

Unit E: Plant Propagation

Lesson 3: Propagating Plants by cuttings

Student Learning Objectives: Instruction in this lesson should result in students achieving the following objectives:

1. Explain why plants are propagated asexually.
2. Describe leaf and leaf-bud cuttings and how they are used to propagate plants.
3. Describe the three types of stem cuttings.
4. Explain how root cuttings are prepared for propagation.
5. Identify some of the environmental factors that determine the success of rooting of cuttings.

Recommended Teaching Time: 3 hours

Recommended Resources: The following resources may be useful in teaching this lesson:

- A PowerPoint has also been developed with use of this lesson plan
- <http://aggie-horticulture.tamu.edu/propagation/propagation.html>
- <http://www.nmmastergardeners.org/Manual%20etc/other%20references/Propagation.htm>
- http://en.wikipedia.org/wiki/Plant_propagation

List of Equipment, Tools, Supplies, and Facilities

Writing surface
PowerPoint Projector
PowerPoint slides
Transparency Masters
Copies of Student Lab Sheet
Plants
Rooting Hormone (Auxin)
Scissors
Plant Pot
Soil
Labels for plants

Terms: The following terms are presented in this lesson (shown in bold italics and on PowerPoint Slide #2):

- Asexual propagation
- Growing medium
- Hardwood cuttings
- Herbaceous cuttings

- Leaf cutting
- Leaf-bud cutting
- Root cutting
- Semi-hardwood cuttings
- Softwood cuttings
- Stem cuttings

Interest Approach: Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here.

Bring to class several types of plants, some blooming herbaceous plants (geranium), herbaceous foliage plants (ivy), and hardwood plants (shrub rose or evergreen). Encourage students to discuss how they would produce more of the plants. Which of their ideas would produce plants faster or perhaps cheaper? What are other reasons for using asexual propagation for plant or crop production?

**** Use this activity to lead into the importance of propagations of plants by other plants.**

Summary of Content and Teaching Strategies

Objective 1: Explain why plants are propagated asexually.

(PowerPoint Slide #3)

I. **Asexual propagation** in plants involves the reproduction of new plants using only the vegetative parts (stem, leaf and root) of the parent plant. This is possible because many plants have the ability to regenerate or grow not only the vegetative part of the plant, but also missing plant parts.

(PowerPoint Slide #4)

- Asexual propagation enables the production of plants that would otherwise be difficult or impossible because the plant does not produce viable seed or the seed is difficult to germinate.
- Asexual reproduction is also used when plants will not breed true and when it is necessary to maintain certain genetic forms of the plant.

(PowerPoint Slide #6)

This important benefit of asexual reproduction produces plants that are genetically identical to the parent plant; therefore, they have the same traits of the parent plant. The existence of many valuable crop plants depends upon our ability to reproduce them asexually.

(PowerPoint Slide #6)

- Asexual propagation may be faster than propagation by seed. Germination and growth of seedlings is often slow compared to propagation by cuttings. It may also be more economical to produce plants asexually and in many cases it is easier.

****Rooted cuttings of various plants may be used to illustrate asexual propagation. Since many foliage plants can be easily propagated in a zip-lock bag, this technique can be used to introduce students to asexual propagation. Fill bag approximately one third full of propagation soil medium, add water to moisten soil (mix by kneading soil and water**

from outside the bag), place cuttings in the wet soil mix and zip bag closed. Place bag away from direct sunlight.

Objective 2: Describe leaf and leaf-bud cuttings and how they are used to propagate plants.

(PowerPoint Slide #7)

II. Entire leaves or portions of a leaf can be removed from the parent plant for use as a leaf cutting. A **leaf cutting** is a piece of a leaf blade, or a leaf blade with the petiole attached. Leaf cuttings have the ability to reproduce new stems and roots from the edge of the leaf. After the roots develop to support the new plant, the old leaf dies.

(PowerPoint Slide #8)

A **leaf-bud cutting** consists of a leaf blade, the petiole, and a short piece of stem with an attached bud. The small bud will develop into a new plant stem that will eventually produce the new plant roots.

