These lesson plans are intended for use in conducting classes on sexual plant reproduction. Presented first are an attention step/problem statement and a series of questions and answers designed to convey general information about sexual plant reproduction/propagation. The following topics are among those discussed: sexual and asexual plant propagation, seeds and seed parts, types of seeds, monocot and dicot seeds, germination, stages of germination, seedling parts, environmental conditions needed for germination, plant media, germination rate, planting depth, and the relationship between soil temperature and planting depth. Also provided are the following: a glossary of pertinent scientific terms, 3 worksheets, answers to the worksheets, a quiz and quiz answers, 14 overhead transparency masters, and lesson plans for teaching students to test seed for germination percentage and sow seeds. Each lesson plan includes an objective, list of equipment needed, student activity record sheet, and detailed steps for completing the activity. (MN)
Agricultural Lesson Plans

SEXUAL PLANT REPRODUCTION

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Southern Illinois University at Carbondale

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SEXUAL PLANT REPRODUCTION

ATTENTION STEP/PROBLEM STATEMENT

Have popcorn popping when students arrive for class or pop the popcorn before class starts. The students can eat the popcorn while you discuss seeds.

All seeds have 3 parts: the outside seed coat, the young plant inside the seed, and a stored food supply. Dicot plants and monocot plants store food for emerging seedlings differently. Dicots store the food for the seedlings in the seed leaves (cotyledons). Monocots store their food inside the seed and it is called endosperm. In fact the popcorn we eat is actually endosperm.

General Information about Sexual Reproduction of Plants

1. What are two means of propagation for plants?
   - Plants are propagated either sexually or asexually.

2. Define sexual propagation?
   - Sexual reproduction of plants involves the union of male and female sex cells. The formation of seeds is the result of the sexual union of plants.

3. What is the definition of asexual plant reproduction?
   - In asexual reproduction, there are no sex cells involved and the offspring has only one parent. The offspring is formed by division from a cell or group of cells coming from only one parent, so the offspring has the same genes as the parent. New plants have the same chromosomes as the parent plant, so plants are identical and do not vary genetically.

4. Why are sexual offspring different from the parent plant?
   - The offspring of sexually reproduced plants have genes from 2 parents and has a new gene combination. The offspring are not identical to either parent.

5. How are sexually produced plants propagated?
   - Sexually reproduced plants are propagated by seed.

6. What is the definition of a seed?
   - A seed is a ripened ovule of a plant.

7. What are three parts of all seeds?
   - All seeds contain an embryo, an outside seed coat, and a stored food supply. The embryo is the young plant inside the seed. The outside seed coat protects the embryo from the environment while the seed is still dormant. The stored food supply may be found in the endosperm or in the cotyledons.
8. What are the two types of plant seeds?
   - The two types of plant seed are monocot and dicot. They germinate differently.

9. What are some important characteristics of monocot seeds?
   - Monocots have one seed leaf known as a cotyledon. Food for the embryo to use during germination is stored in the endosperm of the seed.

10. What are some important characteristics of dicot seeds?
    - Dicots have two cotyledons. Food for the embryo to use during germination is stored in the cotyledons.

11. What is germination?
    Seed germination is the changes undergone by a seed immediately before and including the first signs of growth.

12. What are the three stages of germination?
    There are 3 stages of seed germination: the awakening stage, the digesting stage and seedling growth stage.

13. What occurs during the awakening stage?
    The awakening stage of the seed starts with the absorption of water by the dry seed. The seed swells. The essential living matter of the plant cell called protoplasm becomes hydrated. Enzyme activity begins in the embryo. The DNA, RNA, and ATP in the embryo are activated. DNA is the substance of which genes are made. RNA is needed for copying genetic information during protein synthesis. ATP is the major energy transferring molecule in biological systems and is essential for the synthesis of DNA and RNA. The cells that form the radicle elongate and the radicle emerges from the seed. The radicle forms the primary root.

14. What occurs in the digestive stage?
    In the Digesting Stage the fats, proteins, and carbohydrates that are stored in the endosperm (monocots) or cotyledons (dicots) are digested by the seed embryo. The digested food moves to the growing points of the embryo. The seed continues to take up water. The oxidative breakdown of food substances within the cells of the embryo occurs. This process is called respiration. Enzyme activity continues.

