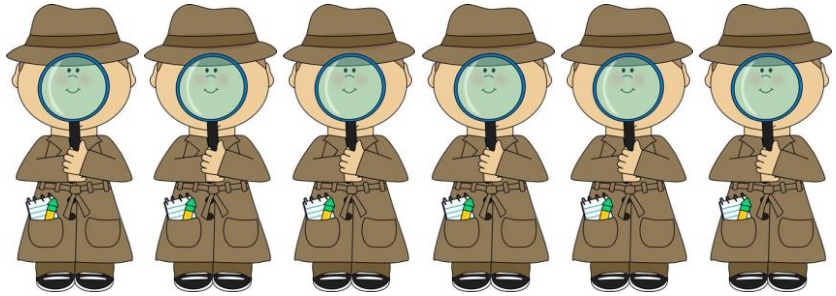
Plants Week 6 Booklet

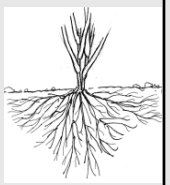
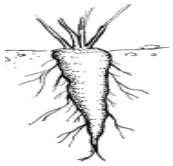
- Living vs. Non-Living
- Foss Investigation #5 The Vascular System
- Part 1: What Happened to the Water?
- Part 2: Looking at Plant Structures

Not in Foss-

- Nonvascular Systems
- Types of Roots



Vascular/Nonvascular Vocabulary

Word	Definition
1. Vascular	Largest group in the plant kingdom that has a well-developed system for transporting water and food (xylem/phloem in tube-like support and circulatory system); therefore they have true roots, stems and leaves.
2. Vascular Examples	Woody stems: trees, shrubs/Soft stems: dandelions, grasses, tomato plants.
3. Xylem "Xylem UP"	Transports water and minerals from the roots UP to the rest of the plant.
4. PHloem "PHloem DOWN"	Transports food (sugar/glucose) made in PHotosynthesis DOWN from the leaves to the rest of the plant.
5. Nonvascular	Do not have a well-developed system for transporting water and food; therefore, do not have true roots, stems, or leaves. They must transport food and water from cell to cell.
6. Nonvascular Examples	Mosses, liverworts and hornworts.
7. Roots	Anchor the plant, absorb water and nutrients from soil, store extra food for the plants, increase surface area to absorb more water and nutrients .
8. Root hairs	Help to increase surface area of roots.
9. Fibrous roots 	Consist of several main roots that branch off to form a mass of roots. Examples- grass, corn, and some trees.
10. Taproots 	Consists of one large, main root with smaller roots branching off. Examples-carrots, dandelions, or cacti.

CELERY-INVESTIGATION CONSIDERATIONS

Materials

1 Stalk of celery

1 Vial

1 Vial holder

1 Syringe

1–2 Accurate balances (for class)

• Water

Things to consider

1. How will you determine if water is lost to evaporation?

2. How will you determine if water is absorbed into the celery?

3. What tools will you use to make your measurements?

Celery Investigation A

Data

	Day 0 (set-up)	Day 1 (final)	Change
Water in control vial (volume)			
Water in celery vial (volume)			
Celery mass			

Part 1

1. Take the celery stalk out of the vial. Measure the amount of water in the celery vial, using a graduated cylinder. Record.
2. Record the amount of water in the class control (evaporation) vial.
3. Calculate the changes in volume of water in the vials. Record.

4. How much water was lost to evaporation? _____
5. How much water was lost in the celery vial? _____
6. Do the amounts match? _____ Why or why not?

Part 2

7. *Predict* the current mass of the celery stalk. (Remember that for water, 1 mL = 1 g.) _____
8. Determine the actual mass of the celery. Record.

LAB: Part 1: What Happened to the Water?