(PowerPoint Slide #9)

A. Healthy leaves that have just reached maturity should be used for leaf cuttings. Some plants may be propagated using only the leaf blade or a section of the leaf. The leaf is cut from the parent plant and the cut edge placed on top of the rooting medium or inserted into the medium.

(PowerPoint Slide #10)

New plants develop along the edges of the leaf. Sedum and jade plants are examples of plants that can be propagated with only a section of leaf blade. Some plants require that both the leaf blade and petiole be removed from the parent plant. These cuttings should be placed deep enough in the medium to keep the cutting upright. African violets and peperomia are commonly propagated by this method.

B. Leaf-bud cuttings are important to the propagator when there is limited plant material and many new plants are needed.

(PowerPoint Slide #11)

This type of cutting consists of a leaf blade, petiole and short piece of stem with an attached bud. Leaf-bud cuttings should be made from healthy growing leaves and well developed buds. The stem of the cutting is inserted into the growing medium with the bud just below the surface of the medium. Plants such as English ivy, philodendron and maple can be propagated using this method.

****Use TM: E3-1 to review leaf structure. Use TM: E3-2 to illustrate the difference between leaf cuttings and leaf-bud cuttings.**

Objective 3: Describe the three types of stem cuttings.

(PowerPoint Slide #12)

III. Portions of stems that contain terminal or lateral buds are used for **stem cuttings**. There is a great variety of plants and therefore great variety in plant stems. The stem of a geranium is different from that of an ivy or carnation. The types of stems are grouped as herbaceous, softwood, semi hardwood and hardwood.

(PowerPoint Slide # 13)

The end of the stem from the leaf to the next bud (terminal cutting) is placed in the medium. Stem cuttings may also be made by sectioning the stem (heel cuttings and mallet cuttings) but this may require two to three weeks longer to produce a new plant.

(PowerPoint Slide # 14)

- A. **Herbaceous cuttings** are made from plants with stems that do not become woody. Many greenhouse plants are propagated by the use of herbaceous cuttings. These cuttings should be 7 to 10 centimeters long and contain several leaves. This type of cutting may be taken at any time of the year. Many species root easily. Examples include geranium, coleus and carnations.

(PowerPoint Slide # 15)

- B. **Softwood cuttings** are taken from the soft, new growth in the spring or early summer. These cuttings root easily but require a moist environment. The stems are cut and placed in moist media. All flower buds and one third of the lower leaves are removed to prevent moisture loss. A rooting hormone is applied to the cutting before planting to stimulate root production.

(PowerPoint Slide # 16)

- C. **Semi-hardwood cuttings** are usually made from woody broadleaf plants in the summer. The 7 to 15 centimeter cuttings are taken from the plant after it has finished its rapid summer growth. The cuttings are treated with rooting hormone and planted in moist medium. Evergreen plants such as yew, juniper and holly are propagated by semi-hardwood cuttings.

(PowerPoint Slide # 17)

- D. **Hardwood cuttings** are used to propagate evergreens and deciduous plants with woody stems. The cuttings are made during the winter when the plant is in the dormant stage. The cuttings are 5 to 15 centimeters in length and are dipped in rooting hormone before planting in moist medium. Several months later in the spring, the cuttings will develop roots.

****Use TM: E3-3 to discuss the types of cuttings, especially stem cuttings. Have some examples of each type of cutting available for the students to view. Hold up the different types of cuttings and have the students say what type of cutting it is.**

Objective 4: Explain how root cuttings are prepared for propagation.

(PowerPoint Slide # 18)

- IV. Root cuttings are similar to stem cuttings, except that a **root cutting** uses the root or part of the root to propagate a new plant. This method of propagation is perhaps the least favorite because of the lack of a standardized technique for most plants. Root cuttings are not as predictable, being more dependent on seasonal influences, but they are useful for starting plants that are difficult to propagate by other methods.

(PowerPoint Slide # 19)

- A. Winter and early spring when the parent plant is dormant seems to be the best times to obtain root cuttings. Usually the parent plant is lifted from the ground and the roots cleaned with water. Then the new root growth is removed from near the crown of the plant. Cut these young roots close to the crown and either throw away the parent plant

or replant it. If the parent plant is replanted, you must severely prune away the top of the plant to enable the plant to recover and produce more roots.

