

California Walnuts

The Importance of Grafting

Grades 4-5



A partnership project of
California Walnut Board
California Foundation for Agriculture in the Classroom

Written by
Robin Satnick
Crane Country Day School
Santa Barbara County



California Walnuts

The Importance of Grafting

Learning Objectives

The purpose of this unit is for students to understand the science and economic importance of grafting walnut trees.

Grade Level

4th and 5th

Time

Teacher Preparation:
30 minutes

Student activity:
60 minutes

Materials

For each partnership of 3-4 students:

- *two colors of play-doh*
- *plastic knife*
- *6 oz. plastic cup*
- *sand or soil*
- *white paint*
- *paint brush*
- *candle*
- *matches*
- *rubber band*
- *scissors*
- *ruler*
- *toothpicks*

Background Information

California walnut farmers have scientifically learned how to produce nuts with thinner skins, larger nutmeat, and disease and pest resistant trees through a process called **grafting**. Grafting is a common type of plant **propagation** where healthy and disease resistant rootstock is **fused** onto a scion. A scion is a shoot from another plant that contains the desired genes to be duplicated in future production. The scion is often selected due to its leaves, flowers, and in the case of the walnut, its fruit.

Black walnuts are **indigenous** to California, however their thick shell and small nut size are not ideal for human consumption. However, the English walnut that is native to Ancient Persia, now known as Iran, produces walnuts with thinner shells and larger nuts making them a better choice for consumers. English walnuts are more prone to diseases and pests because they are not native to California. This is why California walnut farmers graft black walnut rootstock onto English walnut scions.

There are a number of types of grafting. The most common type is called whip or tongue grafting. Grafting is done in the late spring after the **rootstock** has produced leaves and is less likely to fail. The most difficult step in grafting is making sure that sap doesn't flow from the cut rootstock. To avoid this "bleeding," farmers need to be mindful of weather conditions. In periods of heavy rain or strong temperature **fluctuations**, bleeding is more likely to occur.

Black walnut seeds are planted during October through December. The seedlings emerge in early spring. The seedlings continue growing for one full year until they are strong and large enough to be grafted. Scions, from English walnut trees, are selected for their well-developed buds are collected during the dormant winter months from December to February. They are placed in moist wood shavings or a plastic bag in a refrigerator until the rootstock is ready.

When grafting, it is important to choose a piece of scion wood that closely matches the diameter of the rootstock. The scion and rootstock are both diagonally cut during the whip grafting process. A small slit is cut into the center of the cut pieces. The two cut pieces are matched together and the small slits help lock the rootstock and scion together. The union is sealed with grafting or masking tape. A rubber compound called yellow cap is also used. The young rootstock is painted white to protect it from the sunlight. The top of the unexposed scion is sealed with a grafting wax to keep the top of the walnut tree from drying out.

California Walnuts

The Importance of Grafting

Common Core Standards	Procedure
ELA/Literacy	
4th Grade	
RI.4.1	1. As a class, show informational video on the Walnut.org website on how walnut seedlings are grafted. Provide Background Information to students.
RI.4.7	2. Distribute worksheet, "Let's Graft!" to students and read together the informational paragraphs before beginning the activity.
W.4.2	3. Divide students into groups of 2-3 students per group and distribute materials for the activity. Make sure each student will have enough play-doh for 5" long ropes.
W.4.9	4. Explain to students that they will be simulating how grafting is done.
NGSS	5. Ask students to roll each piece of modeling clay or play-doh separately into ropes that are approximately ½ inch diameter throughout.
4-LS1-2	6. As students are working, ask them to compare their rolled piece of clay with their lab partner's. Ask them to continue working until they feel the diameter of each rolled piece of clay is the same.
5th Grade	7. Assign each colored piece of clay as the scion or rootstock to help students differentiate between the two pieces that are grafted together.
RI.5.7	8. Using the plastic knife, have students cut a diagonal cut that measure approximately 1 ½ inches from one end of <u>one of the ropes</u> and leave the other end untouched. This piece of clay is the rootstock.
RI.5.1	9. Ask the students to set the piece of clay down once the appropriate cut has been made.
RI.5.9	10. Have students pick up the other piece of clay and make a similar 1 ½ inch diagonal cut on one of the ends. On the other side of the rope, ask students to cut the clay so it is a straight cut. This piece of clay is the scion.
W.5.1	11. Using the plastic knife, ask students to cut a small notch on both
W.5.9	
NGSS	
5-LS1-1	
See last page for complete Common Core Standards descriptions.	

