SNC 2DI **Plant Cells, Tissues, and Organs** **SOLUTIONS**

Read through Section 2.1 starting on page 57 and read/answer the questions below…

Tree planters help to speed the process of regrowth in a forest that has been burned or logged. However, even if seedlings are not planted, seeds will be brought in naturally, either by wind or by animals. How do these seeds change, turning into seedlings and finally adult trees? The answer lies in the process of **mitosis** and **cell specialization**.

Define the terms:

-Cell Specialization: ***the process by which cells develop from similar cells into cells that have specific functions within a multicellular organism***

-Cell Differentiation: ***a stage of development of a living organism during which specialized cells form***

Look at Figure 2.2 on page 57 and answer the questions below;

a) what type of cells are these? **Plant** OR **Animal**

b) How is cell A specialized? –***Storage vacuole***

c) How is cell B specialized? -***Chloroplasts***

Prior Knowledge…

-Refer to class notes on cells

-What structures are present in **plant cells but not in animal cells**?

****Plants have*** a cell wall, larger vacuole-typically only 1, no centrioles visible, contain chloroplasts, tend to have a boxy shape

****Animal cells*** do not have a cell wall, do not have chloroplasts, centrioles are visible, often have many, small vacuoles, circular in shape

Specialized Cells and Tissues in Plants

*A healthy plant is always growing and making new specialized cells, except when dormant during cold or very hot weather.

Cells → Groups of specialized cells form**_TISSUES_** → Groups of tissues work together in **_ORGANS**.

Meristematic Cells or meristem are undifferentiated cells that can form specialized cells in plants

What type of cell in the human body can become any type of cell? **_TOTIPOTENT____**

Meristematic cells are constantly producing more cells, which then become specialized. These types of tissue found in the body of a plant are…See Figure 2.3 page 58

Type of Tissue	***Dermal Tissue***	***Ground Tissue***	***Vascular Tissue***
Main Function	***-outermost covering -acts as a barrier between plant and external enviro -protects inner tissues and controls exchange of water and gases***	***-several functions -some perform photosynthesis -others provide support***	***-transports water, nutrients and sugars throughout the plant -physical support as well***

Ground Tissue (internal non-vascular tissue)
There are three types of ground tissue:

a) Parenchyma (storage, photosynthesis)
b) Collenchyma (support)
c) Sclerenchyma (support)

Repairing and Replacing Specialized Cells
-The cells, tissues and organs of multicellular animals, such as worms, fish, snakes and mammals are formed as the embryo develops. While some cells and tissues can be repaired and replaced, organs must last for an animal's lifetime
-Plants are different. In addition to forming new cells and tissues, plants form new organs periodically throughout their lives. For example, as leaves become less efficient with age, these light collecting organs die and are replaced by new, more efficient leaves. Roots grow continuously too, so there are always fresh roots to absorb water and minerals from the soil.

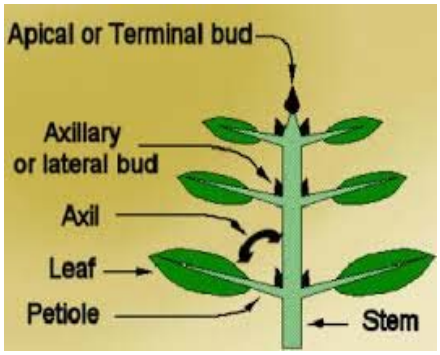
-Meristematic cells can also be above ground in branches. Some produce cells specialized for leaves and flowers.