(PowerPoint Slide # 20)

B. Most root cuttings should be 10 centimeters long. The cutting needs sufficient food to support itself while it develops stem and leaves. Root cuttings are affected by gravity (polarity) and need to be planted with the “right side up.” Cuttings planted vertically and with the correct end up will have a much higher success rate. Propagators traditionally cut the root flat or straight across the top end, and at a slant on the bottom end. This method of cutting ensures that it is possible to recognize the top of the root cutting and that it is planted correctly.

****Use TM: E3-4 to illustrate the technique for obtaining root cuttings. Use TM: E3-5 to discuss the importance of polarity, or planting root cuttings with the “right side up.” Use asters, phlox, or forsythia for a laboratory exercise on the use of root cuttings.**

Objective 5: Identify some of the environmental factors that determine the success of rooting of cuttings.

(PowerPoint Slide # 21)

V. Plants are very individual and each seems to have a preferred method of propagation.

Plants also seem to have a preference for the type of medium, amount of moisture, and temperature for the rooting of their cuttings.

(PowerPoint Slide # 22)

A. Most plants do best in a loose well-drained growing medium. The *growing medium* will provide the moisture, aeration, nutrients and other conditions favorable for root formation. Sterile, disease free rooting medium is essential for success. Sand, vermiculite, peat moss, perlite and wood pulp are common examples of materials used alone or in combination in good growing medium. Many types of commercially prepared propagation media are available.

(PowerPoint Slide # 23)

B. Moisture is very important for the growth of the cutting. The cuttings cannot absorb water quickly so they must be kept moist. However, too much water will cause the cuttings of most plants to rot. Misting systems are excellent for providing moisture at frequent intervals to promote root formation.

(PowerPoint Slide # 24)

C. Many plants root easily and do not need special treatment. However, some plants root better when treated with root-inducing chemicals. These powders or liquids contain synthetic root promoting hormones of varying strengths that hasten root initiation as well as increase the number of roots formed.

****If available, show products such as Rootone and Hormodin to the students.. If possible show students perlite, vermiculite and peat moss. Discuss qualities of a good germination medium, i.e., wet-ability, drainage etc.**

**** Have students complete LS: E3-1 to give them a better understanding of the cuttings that were talked about in this lesson.**

Review/Summary: Use the student learning objectives to summarize the lesson. Have the students explain the response to the anticipated problem of each objective. Student responses can be used to determine which objectives need to be reviewed. Questions on PowerPoint Slide # 25 and #26 can be used as review.

Application: Application can involve the following student activity. Students may propagate a variety of plants using leaf, stem and root cuttings in LS:E3-1

Evaluation: Evaluation should focus on student achievement of the objectives of this lesson. A sample written test is attached.

Answers to Sample Test:

Part One: Matching

1. h
2. f
3. g
4. d
5. a
6. e
7. b
8. i
9. j
10. c

Part Two: Completion

asexual
root-inducing chemicals
growing medium
moist
stem, leaf, root

Part Three: Short Answer

1. Some plants are difficult to reproduce sexually. They may produce few seeds or the seeds have a low germination rate. Large numbers of genetically identical plants can be produced. Plants can be grown that are free of diseases. Mature plants can be obtained more rapidly.

2. The four stem cuttings are herbaceous, softwood, hardwood, and semi-hardwood. Herbaceous cuttings are taken from plants whose stems do not turn woody. Softwood cuttings are taken from the soft, new, spring growth of woody plants. Hardwood cuttings are prepared during the dormant season from woody plants. Semi-hardwood cuttings are taken in the summer from woody broad-leaved plants.

3. Leaf and leaf-bud cuttings are used when plant material is scarce and a large number of new plants are needed.
4. Roots of young plants are dug in late winter or early spring. The roots are cleaned and cut into pieces 5 to 15 centimeters long. The roots are then planted vertically with the end closest to the crown of the plant upright.
5. Some common types of growing media used for rooting cuttings include peat moss, perlite, vermiculite and sand.