Celery Investigation B

Part 2. *(continued)*

9. Does your prediction match the actual mass of the celery? _____ Record any ideas you have about your results.

10. Calculate the *change* in mass of the celery. Record in the data table.

Part 3

11. How much of the water from the celery vial ended up in the celery? _____ How do you know?

12. What do you think happened to the rest of the water that was lost from the celery vial?

13. Determine the amount of water unaccounted for in your vial.

water lost from celery vial — water that evaporated — any *increase* in mass of the celery = water unaccounted for

Part 4

14. In your notebook, describe any patterns you notice in the class celery and class data.

LAB: Part 1: What Happened to the Water?

Leaf Observations

Tradescantia leaf (100X)

Tradescantia leaf (400X) one stoma

Crisp celery leaf (400X) (optional)

Wilted celery leaf (400X) (optional)

1. Label the guard cells and one stoma in the high-power drawing.
2. Describe the structure of a stoma.
3. Explain how stomata work.

LAB: Part 2: Looking at Plant Structures

Response Sheet—Investigation 5

A student noticed a plant outside that had really wilted leaves. He remarked to a friend,

Those leaves must be losing a lot of water to become so wilted. I bet that the stomata are totally open right now.

Do you agree or disagree? What would you add to the conversation?

LAB: Part 2: Looking at Plant Structures

CELERY-INVESTIGATION CLASS RESULTS

Group	Water gone from celery vial (mL or g)	Change in mass of the celery (g)	Water unaccounted for (mL or g)

LAB: CELERY INVESTIGATION CLASS RESULTS

Video

Classifying Plant Groups

Group	Write or draw a fact as you watch the video
Vascular	
Nonvascular	
Seed producing	
Spore producing	
Flowering	
Cone bearing	
Monocot	
Dicot	

GROUPS OF PLANTS

All plants are included in this kingdom, which is then broken down into smaller divisions based on several characteristics, for example:

- How they absorb and circulate fluids – **vascular or nonvascular;**
- How they reproduce – **spores or seeds**;
- Method of seed production – **cones or flowers**;
- Type of seed leaf – **monocot or dicot**.