-**A bud is a …..*is a swelling of the stem that contains meristem for new, not yet developed tissues in organs such as leaves and flowers***

-**Auxin** is a plant hormone that controls the cells below and behind it. **See figure 2.5 to explain what how the plant will grow if …**

a) the terminal bud is actively growing

The plant will grow upwards rather than outwards



b) if the terminal bud is removed

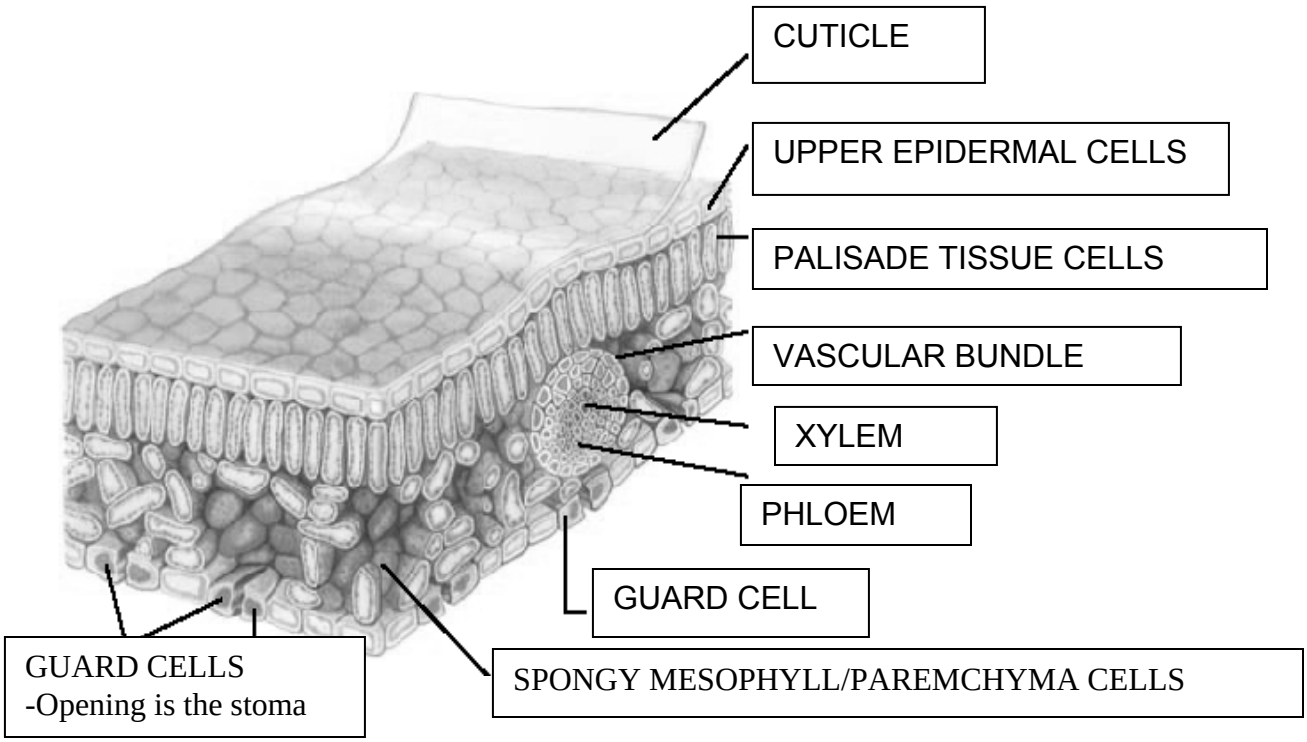
The plant will grow outwards or "bush" out at the lateral buds. Once the tip grows back the plants lateral growth will slow down and will start to grow upwards again.

Tissues Working Together: Plant Organs

-Different kinds of tissues combine to make up organs. In a plant the three type of organs are;
-LEAVES
-STEM
-ROOT

The Leaf
-The primary role of the leaf is to provide a large surface area where photosynthesis can take place. If photosynthesis produces more glucose that the leaf needs, the excess is converted to starch and stored in the leaf and roots.