Test

Unit E Lesson 3: Propagating Plants by Cuttings

Part One: Matching

Instructions. Match the term with the correct response. Write the letter of the term by the definition.

- | | | |
|--------------------------|------------------------|---------------------|
| a. herbaceous cutting | e. asexual propagation | h. root cutting |
| b. stem cutting | f. softwood cutting | i. leaf-bud cutting |
| c. growing medium | g. leaf cutting | j. hardwood cutting |
| d. semi-hardwood cutting | | |

- _____ 1. A propagation method using root pieces of young plants during the winter or early spring.
- _____ 2. Cutting taken from soft, succulent new spring growth of herbaceous or woody plants.
- _____ 3. A propagation method using a leaf blade.
- _____ 4. Cutting taken in the summer from new shoots of woody broad-leaved plants.
- _____ 5. Cutting taken from a plant that has a soft, non woody stem that dies back to the ground each year.
- _____ 6. The reproduction of new plants from leaves, stems or roots of the parent plant.
- _____ 7. Propagation of a plant using the plant stem that contains terminal or lateral buds.
- _____ 8. A propagation method using a leaf, petiole, and a short piece with the lateral bud.
- _____ 9. Cuttings taken from one-year old woody plants during the dormant season.
- _____ 10. Artificial soil mix that holds water, nutrients and oxygen for the cutting while it is becoming a new plant.

Part Two: Completion

Instructions. Provide the word or words to complete the following statements.

1. The plant leaf, stem and root may be used for _____ propagation.
2. The amount of roots on a plant cutting may be increased by applying _____.
3. Plant cuttings obtain support, moisture, aeration and nutrients from the _____.
4. It is important to keep plant cuttings _____ to prevent wilting.
5. The three basic types of plant cuttings are _____, _____, and _____.

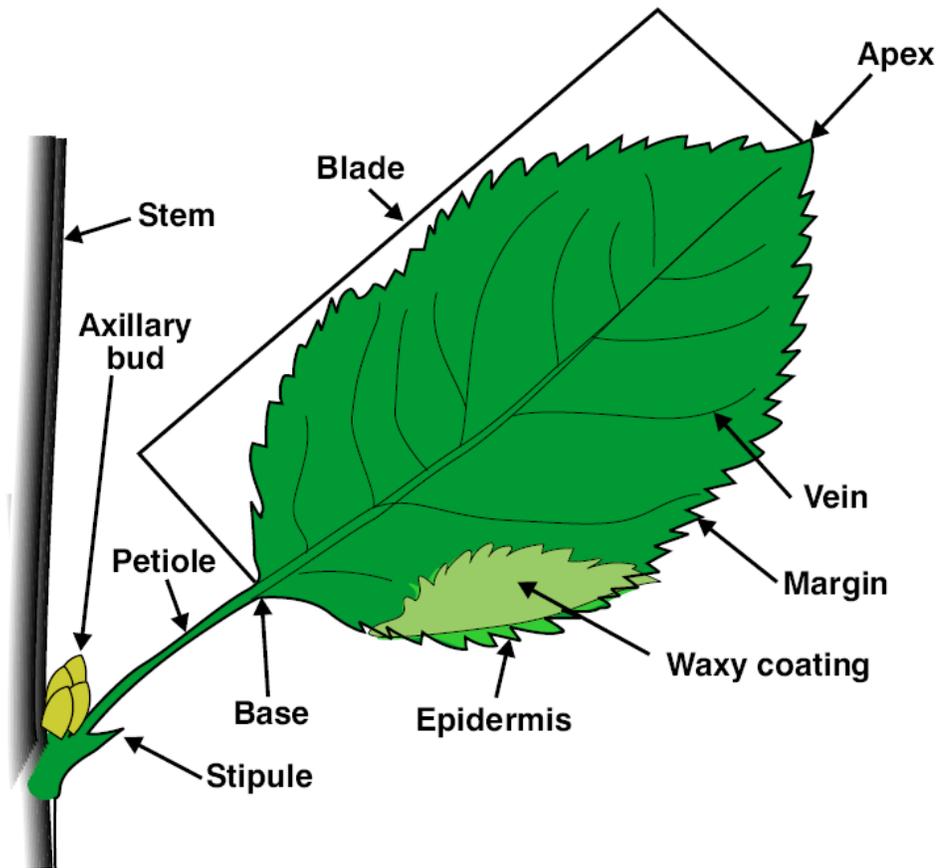
Part Three: Short Answer

Instructions. Provide information to answer the following questions.

