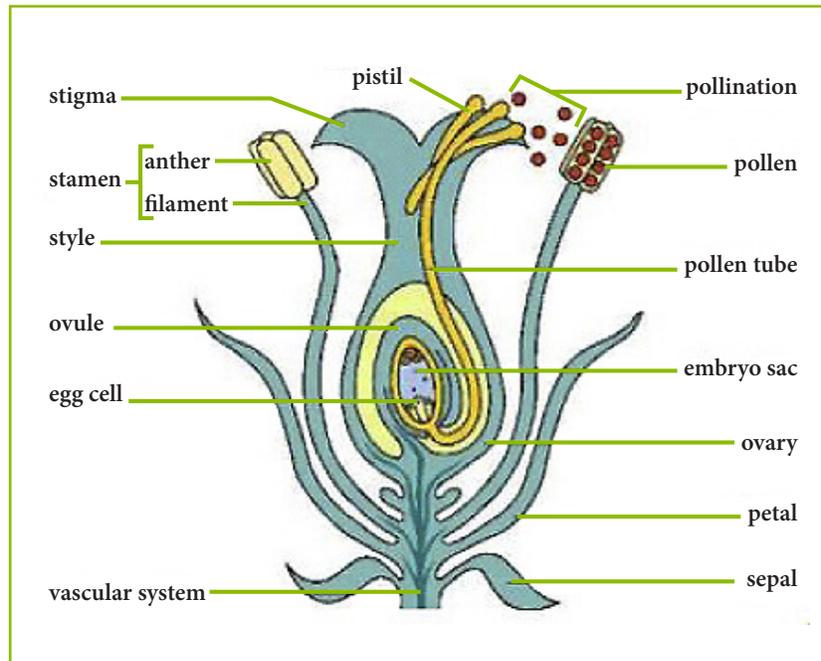
_____ Ovary containing seeds swells and ripens into a fruit.

_____ Pollen lands on stigma. This is called pollination.

_____ Fertilized ovules develop into seeds.

4. Name a ripened ovary you like: _____

HOW FERTILIZATION TAKES PLACE



How flowers make seeds and fruit

Part 2: Fertilization



DEVELOPED BY:

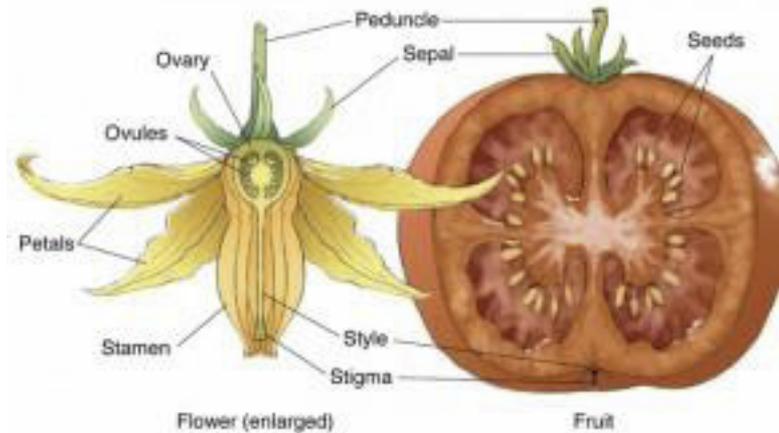
Debra Zinicola, Ed.D., Seton Hall University, Chair, Department of Educational Studies, and
Marian Glenn, Ph.D., Seton Hall University, Professor, Department of Biological Sciences





Fertilization

How a Flower Makes Seeds and Fruit

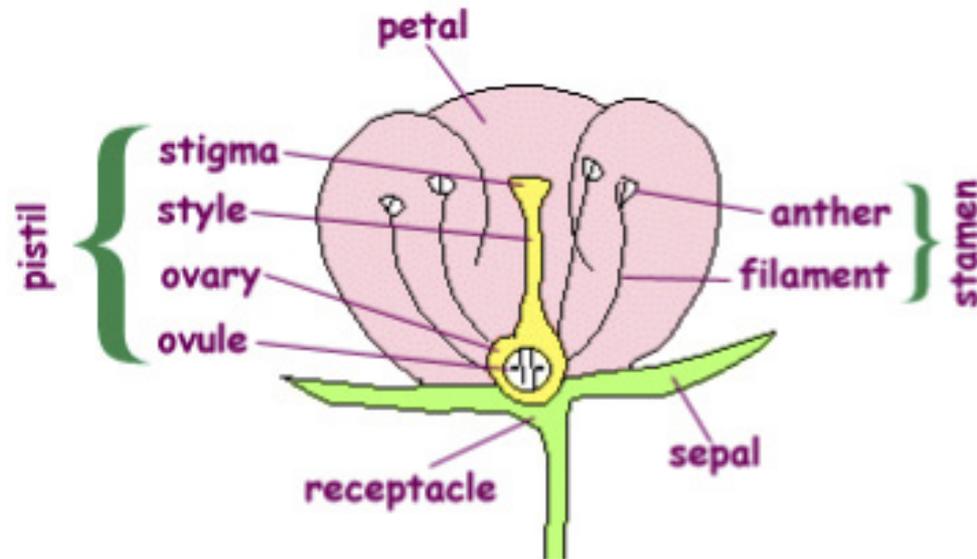


What do you notice about the two images—
flower and fruit?