15. What occurs during the seedling stage?
    Cell division and the expansion of the seedling structures occur during the seedling stage. A seedling is a young plant that is forming roots, stems, and leaves. The seedling begins to develop. Respiration rate increases with growth. Water absorption increases as the radicle and new roots take up water. The upper part of the seedling pokes through the soil and emerges at the surface. The following parts of the seedling are present soon after emergence:
16. What is the Coleoptile?  
- sheathlike structure that protects the epicotyl in germinating monocot seed.

17. What is the Epicotyl?  
- forms the stem above the cotyledon.

18. What is the Hypocotyl?  
- forms the stem below the cotyledon.

19. Do seeds need a rest period before germination?  
Yes, Most seeds need a period of dormancy, or required rest period, before they can germinate.

20. Where is the seeds stored food supply usually found?  
The stored food supply may be found in the endosperm or in the cotyledons, depending on the type of seed.

21. What are three and sometimes four Environmental Conditions Needed for Germination?  
- Seeds require the proper amount of oxygen, water, temperature, and sometimes light to germinate. These requirements differ with each plant species. Each specific plant species has specific germination requirements.

22. What are three important characteristics of plant media?  
- Many different types of media are used in seed propagation. Media must be able to retain moisture, allow for drainage, and be free of diseases.

23. What are some of the more common items used for plant media?  
- Common media used for seed germination include:  
  - soilless potting soil mix, usually containing peat moss and vermiculite,  
  - vermiculite, - sphagnum moss, - peat moss, and foam.

24. What is the term used to describe the number of living seeds?  
- The difference between the number of viable seed and seed that is not viable is called germination percentage. Seeds may live a long time until conditions are favorable for germination and development.

25. How is the seed germination rate determined?  
- Figure germination percentage as follows:  
  Number of seedling that emerged divided by the number of seeds planted = _______ x 100 = _____ %

26. Generally, how deep should seeds be planted?  
- As a general rule, seeds are planted to a depth of 3-4 times their diameter.
27. What is affected by planting depth?
   - The depth a seed is planted in the soil may affect the amount of oxygen available, the amount of water available, its temperature, and amount of light available.

28. What problems may be caused by improper planting depth?
   - The planting of seeds too deep may be one cause of poor aeration. Seeds may dry out if planted too shallow.

29. What are the general temperature requirements for seeds?
   - Some plant species require either cool temperatures or warm temperatures for seeds to germinate. Others require the temperature to fluctuate from warm to cold for seed germination.

30. How is soil temperature and planting depth related?
   - Planting depth can effect temperature. Seeds that are planted too deep in the early spring can suffer from cool temperatures.

GLOSSARY OF SCIENTIFIC TERMS:

ATP - the major energy transferring molecule in biological systems and essential for the synthesis of DNA and RNA.

coleoptile - sheathlike structure that protects the epicotyl in germinating monocot seed.

cotyledons - (seed leaves) the first leaf or leaves of the embryo in seed plants.

dicots - plants having embryos with two cotyledons.

DNA - the substance of which genes are made.

dormancy - a period of rest required by most seeds before they can germinate.

embryo - young plant inside a seed.

endosperm - part of seed where food is stored in monocots.

epicotyl - forms the stem above the cotyledon.

genes - the unit of inheritance found on chromosomes.
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition and Example</th>
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<tbody>
<tr>
<td>germination</td>
<td>the changes undergone by a seed immediately before and including the first signs of growth.</td>
</tr>
<tr>
<td>hypocotyl</td>
<td>forms the stem below the cotyledon.</td>
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<tr>
<td>media</td>
<td>material in which a plant is grown. Example: soil.</td>
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<tr>
<td>monocots</td>
<td>plants having embryos with one cotyledon (seed leaf).</td>
</tr>
<tr>
<td>plant species</td>
<td>a distinct kind of plant.</td>
</tr>
<tr>
<td>propagation</td>
<td>multiplication of plants by both sexual and asexual methods.</td>
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<tr>
<td>protoplasm</td>
<td>essential living matter of plant and animal cells.</td>
</tr>
<tr>
<td>radicle</td>
<td>forms the primary root.</td>
</tr>
<tr>
<td>respiration</td>
<td>the oxidative breakdown of food substances within the cells of plants and other living organisms.</td>
</tr>
<tr>
<td>RNA</td>
<td>needed for copying genetic information during protein synthesis.</td>
</tr>
<tr>
<td>seed</td>
<td>the ripened ovule in seed plants; contains embryo, outside seed coat, and stored food supply.</td>
</tr>
<tr>
<td>seed coat</td>
<td>covering of a seed that protects the embryo.</td>
</tr>
<tr>
<td>seedling</td>
<td>a young plant that is forming roots, stems, and leaves.</td>
</tr>
<tr>
<td>sexual reproduction</td>
<td>the formation of offspring of a species by the union of two cells.</td>
</tr>
<tr>
<td>viable</td>
<td>seeds that are able to germinate and grow.</td>
</tr>
</tbody>
</table>
Directions: Complete the following questions.