1. What are the advantages of asexual propagation?
2. What are the four types of stem cuttings and how do they differ?
3. When are leaf and leaf-bud cuttings used?
4. How are root cuttings prepared?
5. What are some common types of growing media used for rooting cuttings?

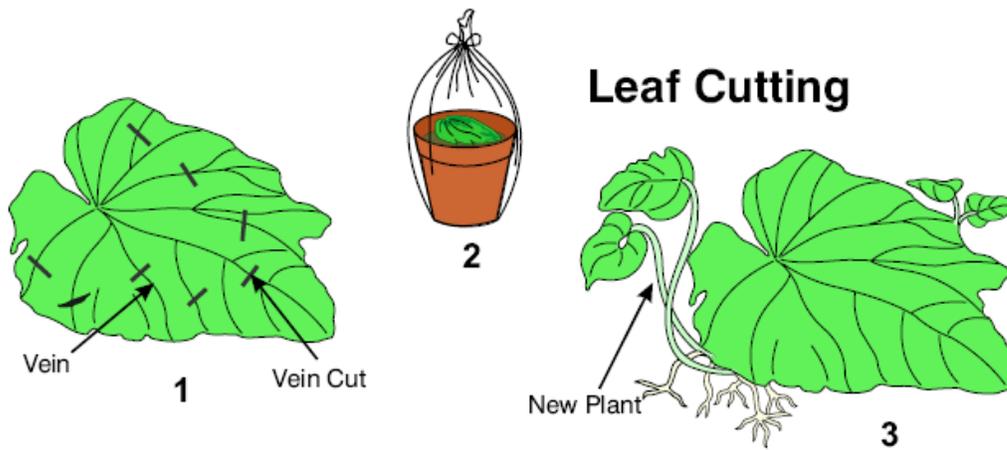
TM:E3-1

PARTS OF A SIMPLE LEAF

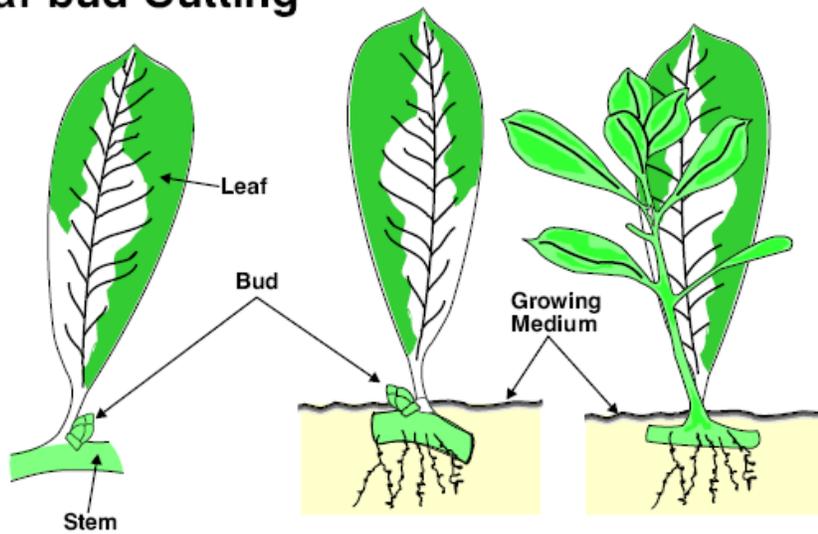


TM: E3-2

LEAF CUTTING AND LEAF-BUD CUTTING



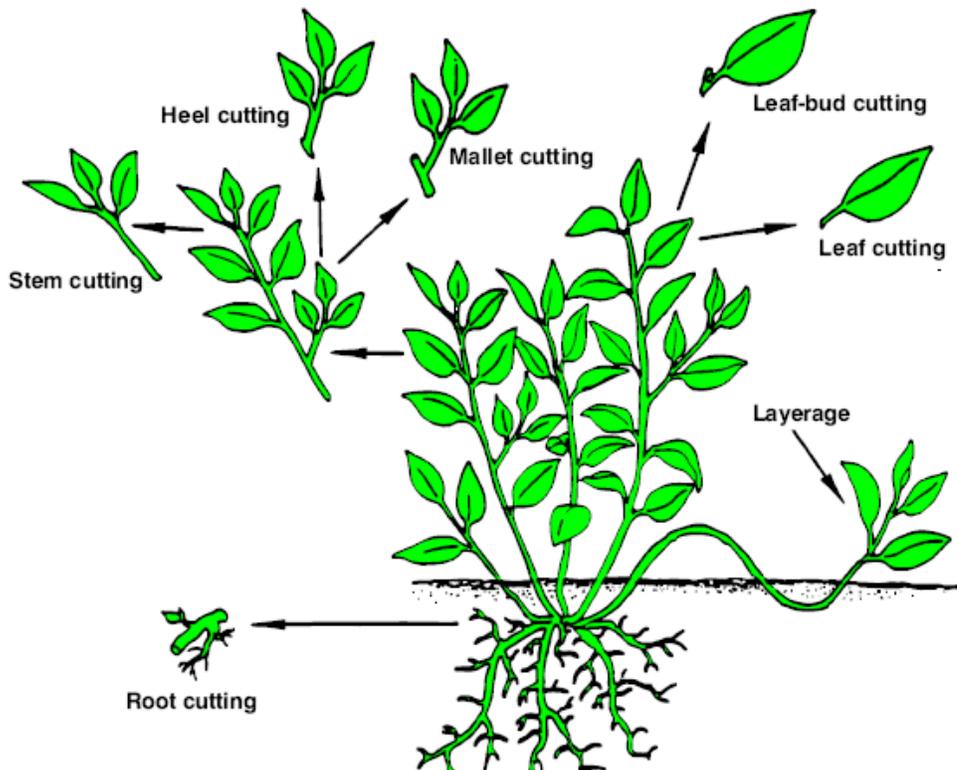
Leaf-bud Cutting