Fertilization

Flower Parts for Fertilization:





Fertilization

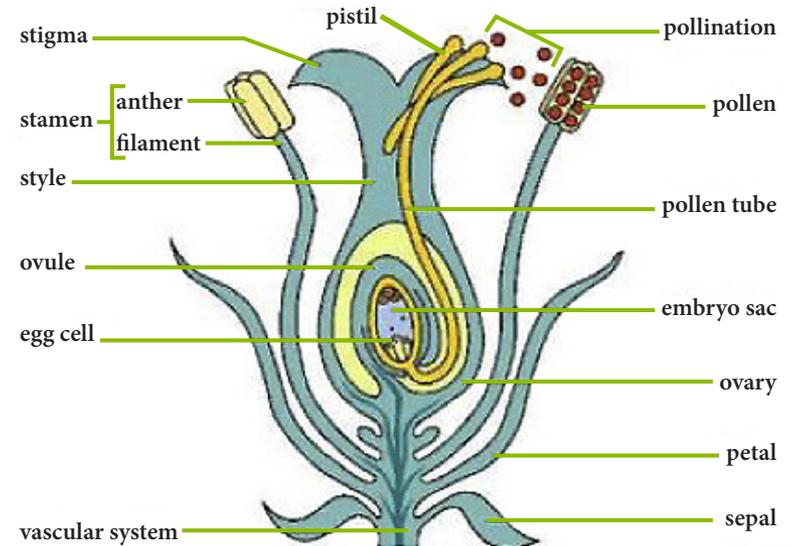
Do you remember the parts?





Steps of Flower Fertilization

- 1 Pollen lands on stigma. This is called _____.
- 2 Pollen tube grows down the style of the pistil and into the ovary.
- 3 Pollen + ovules → fertilization
- 4 Fertilized ovules → seed(s)
- 5 Ovary containing seeds swells and ripens into a fruit





Fertilization

Alstroemeria (Peruvian Lily) is the flower we will dissect with 3 petals, 3 sepals.

There are 6 stamens and a three-lobed, short, thin pistil.

Stamens may have a green anther cap so you may not see pollen.





Fertilization

Alstroemeria Dissection Lab:

Observe the flower.

- 1 What is the most notable feature?
- 2 What do you notice about the **petals** and **sepals** and their number and pattern?
- 3 Does this flower get **pollinated** by the wind or an animal? How do you know?
- 4 Is it a **perfect** flower (has both stamens and pistil) or **imperfect** flower (only stamens or only pistil)?

Draw your petal and sepal pattern in your notebook.

Gently pull off the petals and sepals and put them on your plate.



Fertilization

Alstroemeria Dissection Lab:

Observe the stamen (with anthers and filament) and the small, thin, pistil.

1 Do you see **pollen**?

There is an anther cap; pollen is not released until the flower is ready.

2 How is this **pistil** different from the diagrams you have seen?

3 How many **stamens** are there?

Draw the stamens and pistil in your notebook and label them. Gently pull out each of the stamens. Only a pistil and ovary (the bottom bulb-like structure) will remain.



Fertilization

Alstroemeria Dissection Lab:

Disect the ovary.

With your toothpick, make a vertical slice down the middle of the ovary and open it like a book. Place the two halves of the ovary on your plate.

- 1 What do you see inside the **ovary**?
- 2 What do you notice about the way **ovules** are arranged?
- 3 What needs to happen so **ovules** grow into seeds?

Draw your dissected **ovary** with **ovules** in your notebook and label them.