1. Plants that reproduce sexually have ________ parent(s), while plants that reproduce asexually have__________ parent(s).

2. The formation of ________ is the result of the sexual union of plants.

3. Sexually reproduced plants are propagated by ________.

4. The three parts of a seed are:
   a. __________________________
   b. __________________________
   c. __________________________

5. The two types of plant seed are ________________ and ________________.

6. Monocots have _______ cotyledon(s) and food for the embryo is stored in the ________________.

7. Dicots have _______ cotyledon(s) and food for the embryo is stored in the ________________.

8. Four environmental conditions necessary for seed germination are:
   a. __________________________
   b. __________________________
   c. __________________________
   d. __________________________

9. The difference between the number of viable seed and seed that is not viable is called ____________.

10. As a general rule, seeds are planted at a depth of _____ times their diameter.
Directions: Complete the following questions.

1. Plants that reproduce sexually have ____2____ parent(s), while plants that reproduce asexually have ____1____ parent(s).

2. The formation of _____seeds_____ is the result of the sexual union of plants.

3. Sexually reproduced plants are propagated by ____seed_____.

4. The three parts of a seed are:
   a. ____embryo_____ 
   b. ____seed coat_____ 
   c. ____stored food supply_____ 

5. The two types of plant seed are ____monocot_____ and ____dicot_____.

6. Monocots have ____1____ cotyledon(s) and food for the embryo is stored in the ____endosperm_____.

7. Dicots have ____2____ cotyledon(s) and food for the embryo is stored in the ____cotyledons_____.

8. Four environmental conditions necessary for seed germination are:
   a. ____oxygen_____ 
   b. ____water_____ 
   c. ____suitable temperatures_____ 
   d. ____sometimes light_____ 

9. The difference between the number of viable seed and seed that is not viable is called ____germination percentage_____.

10. As a general rule, seeds are planted at a depth of ____3-4____ times their diameter.
Directions: The answers to the following fill-in-the-blank questions are terms which have something to do with sexual reproduction. Choose the term from the word list below that best answers each question. Each term may be used only once.

Word List:

ATP
coleoptile
cotyledons
dicots
DNA
dormancy
embryo
endosperm
epicotyl
genes
germination
hypocotyl
media
monocots
plant species
propagation
protoplasm
radicle
respiration
RNA
seed
seed coat
seedling
sexual reproduction
viable

Fill-in-the-blank:

1. The formation of offspring of a species by the union of two cells is called ____________________________.

2. The unit of inheritance found on chromosomes is called ____________.

3. A _____________ is a ripened ovule containing an embryo, seed coat, and a stored food supply.

4. An ______________ is the young plant inside a seed.

5. A ______________ is a covering that protects the embryo.

6. ______________ is the changes undergone by a seed immediately before and including the first signs of growth.

7. ______________ is the period of rest required by most seeds before they can germinate.

8. Seeds that are able to germinate and grow are called ______________.
9. The first leaves of the embryo during germination are called ________________.

10. Seed that have embryos with two cotyledons are called ________________.

11. Seed that have embryos with one cotyledon are called ________________.

12. The food of a monocot seed is stored in the ____________.

13. ____________ is the multiplication of plants by both sexual and asexual methods.

14. A young plant that is forming roots, stems, and leaves is called a ________________.

15. A distinct kind of plant is known as a ____________.

16. Plants are grown in ________________.

17. The ________________ forms the stem above the cotyledon on the germinating seedling.

18. The ________________ forms the stem below the cotyledon on the germinating seedling.

19. The ____________ forms the primary root.

20. The ________________ protects the seed in the germinating monocot seedling.

21. Genes are made of ____.

22. ____ is needed for copying genetic information during protein synthesis.

23. ____ is essential for the synthesis of DNA and RNA.

24. ________________ is the essential living matter of all living things.