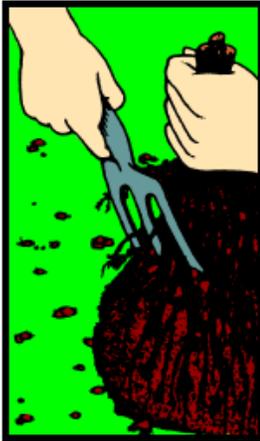
TM: E3-3

TYPES OF CUTTINGS

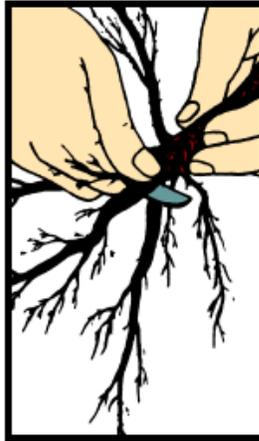
	Shoot Present on Cutting	Roots Present on Cutting
Mallet cutting	Yes	No
Heel cutting	Yes	No
Stem cutting	Yes	No
Root cutting	No	Yes
Layerage	Yes	No
Leaf-bud cutting	Yes	No
Leaf cutting	No	No



ROOT CUTTINGS



Lift the plant in the middle of the dormant season. Cut any top growth.

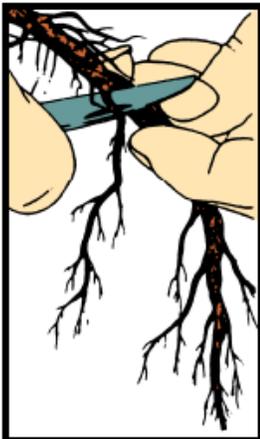


Wash its roots. Then cut off the young roots close to the crown and set aside.