Classifying Plant Groups

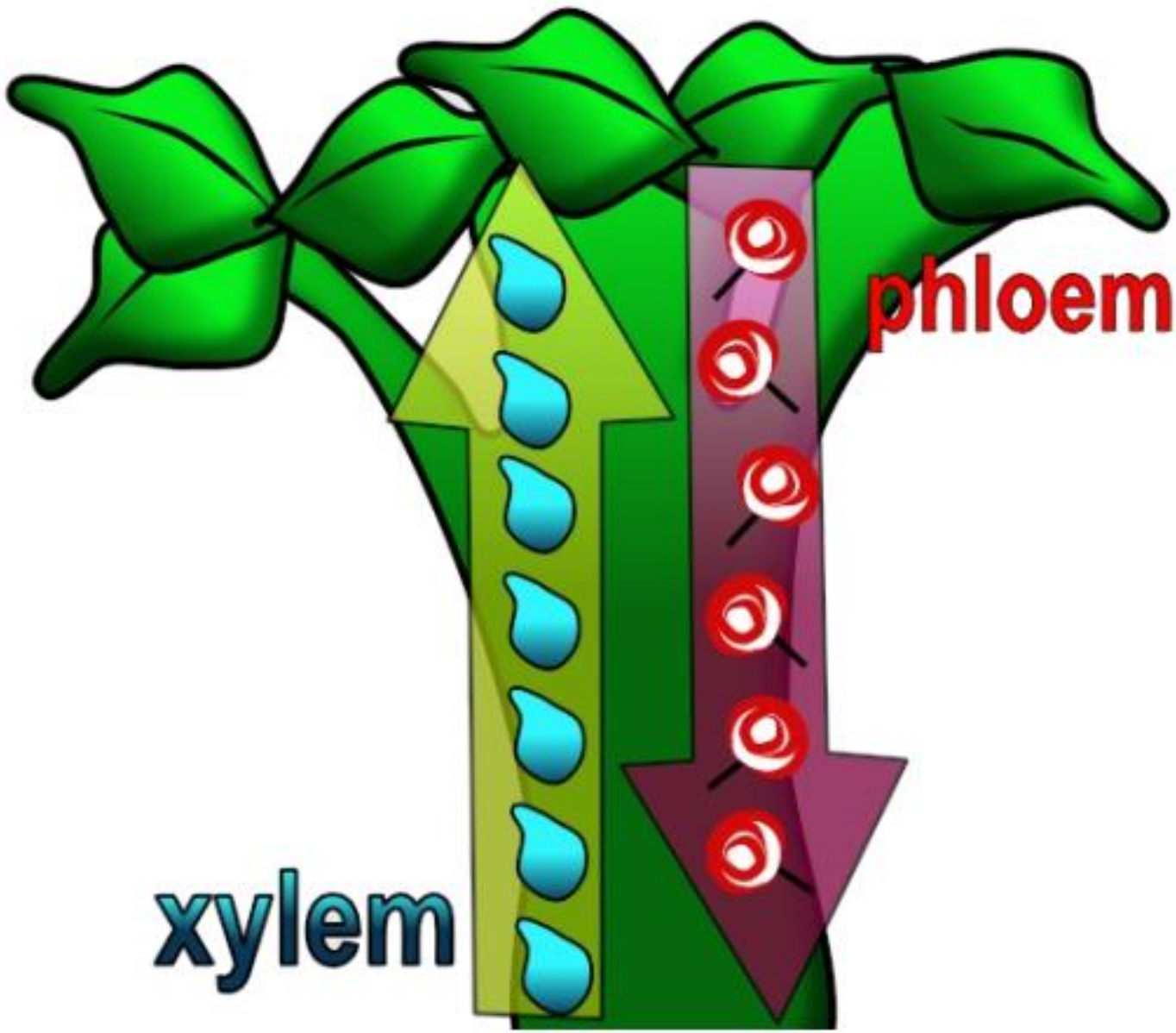
Vascular

- It is the largest group.
- It has a well-developed system for transporting water and food; they have true roots, stems, and leaves.
- It helps circulate water and food throughout the plant.
- ***Xylem*** transport water and minerals from the roots up to the rest of the plant.
- ***Phloem*** transport food from the leaves down to the rest of the plant.
- **Examples**:
- *woody* stems- trees & bushes
- *herbaceous* stems- grasses

Nonvascular

- Plants do not have a well-developed system for transporting water and food; do not have true roots, stems, or leaves.
- They must obtain nutrients directly from the environment and distribute it from cell to cell
- throughout the plant. This usually results in these plants being very small in size.
- **Examples**:
- mosses, liverworts, and hornworts

Vascular Plants: Xylem & Phloem



Xylem & Phloem Get Things Moving

Cross-Curricular Focus: Life Science

Most plants are vascular plants, having organized systems for transporting materials around to the various parts of the plant. We all know that the human body has organs in it, like the heart, lungs, kidneys and so on. But vascular plants have organs, too. The organs in a vascular plant include leaves, roots and stems. Leaves help the plant produce food by gathering sunlight and using it in the process of photosynthesis. The roots help the plant stay in one place. They burrow down into the ground and hold on. The roots also absorb nutrients and water out of the ground that the plant can use. Stems hold water, and help support the plant. They also act as a highway system to help plants get what they need.

There are two kinds of vascular tissue inside the plant's organs: **xylem** and **phloem**. Xylem carries water and nutrients through the plant from the roots to the stem and leaves. Xylem always flows up, not down. After sugar is made in the leaves during the process of photosynthesis, phloem picks up the sugar and carries it throughout the plant. The natural direction of phloem is downward, but it can flow upward when it has sugar to deliver. Sometimes the plant needs to use the sugar right away. At other times, the sugar is stored to be used later.

Vascular tissue is found in clusters in most plants, with xylem and phloem "packaged" together. It takes a certain amount of "pull" to make water flow up a plant. Root pressure gets the process started. Roots tend to be salty, which draws water in. The special tissue of the roots prevents the water from going back out. Water drops cling to each other, and to some other molecules. This property of water is called cohesion. But even root pressure and cohesion are not enough. **Transpiration** is the final piece that keeps things moving. As water evaporates off of the plant's leaves, it "pulls" more water up through the plant to take its place. In fact, almost all of the water that flows through a plant moves up through the plant fairly quickly and is transpired.