California Walnuts

The Importance of Grafting

pieces of clay in the middle of the diagonal cut.

12. Place the ropes of clay end to end with the diagonal cuts and notches connecting together as shown in the diagram.
13. Cut one end of a rubber band. Holding both ends of the rubber band, carefully place the middle of the rubber band in the middle of the graft. Tell students to think of the rubber band like a bandage.
14. Carefully wrap the rubber band around the graft and tie the ends together in a knot.
15. Tell students that farmers paint the rootstock white to protect it from the sun. Ask students to paint their rootstock white.
16. Share with students that farmers dip the top of the scion in wax to keep it from getting dried out. Using the wax from a melted candle, have students coat the top part of the scion with wax.
17. Place sand or soil into a plastic cup. Gently “plant” the grafted walnut seedling making sure to bury only the bottom of the rootstock.

Extension Activities

1. Take the students on a field trip to a walnut orchard nursery. Ask a horticulturist to share with students how walnut seedlings are grafted. Have students make observations of the walnut tree’s trunk. Can they see where the grafting took place? What do they notice? Compare the size of the young trees with the older trees.
2. Have a walnut farmer visit the classroom and share his work on the farm.
3. As a class, plant a walnut seed and see how long it takes to germinate. Offer students a prompt about the growth of the seed and ask them to write a creative story about what will happen to the seed when it sprouts.
4. Place a stock of freshly cut celery in colored water. Have students observe the changes in color of the celery the next day. Explain to students that plants need water to survive and they draw water up from their roots through their capillaries. The capillaries

California Walnuts

The Importance of Grafting

are hollow and act a lot like a straw. Share with students this is why when grafting it is important to match the diameter of the rootstock with the scion.

5. Obtain different species of walnuts (California Black walnut tree, *Juglans californica* and English walnut, *Juglans regia*). Have students compare and contrast the physical difference of each species.
6. Demonstrate the importance of matching diameters of the scion and rootstock when grafting using a celery stalk. Trim the bottom of a celery stalk keeping the leaves intact and place it in a clear cup filled half full of water adding 8 drops of red food coloring until the water is a deep red color. The next day the leaves of the celery will be red. The water and nutrients are carried up through the celery stalk by the xylem. The xylem is the woody tissue in plants that is responsible for the movement of water and nutrients throughout the plant. During the grafting process, it is important to match the woody part of the walnut cuttings so the xylem and phloem (food conducting tissue) have the best possible chance of growing together. This will increase the likelihood of the walnut tree's success.

Let's Graft!

Name _____

Trees in California walnut orchards are propagated by grafting seedlings in order to produce disease and pest resistant plants with nuts that are optimal for eating. During the grafting process, healthy rootstock from a native black walnut tree is fused with a shoot, or scion, from an English walnut tree. Native trees are more disease and pest resistant than non-native species. The fruit of the English walnut has a thinner shell and more meat than the black walnut making it easier to crack open and more enjoyable to eat.

Materials

• two colors of clay or play-doh	• 6 oz. plastic cup
• white paint	• candle
• rubber band	• ruler
• plastic knife	• sand or soil
• paint brush	• matches
• scissors	• toothpicks

IMPORTANT – When you are not working with the clay set it down in your work area. Holding the clay will cause warming and could affect the results of this activity.