Return the plant to its usual position in the garden.

Taking a root cutting



Cut off any fibrous lateral roots on undamaged young roots.



Make a right-angled cut on a root where it was severed from its parent.



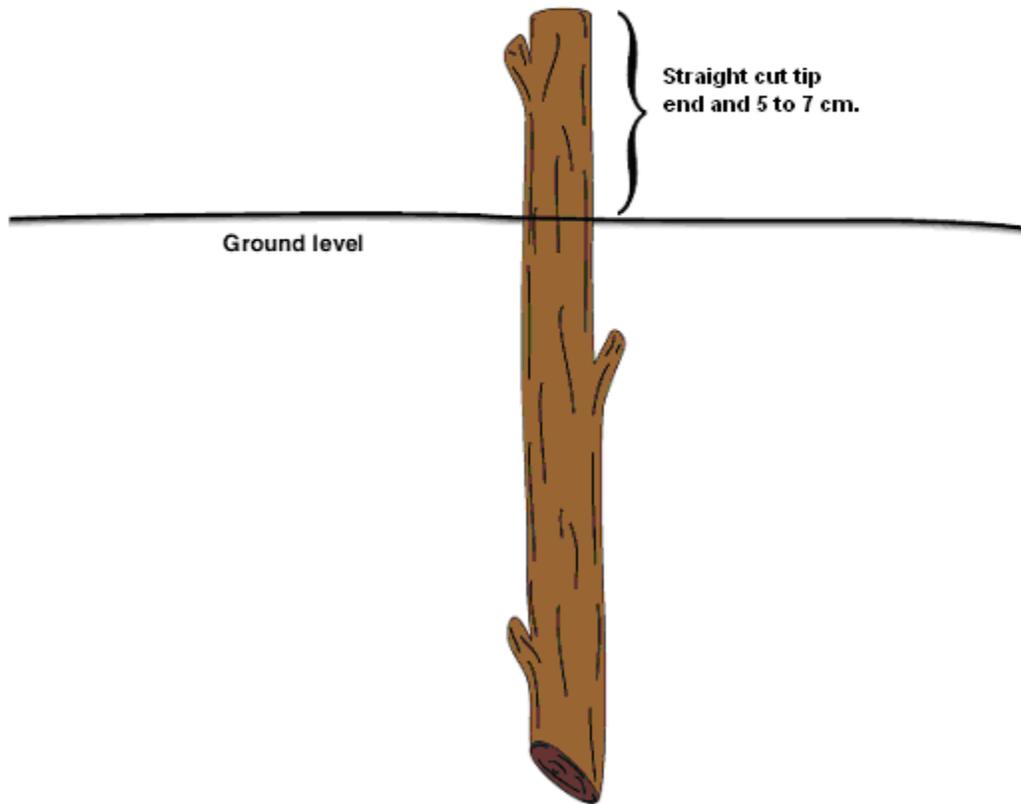
Cut away the thin root end at the appropriate length, using a sloping cut.

TM: E3-5

POLARITY IN CUTTINGS



Single cutting



Lab Sheet

Asexual Propagation

Materials:

- Plants
- Rooting Hormone (Auxin)
- Scissors
- Plant Pot
- Soil
- Labels for plants

Procedure:

1. Choose one of the plants laid out for this lab.
2. Collect 16 cuttings from the plants
 - Four leaf cuttings
 - Four leaf-bud cuttings
 - Four stem cuttings
 - Four root cuttings
3. Fill a pot with potting soil
4. Dip each individual plant in the rooting hormone.
5. Plant the plants in the pots.
6. Label each type of plant and identify the type of cutting.
7. Place pots in the greenhouse for further evaluation.
8. In a few weeks, check the plants to see which type of cutting worked best with the plant you chose. Do this by filling out the graph below. Mark a yes if there are roots growing and a no if there are not. Compare with the class when everyone is finished.

Plant used: _____

Cutting:	Cutting #1	Cutting #2	Cutting #3	Cutting #4
leaf cutting				
leaf-bud cutting				
stem cutting				
root cutting				