Name: _____

Answer the following questions based on the reading passage. Don't forget to go back to the passage whenever necessary to find or confirm your answers.

1) What is a vascular system?

_____

_____

2) What is the main difference between xylem and phloem? _____

_____

_____

_____

3) What are the three primary organs in a vascular plant? _____

_____

4) Why is it important to the plant that phloem moves both up and down?

_____

5) How does water flow up a plant?

_____

_____

_____

_____

Note Guide

Fill in the blanks with teacher!

Plant Kingdom

- **Vascular Plants**
  - _____
    - _____
    - _____
  - _____
    - _____
- **Nonvascular Plants**
  - _____
  - _____
  - _____

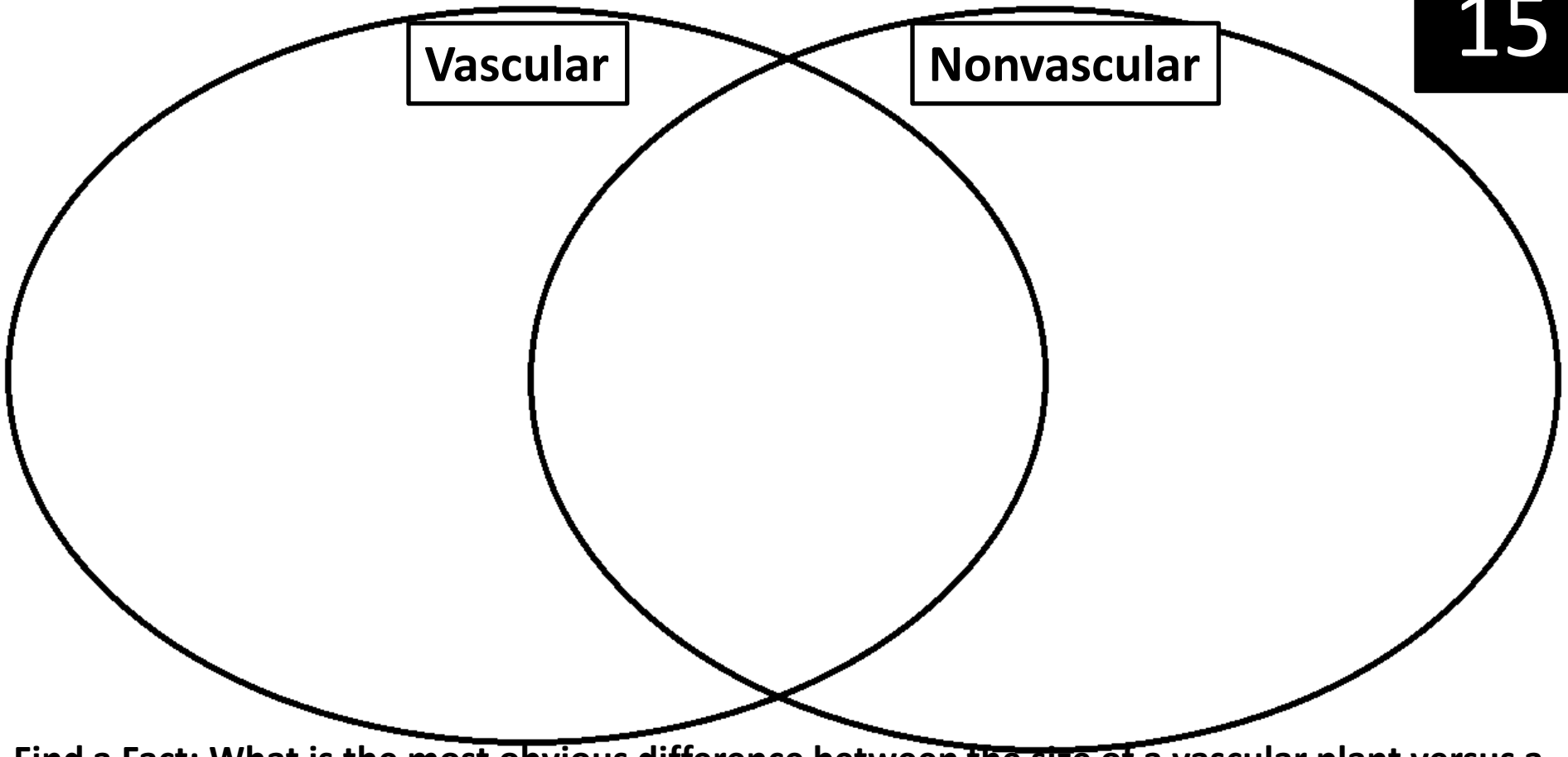
How are the vascular and nonvascular plants alike and different in transport of food and water?