Procedure

1. Roll each piece of modeling clay or play-doh separately into ropes that are approximately ½ inch in diameter and 5" in length.
2. Using the ruler, compare each rope and continue working with the clay until the diameters of both pieces are the same.
3. Using a toothpick and a ruler, mark cutting lines described in steps 3 and 4 below.
4. Using a plastic knife, cut one end of one of the ropes with a 1-½ inch diagonal cut. Do not cut the other end of this rope. This piece of clay is your rootstock.
5. Take the other piece of clay and cut a 1-½ inch diagonal on one end. On the other end, cut the clay straight across. This is your scion.
6. Using the plastic knife, cut a small notch on both pieces of clay in the middle of the diagonal cut.
7. Place the ropes of clay end to end with the diagonal cuts and notches connecting together as shown in the diagram.
8. Cut one end of a rubber band. Holding both ends of the rubber band, carefully place the middle of the rubber band in the middle of the graft. The rubber band is like a bandage covering the plant's wound.
9. Carefully wrap the rubber band around the graft and tie the ends together in a knot.
10. Using white paint, coat the rootstock white to protect it from the sun.
11. With your teacher's help, dip the top of the exposed scion with melted candle wax to protect the plant drying out.
12. Place sand or soil into a plastic cup. Gently "plant" the grafted walnut seedling making sure to bury only the bottom of the rootstock.

Let's Graft (continued)

Conclusion

1. Why do walnut farmers graft their trees?
2. Why do you think native plants are better at fighting diseases and pests than non-native plants?
3. What time of year is best for planting the seeds of walnuts?
 - a. summer
 - b. fall
 - c. winter
 - d. spring
4. How long does a walnut seedling grow before it is ready to be grafted?
 - a. 3 months
 - b. 6 months
 - c. 9 months
 - d. 12 months
5. Why do farmers paint the rootstock of walnut trees white when they are young?
 - a. the nutrients help them grow
 - b. to keep the rootstock warm in the winter
 - c. to keep the rootstock from getting sunburned
 - d. to mark the plants that have been grafted
6. A scion is:
 - a. a small piece of rootstock
 - b. the hard exterior of a nut
 - c. the shoot of a plant with the desired genes for growth
 - d. a young tree
7. There are many different kinds of propagation methods that walnut farmers utilize in order to produce more walnut trees for their farms. Research this website and compare two different kinds of walnut propagation: <http://fruitandnuteducation.ucdavis.edu/education/fruitnutproduction/Walnut/WalnutPropagation/> In the space provided below, write a paragraph stating which kind of propagation method you would choose and why.