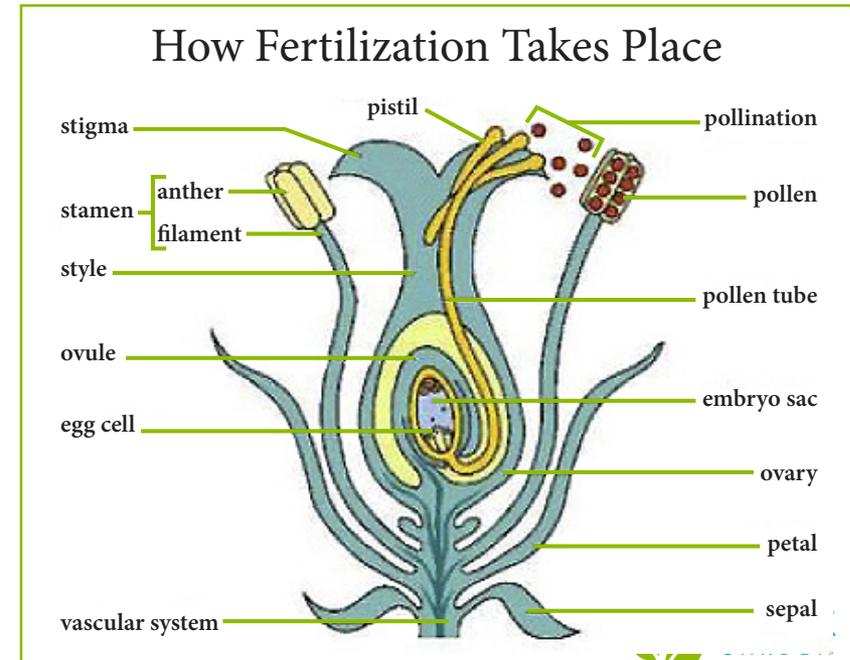
Use your hand lens to see the arrangement of **ovules**. Select a few on the end of your toothpick to observe.



Fertilization

Review of flower fertilization:

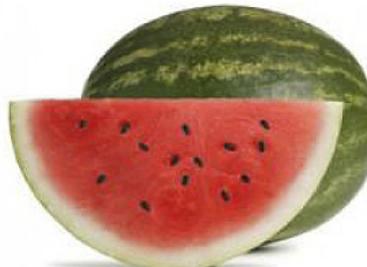
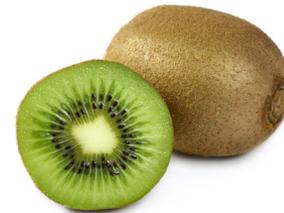
1. Pollen lands on stigma. This is called _____.
2. Pollen tube grows down the style of the pistil and into the ovary.
3. Pollen + ovules → fertilization.
4. Fertilized ovules → seed(s).
5. Ovary containing seeds swells and ripens into a fruit.





Fertilization

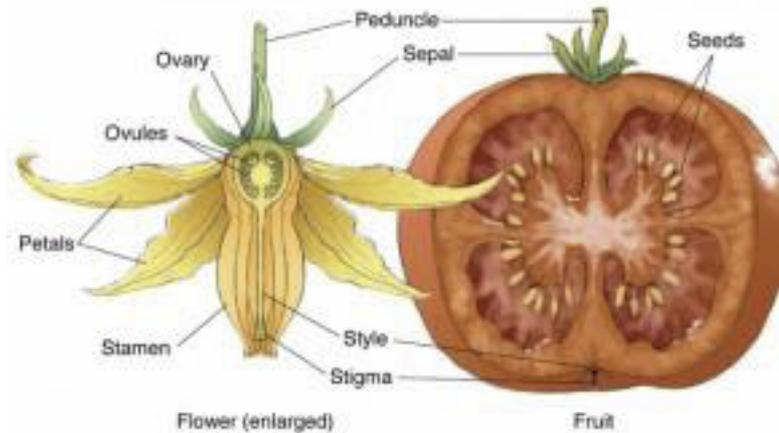
Ripened ovaries you may know:





Fertilization

Review: How a Flower Makes Seeds and Fruit



- 1 Explain what you learned about these two ovaries.
- 2 Why are flowers so important?



Fertilization

Thinking About Fruits

You may have to help pollinate your cucumbers and tomatoes in the Tower Garden.

- 1 What will happen after you place or shake the pollen on the pistils?
- 2 If you get cucumbers and tomatoes to grow, what part of the FLOWER are they?
- 3 Do those fruits have **seeds** or **ovules** inside?
How do you know?





Fertilization: Terms and Definitions

- **pollen** – microscopic grains formed on a part of the flower called stamens that are needed to make a seed
- **stamen** – male flower part that contains an anther with pollen
- **anther** – part of the stamen that holds pollen
- **pistil** - female flower part with a stigma on top and an ovary on bottom where seeds are formed
- **stigma** – sticky top part of pistil where the pollen from the anthers must land in the seed making process
- **pollen tube** – tube extension of a pollen grain that leads from stigma of pistil to the ovule
- **ovary** – part of the pistil that holds the ovules
- **ovule** – structure in ovary that contains egg cells that develops into a seed after fertilization
- **fertilization** – cells in pollen tube join together with the ovule to make seed
- **seed** – plant part capable of growing into another plant
- **fruit** – ripened ovary containing seed(s)
- **dispersal** – the transport of seeds away from the parent plant



Fertilization

The Life Cycle of a Flowering Plant