- True roots, leaves & stems
- No true roots, stems & leaves
- Usually very small
- Has tube-like structures that circulate food and water
- Make their own food

- Has xylem (UP)
- Has phloem (DOWN)
- Can grow very large
- Grow close to ground
- Transport H_20 cell to cell

- Needs water
- Usually green
- Needs nutrients
- Largest group
- Smallest group

- Ex. Mosses, liverworts, hornworts
- Ex. Woody stems: trees, shrubs, soft stems: grasses, tomato plants, dandelions
- Cells include chloroplasts, cell walls, vacuoles

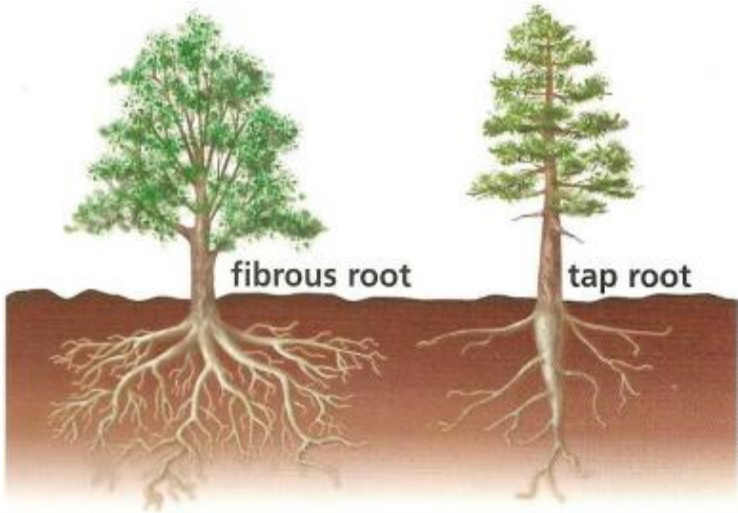


<u>Find a Fact</u>: What is the most obvious difference between the size of a vascular plant versus a nonvascular plant? _____Why do you think this is?_____

Types of roots

Take a look at the plants below. You can see that they have different types of leaves. They are different colors, sizes, and shapes. Some plants grow flowers. Other plants grow nuts, fruit, or vegetables. You cannot see the roots of plants because they grow under the soil. Do you think the roots are different too?

Plant roots take in water and minerals from the soil. They hold the plant in place. The roots also help keep soil from blowing away in the wind or being washed away by water. Some plants have roots that spread out under the surface of the soil to collect water. These are called fibrous roots. Other plants have longer roots that are thick and grow deep in the soil. These are called tap roots.



Types of roots

Here are some pictures that show plants with their roots.