25. The oxidative breakdown of food substances within the cells of plants and other living organisms is called ________________.
WORK SHEET B ANSWERS

Directions: The answers to the following fill-in-the-blank questions are terms which have something to do with sexual reproduction. Choose the term from the word list below that best answers each question. Each term may be used only once.

Word List:

ATP
coleoptile
cotyledons
dicots
DNA
dormancy
embryo
endosperm
epicotyl
genes
germination
hypocotyl
media
monocots
plant species
propagation
protoplasm
radicle
respiration
RNA
seed
seed coat
seedling
sexual reproduction
viable

Fill-in-the-blank:

1. The formation of offspring of a species by the union of two cells is called sexual reproduction.

2. The unit of inheritance found on chromosomes is called genes.

3. A seed is a ripened ovule containing an embryo, seed coat, and a stored food supply.

4. An embryo is the young plant inside a seed.

5. A seed coat is a covering that protects the embryo.

6. Germination is the changes undergone by a seed immediately before and including the first signs of growth.

7. Dormancy is the period of rest required by most seeds before they can germinate.
8. Seeds that are able to germinate and grow are called **viable**.

9. The **first** leaves of the embryo during germination are called **cotyledons**.

10. Seed that have embryos with two cotyledons are called **dicots**.

11. Seed that have embryos with one cotyledon are called **monocots**.

12. The food of a monocot seed is stored in the **endosperm**.

13. **Propagation** is the multiplication of plants by both sexual and asexual methods.

14. A young plant that is forming roots, stems, and leaves is called a **seedling**.

15. A distinct kind of plant is known as a **plant species**.

16. Plants are grown in **media**.

17. The **epicotyl** forms the stem above the cotyledon on the germinating seedling.

18. The **hypocotyl** forms the stem below the cotyledon on the germinating seedling.

19. The **radicle** forms the primary root.

20. The **coleoptile** protects the seed in the germinating monocot seedling.

21. Genes are made of **DNA**.

22. **RNA** is needed for copying genetic information during protein synthesis.

23. **ATP** is essential for the synthesis of DNA and RNA.

24. **Protoplasm** is the essential living matter of all living things.

25. The oxidative breakdown of food substances within the cells of plants and other living organisms is called **respiration**.
DIRECTIONS: Complete the following questions.

A. Fill-in-the-Blank:

The Awakening Stage
1. Seed germination begins with the absorption of _____________ by the dry seed. The seed swells and the ________________ in the seed becomes hydrated.

2. ______________ activity begins in the embryo and DNA, RNA, and ATP are activated.

3. After cells ______________, the radicle emerges from the seed.

The Digesting Stage
4. The stored fats, proteins, and carbohydrates are ______________ by the seed embryo and moved to its growing points.

5. The embryo continues to take up water, and________ and enzyme activity continues.

Seedling Growth Stage
6. The cells ___________ and the expansion of the seedling structures occur.

7. ______________ rate increases with growth and water absorption increases as the ______________ take up water.
DIRECTIONS: Complete the following questions.

A. Fill-in-the-Blank:

The Awakening Stage
1. Seed germination begins with the absorption of [water] by the dry seed. The seed swells and the [protoplasm] in the seed becomes hydrated.

2. Enzyme activity begins in the embryo and DNA, RNA, and ATP are activated.

3. After cells [elongate], the radicle emerges from the seed.

The Digesting Stage
4. The stored fats, proteins, and carbohydrates are [digested] by the seed embryo and moved to its growing points.

5. The embryo continues to take up water, and [respiration] and enzyme activity continues.

Seedling Growth Stage
6. The cells [divide] and the expansion of the seedling structures occur.

7. Respiration rate increases with growth and water absorption increases as the [radicle or roots] take up water.
Demonstrate testing seed for germination percentage to the class.

Activity Summary: (Students will work in groups of 2 and test bean and popcorn seeds.) Show students where to write their names on the petri dishes using a waterproof marker. Place 2 pieces of filter paper in the bottom of petri dish. Count 10 bean seeds and place on top of filter paper. Cover with another piece of filter paper. Demonstrate wetting paper with water and pouring off excess water. Repeat this process with the popcorn seed.