Answer Key

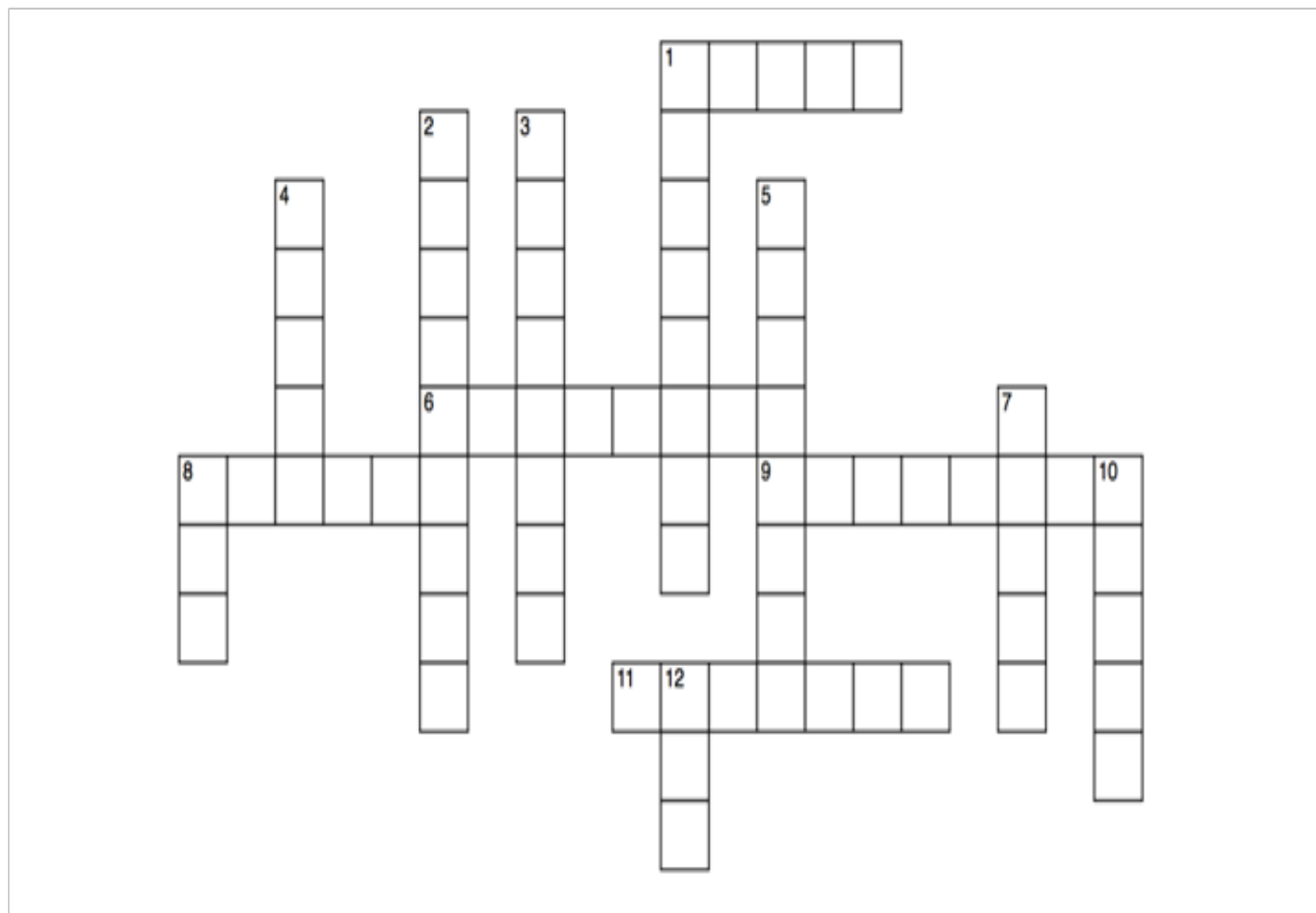
Let's Graft

1. *Why do walnut farmers graft their trees?* **Native black walnut trees are hearty and more disease and pest resistant than walnut trees that are introduced to California. The English walnut from Ancient Persia has larger fruit and a thinner shell making it easier for consumers to enjoy. Therefore, by grafting these two species of trees, farmers are able to get hearty trees and better fruit.**
2. *Why do you think native plants are better at fighting diseases and pests than non-native plants?* **Native plants evolved with the other native plants and wildlife, therefore they are best suited to meet the needs within their ecosystem. Overall, native plants are better adapted to the environmental conditions where they originated.**
3. *What time of year is best for planting the seeds of walnuts?* **winter**
 - a. summer
 - b. fall
 - c. winter
 - d. spring
4. *How long does a walnut seedling grow before it is ready to be grafted?* **12 months**
 - a. 3 months
 - b. 6 months
 - c. 9 months
 - d. 12 months
5. *Why do farmers paint the rootstock of walnut trees white when they are young?* **To keep the rootstock from getting sunburned**
 - a. the nutrients help them grow
 - b. to keep the rootstock warm in the winter
 - c. to keep the rootstock from getting sunburned
 - d. to mark the plants that have been grafted
6. *A scion is:* **the shoot of a plant with the desired genes for growth**
 - a. a small piece of rootstock
 - b. the hard exterior of a nut
 - c. the shoot of a plant with the desired genes for growth
 - d. a young tree
7. There are many different kinds of propagation methods that walnut farmers utilize in order to produce more walnut trees for their farms. Research this website and compare two kinds of propagation—June budding and grafting: <http://fruitandnuteducation.ucdavis.edu/education/fruitnutproduction/Walnut/WalnutPropagation/> In the space provided below, write a paragraph stating which kind of propagation method you would choose and why.