Grass

Carrot

Dandelion

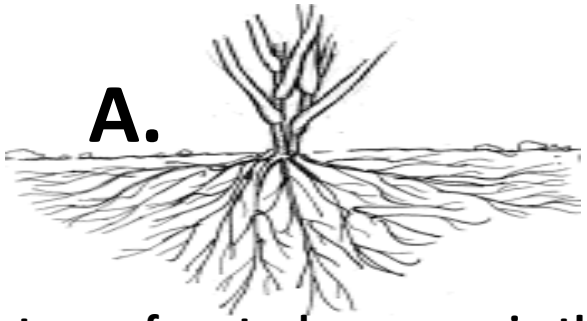
Violet

1. **What are the three jobs of plant roots? _____**
2. **What is a fibrous root? _____**
   Provide an example._____
3. **What is a tap root? _____**
   Provide an example. _____

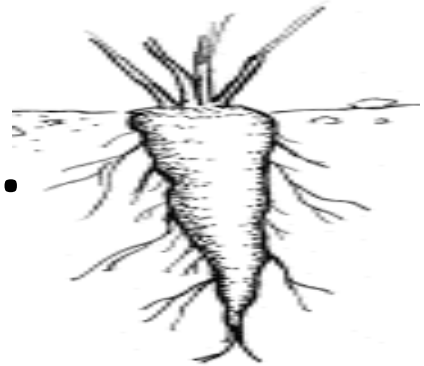
You will notice that one of the root examples above is a carrot. There are actually several roots that make their way into the average diet. Carrots, beets, turnip, yams, parsnips, radish, and potatoes are all roots.

What are the differences between tap roots & fibrous roots

A.



B.



Which type of roots do you see in the diagrams above?

A. _____ B._____

	Tap Root	Fibrous Root
Similarity		
Difference		
Example		

Put a "T" next to a tap root and a "F" next to a fibrous root.

____ dandelion ____rice ____hibiscus ____wheat ____grass ____corn

____ bean ____pea ____carrot ____oak ____palm ____mango

Plant Groups

Vascular Plants

Facts
- **L**_____ group
- Examples: _____
  _____

Parts
- True- _____, S_____, & _____

X_____,
carries _____

p_____,
carries _____

Cone-bearing Plants

Example:
- _____
  _____

S_____ are in the cones!

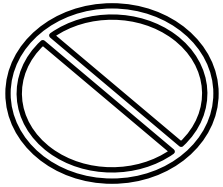
Non-Vascular Plants (NOT!!)

Parts
- **NO** True-
  _____,
  S_____,
  & _____

Examples
- _____
- _____
- _____

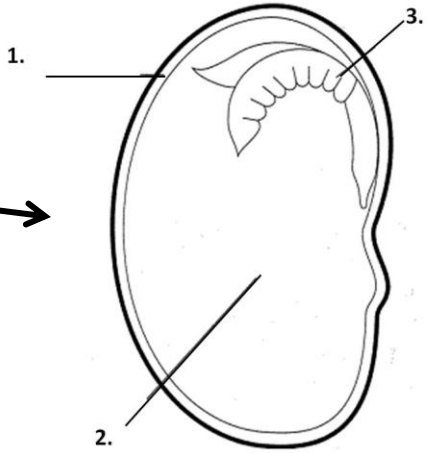
Plants with Spores

Non- Example:
(draw inside picture)



Examples:
- _____
- _____
- _____
- _____

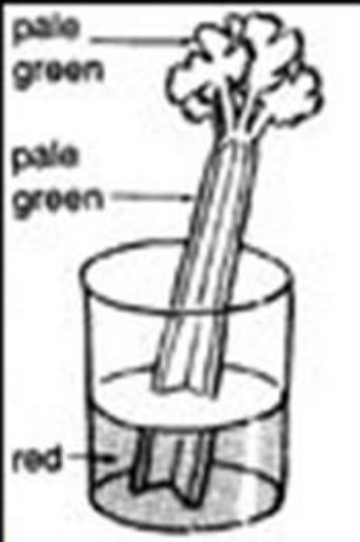
Plants with Seeds



Scientific Argument: Claim, Evidence, Reasoning

6.E.2A.2

Transpiration Data Chart

Time	Observations: Stems	Observations: Leaves	Diagram
0 hours	pale green	pale green	
12 hours	green with pale red stripes running up the stalk	reddish	Note: Draw a colored diagram here.