TESTING SEED
a. Purpose:
to test the viability of the seed.
to observe germinating dicot and monocot seed.

b. What Each Student Needs:
Two plastic petri dishes
Six pieces of filter paper
10 popcorn seeds
10 bean seeds
waterproof marker
water

c. Here's How:
1. Have students work in groups of 2.
2. Each group should get 2 petri dishes, 6 pieces of filter paper, 10 popcorn seeds, and 10 bean seeds.
3. Write your names on the petri dishes with the waterproof marker.
4. Place 2 pieces of filter paper in each petri dish.
5. Put 10 popcorn seeds in one of the petri dishes and 10 bean seeds in the other petri dish.
6. Cover the seeds with a piece of filter paper.
7. Soak the filter paper thoroughly with water.
8. Pour off all excess water.
9. Place petri dish where instructed by your teacher.
10. Add water when needed.
11. Observe the seeds daily for 2 weeks and record observations on Student Activity - 1 Record Sheet.
## STUDENT - RECORD SHEET

<table>
<thead>
<tr>
<th>POPCORN SEEDS</th>
<th>BEAN SEEDS</th>
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<tbody>
<tr>
<td><strong>Date</strong></td>
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**Figure Germination Percentage of Popcorn Seeds:**

Number of seedling germinated / 10 = ______ X 100 = ______%.

**Figure Germination Percentage of Bean Seeds:**

Number of seedling germinated / 10 = ______ X 100 = ______%.
Demonstrate sowing seed to the class.

Activity Summary: Show students where to write their names on pots with a waterproof marker. Number the pots 1 - 4. Students will be planting 20 popcorn seed and 20 bean seed. Five seed of each will be planted at different depths in 4 different pots. In pot #1, the seed will be planted very deep and in pot #4, the seed will be laid on top of the medium. The pots will be watered and observed for at least 2 weeks.

COMPARISON OF DEPTH OF SOWING
a. Purpose: to understand the importance planting depth has on seedling emergence and to compare the differences between monocot and dicot germination

b. What Each Student Needs:
Four 6" standard pots  20 popcorn seeds
20 bean seeds  media
waterproof marker

c. Here's How:
1. Get 20 popcorn seed, 20 bean seeds, and four 6" pots from your teacher.
2. Write your name on the pots and number the pots 1-4 with a waterproof marker.
3. Put one inch of media in the 1st pot. Put 5 popcorn seeds and 5 bean seeds on top of media. Finish filing the pot with media.
4. Put 3 inches of media in the 2nd pot. Put 5 popcorn seeds and 5 bean seeds on top of media. Finish filling the pot with media.
5. Put 5 inches of media in the 3rd pot. Put 5 popcorn seeds and 5 bean seeds on top of media. Finish filling the pot with media.
6. Fill 4th pot completely full with media. Lay 5 popcorn seeds and 5 bean seeds on top of media.
7. Water the seeds.
8. Clean up your work area.
9. Water pots as needed.
10. Observe pots at least twice a week.
11. Record results on activity record sheet.
The student Activity Record Sheet will take at least 2 weeks to complete.

RECORD SHEET

POPCORN SEEDS

A. Sketch the germinating popcorn seed.

B. Is popcorn a monocot or is it a dicot?

C. Record the Number of popcorn seedlings as they emerge on the table below.

<table>
<thead>
<tr>
<th>Date</th>
<th>Pot #1</th>
<th>Pot #2</th>
<th>Pot #3</th>
<th>Pot #4</th>
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<tbody>
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</table>

D. Figure the popcorn germination percentages for the 4 pots using the table below.

Pot 1 ______ / 5 = ______ X 100 = _____%

Pot 2 ____________________ = _____%

Pot 3 ____________________ = _____%

Pot 4 ____________________ = _____%

E. Compare the rate the seedlings emerged.

1. In which pots did the corn seedlings emerge the quickest?

2. In which pots did the corn seedlings emerge the slowest?
SOYBEAN SEEDS
A. Sketch the germinating soybean seed.

B. Is soybean a monocot or is it a dicot?

C. Record the Number of soybean seedlings as they emerge on the table below.

<table>
<thead>
<tr>
<th>Date</th>
<th>Pot #1</th>
<th>Pot #2</th>
<th>Pot #3</th>
<th>Pot #4</th>
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</table>

D. Figure the soybean germination percentages for the 4 pots using the table below.

Pot 1 _____ / 5 = _____ X 100 = _____%
Pot 2 __________________________ = _____%
Pot 3 __________________________ = _____%
Pot 4 __________________________ = _____%

E. Compare the rate the seedlings emerged.
1. In which pots did the soybean seedlings emerge the quickest?

2. In which pots did the soybean seedlings emerge the slowest?

Discuss the Student Activity with the class. Review how to calculate germination percentages.
Students should check their seedlings twice a week for at least 2 weeks. This activity may take 3 weeks. Observations should be recorded on the Student Activity - 2 Record Sheet. The activity should be discussed by the class at the completion of the activity.
Quiz

A. Matching:

Match the best definition with each term.