Walnut Grafting

Crossword Puzzle

Name _____



ACROSS

- 1 A species of walnut that is native to California
- 6 A young developing plant.
- 8 A delicious nut that many people enjoy.
- 9 An intentional planting of trees for food or consumption
- 11 The species of walnut that was first found in Ancient Persia

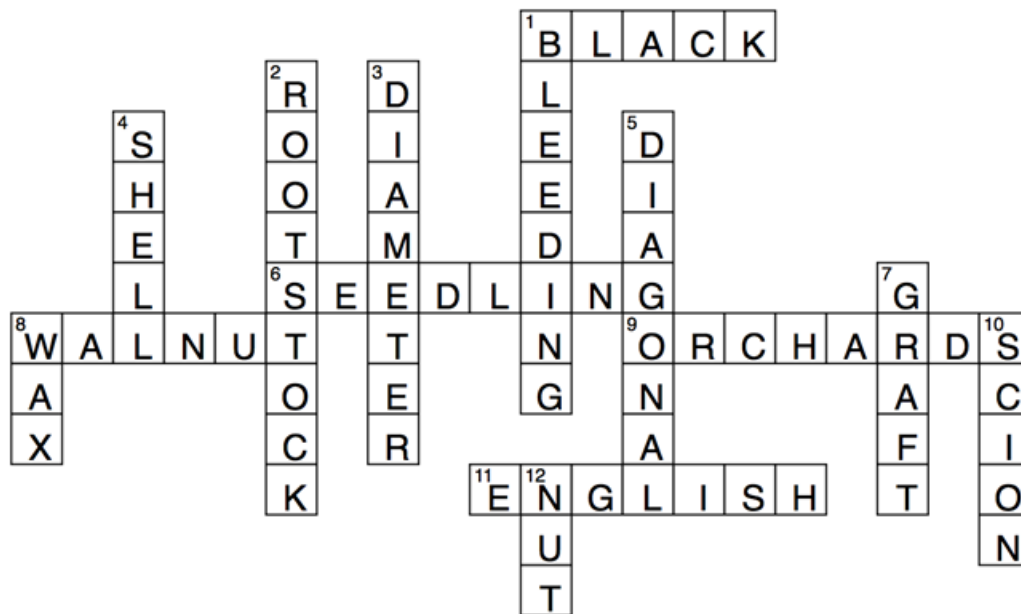
DOWN

- 1 The release of sap from a plant
- 2 The underground part of a plant.
- 3 A straight line segment that passes through the center of a circle
- 4 The hard exterior of a nut.
- 5 A sloping line
- 7 The process of fusing a rootstock with a scion.
- 8 A chemical used to coat the seedling so it doesn't dry out
- 10 The shoot of a plant with the desired genes for growth
- 12 A fruit composed of a hard shell and seed

Answer Key

Crossword Puzzle

Walnut Grafting



Vocabulary

The Importance of Grafting

Fluctuate – to shift back and forth unpredictably

Fuse – to become blended or joined

Graft – to insert a twig or bud from one plant into another plant so that they are joined and grow together

Indigenous – native, or original

Propagate – to grow, generate, or produce

Rootstock – a root or part of a root to which an aboveground plant part is grafted

Common Core Standards

ELA/Literacy

4th Grade

- RI.4.1 Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences to the text.
- RI.4.7 Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on web pages)
- W.4.2 Write informative explanatory texts to examine a topic in order to write or speak about the subjects knowledgeably.
- W.4.9 Draw evidence from literacy or informational texts to support analysis, reflection or research.

NGSS

- 4-LS1-2 Use a model to test interactions concerning the functioning of a natural system.

5th Grade

- RI.5.7 Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently
- RI.5.1 Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from a text.
- RI.5.9 Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably.
- W.5.1 Write opinion pieces on topics or texts, supporting a point of view.
- W.5.9 Draw evidence from literacy or informational text to support analysis, reflection or research.

NGSS

5-LS1-1

*Support an argument with evidence, data, or a model.

*Plants acquire their material for growth from air and water.