<u>Find a fact</u>: According to this Transpiration Data Chart the observations and drawings prove what is carrying the red dye up?
<u>Circle the correct answer</u>: xylem or phloem

Using the graph, use your scientific argument skills to chose the best claim below about the concept of vascular versus nonvascular.

A. Vascular plants are larger than nonvascular plants due to their color.

B. Vascular plants are more able to transport water and nutrients up and down the plant due to the presence of xylem and phloem.

C. Vascular plants are unable to transport water and nutrients up and down the plant due to the lack of xylem and phloem, which is present in nonvascular plants.

D. Vascular plants and nonvascular plants both feed cell to cell and show many colors within the cells.

How to Solve One-Step Dimensional Analysis Problems

The distance from Columbia to Los Alamos is 29 miles. What is the distance in cm?

Steps to Dimensional Analysis

- Step 1: Write out your problem.
- Step 2: Write all conversion factors as fractions.
- Step 3: Include all units with all numbers.
- Step 4: Arrange conversion factors, so that units cancel diagonally (what goes up, must come down).
- Step 5: Numbers on top are multiplied.
- Step 6: Numbers on bottom are divided.

Conversion

1 mi= 160,934.4 cm

Review 22

1. _____ vascular
2. _____ nonvascular
3. _____ xylem
4. _____ phloem
5. _____ roots
6. _____ root hairs
7. _____ fibrous roots
8. _____ tap roots
9. _____vascular examples
10. _____nonvascular examples

A. Consists of one large, main root with smaller roots branching off. Examples-carrots, dandelions, or cacti.
B. Transports food (sugar/glucose) made in PHotosynthesis DOWN from the leaves to the rest of the plant.
C. Anchor the plant, absorb water and nutrients from soil, store extra food for the plants, increase surface area to absorb.
D. Largest group in the plant kingdom that has a well-developed system for transporting water and food (xylem/phloem in tube-like support and circulatory system); therefore they have true roots, stems and leaves.
E. Help to increase surface area of roots.
F. Woody stems: trees, shrubs/Soft stems: dandelions, grasses, tomato plants.
G. Transports water and minerals from the roots UP to the rest of the plant.
H. Do not have a well-developed system for transporting water and food; therefore, do not have true roots, stems, or leaves. They must transport food and water from cell to cell.
I. Mosses, liverworts and hornworts.
J. Consists of several main roots that branch off to form a mass of roots. Examples- grass, corn, and some trees.

Standards 6.L.5B.1 Construct explanations of how the internal structures of vascular and nonvascular plants transport food and water.

HOW VASCULAR & NONVASCULAR TRANSPORT FOOD & WATER

Essential Knowledge

It is essential that students be familiar with internal structures of nonvascular and vascular plants and how those structures transport food and water within the plant. Plants are classified into ***two major groups based on their internal structures***. These two groups are ***vascular*** and ***nonvascular***.

Vascular Plants

- Largest group in the Plant Kingdom.
- Have a well-developed system for transporting water and food; therefore, they have true roots, stems, and leaves.
- Have tube-like structures that provide support and help circulate water and food throughout the plant.
- Xylem transport water and minerals from the roots to the rest of the plant.
- Phloem transport food from the leaves to the rest of the plant.
- Examples include trees and many shrubs with woody stems that grow very tall and grasses, dandelions, and tomato plants with soft stems.

Nonvascular Plants

- Do not have a well-developed system for transporting water and food; therefore, do not have true roots, stems, or leaves.
- Must obtain nutrients directly from the environment and distribute it from cell to cell throughout the plant. As a result, these plants are small in size and grow close to the ground
- Examples include mosses, liverworts, and hornworts.

Standards <u>6.L.5B.1</u> Construct explanations of how the internal structures of vascular and nonvascular plants transport food and water.

HOW VASCULAR & NONVASCULAR TRANSPORT FOOD & WATER

<u>Extended Knowledge</u>

Students can develop and use models to describe how essential processes (movement of water and food) can be different in vascular and non-vascular plants.