___1. Dicot

2. Monocot

3. Sexual Reproduction

4. Epicotyl

5. Hypocotyl

6. Cotyledon

7. Radicle

a. forms the stem below the cotyledon.

b. the first leaves of the embryo in seed plants.

c. forms the primary root of a seedling.

d. seeds having embryos with two cotyledons.

e. formation of offspring of a species by the union of 2 cells.

f. type of seed that stores its food in the endosperm.

g. forms the stem above the cotyledon.

B. True or False:

8. Seeds are generally planted at a depth of 2 times their diameter.

9. The depth a seed is planted can affect the amount of water and oxygen it receives.

10. The stem emerges from the seed before the radicle during seed germination.

11. The difference between the number of live seed and dead seed is called germination percentage.
C. Fill-in-the-blank:

12. Sexually reproduced plants are propagated by _______.

13. If you planted 10 seeds and only 7 seeds germinated, the germination percentage would be _______.

14. The awakening stage of the seed starts with the absorption of ________ by the dry seed.

15. Name three environmental conditions that affect seed germination.
   a. 
   b. 
   c. 
   d. 

16. Name the three parts of a seed.
   a. 
   b. 
   c. 

Quiz Answers

A. Matching:
Match the best definition with each term.

1. Dicot    a. forms the stem below the cotyledon.
2. Monocot  b. the first leaves of the embryo in seed plants.
4. Epicotyl d. seeds having embryos with two cotyledons.
5. Hypocotyl e. formation of offspring of a species by the union of 2 cells.
6. Cotyledon f. type of seed that stores its food in the endosperm.
7. Radicle  g. forms the stem above the cotyledon.

B. True or False:

8. False  Seeds are generally planted at a depth of 2 times their diameter.
9. True   The depth a seed is planted can affect the amount of water and oxygen it receives.
10. False The stem emerges from the seed before the radicle during seed germination.
11. True  The difference between the number of live seed and dead seed is called germination percentage.
C. Fill-in-the-blank:

12. Sexually reproduced plants are propagated by ___seed____.

13. If you planted 10 seeds and only 7 seeds germinated, the germination percentage would be ___70%____.

14. The awakening stage of the seed starts with the absorption of ___water____ by the dry seed.

15. Name three environmental conditions that affect seed germination.
   a. Temperature
   b. Amount of oxygen
   c. Amount of water
   d. Sometimes the amount of light

16. Name the three parts of a seed.
   a. Embryo
   b. Seed Coat
   c. A Stored Food Supply
PARTS OF A SEED

Embryo

Outside seed coat

Stored food supply
TWO TYPES OF PLANT SEED

Monocot

Dicot
CHARACTERISTICS
OF MONOCOTS:

One seed leaf

Food stored in the endosperm.
MONOCOT SEED
(CORN)
SEED COAT

ENDOSPERM

cotyledon
coleoptile
epicotyl
hypocotyl
radicle

EMBRYO
CHARACTERISTICS OF DICOTS:

Two seed leaves

Food stored in the cotyledons
A DICOT SEED
(BEAN)
ENVIRONMENTAL CONDITIONS NEEDED FOR GERMINATION:

- Optimum Oxygen
- Optimum Water
- Optimum Temperature
- Sometimes - Light
MEDIA FOR
SEED GERMINATION:

Soil
Soilless mix
Vermiculite
Sphagnum moss
Peat moss
Foam
FIGURING GERMINATION PERCENTAGE:

Number of seedlings that have emerged divided by Number of seeds planted =

____ X 100 =

____ % germination
GENERAL RULE ABOUT

PLANTING DEPTH:

Plant seed at a depth of 3 - 4 times the diameter of the seed.
THREE STAGES OF SEED GERMINATION:

Awakening Stage

Digesting Stage

Seedling Growth Stage
AWAKENING STAGE

Absorption of water.

Enzyme activity begins.

Cells elongate and radicle emerges.
DIGESTING STAGE

Stored food is digested and moved to growing points of the embryo.
SEEDLING GROWTH

Cell division and expansion of the seedling structures occur.