<u>Non-vascular</u>

- Water movement by osmosis
- Solutes move by diffusion
- Plants not very large, all parts must be near their water source

<u>Vascular</u>

- Plants can be 300’ tall and parts can be distant from water source
- Basic structure of the xylem and phloem
- Adhesion/cohesion of water in the xylem tissue
- Transpiration from leaves as the driving force for water going up
- Diffusion of water from environment to roots
- Vascular tissue provides stiffness and allows some plants such as sequoias to grow to great heights.

<u>Assessment Guidance</u>

The objective of this indicator is to construct explanations related to how the internal structures of vascular and nonvascular plants transport food and water. Therefore, the primary focus of assessment should be for students to construct explanations regarding how the internal structures of nonvascular and vascular plants enable plants to transport food and water. This could include but is not limited to students developing models to describe how xylem and phloem move water, nutrients, sugars, and other key compounds throughout the body of the vascular plant and compare these structures to the way nonvascular plants pass food and water from cell to cell. In addition to construct explanations, students should ask questions; plan and carry out investigations; engage in argument from evidence; obtain, evaluate and communicate information; develop and use models; and construct devices or design solutions.

6.L.5B.3 Develop and use models to compare structural adaptations and processes that flowering plants use for defense, survival and reproduction.

STRUCTURAL ADAPTATIONS/PROCESSES FLOWERING PLANTS USE FOR DEFENSE, SURVIVAL & REPRODUCTION

Parts of the flowering plant that function in reproduction include:

Flowers

- Flowers produce seeds.
- Many flowers contain both male and female organs needed to produce new flowers.
- Flower petals are often colorful or have a scent to attract insects and other animals.

Stamen

- The male organ of a flower that has an anther on a stalk (filament).
- The anther produces the pollen that contains the sperm cells.

Pistil

- The female organ of the flower that contains
  - The ovary, which contains the ovules where the egg cells are produced,
  - The stigma, which is the sticky top where pollen grains land, and
  - The style, which is a stalk down which the pollen tube grows after pollination has taken place.

Seed

- The ovule that contains the fertilized egg (embryo) from which new plants are formed.
- A fruit that is formed from the ovary often protects them.

6.L.5B.3 Develop and use models to compare structural adaptations and processes that flowering plants use for defense, survival and reproduction.

STRUCTURAL ADAPTATIONS/PROCESSES FLOWERING PLANTS USE FOR DEFENSE, SURVIVAL & REPRODUCTION

Extended Knowledge

Plants use a variety of parts to produce new plants such as:

Tubers, bulbs

- These are all types of underground stems.
- The "eyes" or buds of tubers, for example potatoes, grow into roots and shoots to produce a new plant.
- Bulbs, for example onions, are big buds made of a stem and special types of leaves.

Runners

- These are all types of stems that run along the ground.
- New strawberries or some ivy grow from the tips of runners.
- Many lawn grasses grow from runners.

Stem Cuttings

- When a piece of cut stem is planted, roots may form from the cutting, and then a full plant develops.
- Sugar cane and pineapple are examples of plants grown from stem cuttings.

Roots

- Some fruit trees and bushes send up "suckers" or new shoots from the roots.
- Some plants have roots that can produce new plants from root pieces, such as a sweet potato.

Plant cells have larger vacuoles compared to animal cells to store more food and water. This helps plants to store up the water they need in order to perform the process of photosynthesis.

Assessment Guidance

The objective of this indicator is to develop and use models to compare structural adaptations and processes that flowering plants use for defense, survival and reproduction. Therefore, the primary focus of assessment should be for students to construct models that represent (or use simulations to investigate), compare, and contrast structural adaptations and processes flowering plants use for survival. This could include but is not limited to students creating models to describe how various structures of flowering plants help them to grow, develop, reproduce, and survive. In addition to develop and use models, students should ask questions; plan and carry out investigations; analyze and interpret data; use mathematics and computational thinking; engage in argument from evidence; construct explanations; obtain, evaluate, and communicate information; and construct devices or define solutions.