Label the diagram below using figure 2.7 as a guide. **Read the next few pages to identify the function of each part of the leaf.**



Part of Leaf	**Function**	**Type of Tissue** – Refer to the first page and classify the following parts of the leaf in terms of type of tissue
Cuticle	Reduces water loss	Dermal Tissue
Upper Epidermis	Protection	Dermal Tissue
Palisade Mesophyll (Tissue)	Specialized to perform photosynthesis, the rays pass through the elongated cells to maximize the ability to perform photosynthesis	Ground Tissue
Vascular Bundle	Veins in the leaf, transport	Vascular Tissue
Xylem	Delivers water in the form of water vapour	Vascular Tissue
Phloem	Picks up sugars that have been produced and delivers them to other parts of the plant	Vascular Tissue
Spongy Mesophyll	Lightly packed and act like a sponge, contain gases needed or produced for photosynthesis	Ground Tissue
Lower Epidermis	Layer of cells on the bottom of the leaf	Dermal Tissue
Guard Cells	Change shape to allow gases to enter and exit the leaf	Dermal Tissue
Stoma or Stomata	Pores in the leaf, located on the bottom of leaf, allow gases in and out of leaf	Dermal Tissue

Guard cells and stomata play a significant role in transpiration. Carbon dioxide enters through these pores, and oxygen and water vapour exit through them.

Chloroplasts
-Light energy from the sun combines with carbon dioxide from the air and water from the soil to produce glucose and oxygen gas.

Write the Word equation for the chemical reaction that occurs in photosynthesis

-***carbon dioxide + water + light energy → sugar + oxygen***

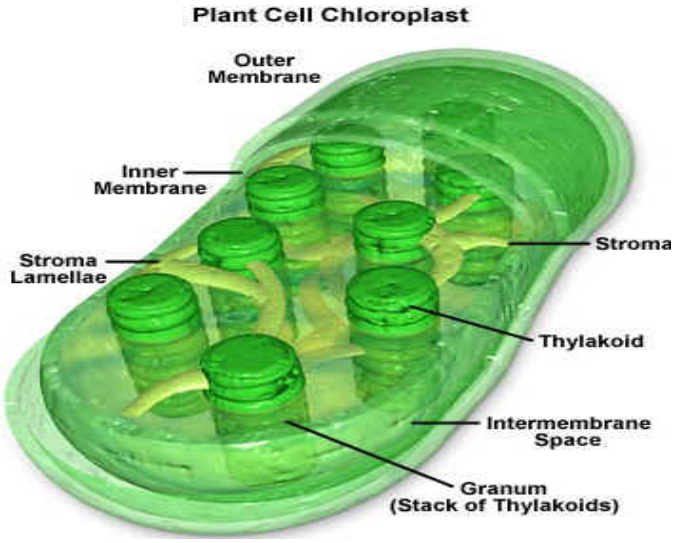
Write the balanced chemical equation for photosynthesis:

$$6\ CO_2 + 6\ H_2O + Light\ Energy \rightarrow C_6H_{12}O_6 + 6\ O_2$$

Cellular respiration occurs in the mitochondria, this is the reverse reaction of photosynthesis, **write the balanced chemical equation for the reaction that occurs in mitochondria.**

$$C_6H_{12}O_6 + 6\ O_2 \rightarrow 6\ CO_2 + 6\ H_2O + Light\ Energy$$

Read the write up on figure 2.9 and fill in the missing words;
"Chloroplasts are filled with **grana**, which are stacks of chlorophyll-containing thylakoids. **Chlorophyll** gives plants their green colour and allows the thylakoids to trap **light energy** from the sun. This energy is used to fuel photosynthesis, the chemical reaction that produces **glucose** and **oxygen**."



Can Chloroplasts change their shape and location in a cell to increase the amount of light they capture?

a) **Yes** OR b) NO

What is the difference between a thylakoid and granum?

-***stacks of thylakoids make up granum***

MICROSCOPE ACTIVITY … Cross Section of a Leaf
-Obtain a slide of a cross-section of a leaf…There are more than one type of leaf to choose from
-**Draw a diagram of the cross section of the leaf** on a piece of paper on medium power/high power
*Remember to include the appropriate title that includes the type of leaf studied, label as many parts of the leaf as possible and to include the magnification the leaf was viewed under.
****SUBMIT Leaf Diagram to teacher for a FORMATIVE Mark**
-**Estimate the** … (Remember to use a ruler to determine the field of view on LP and then calculate the FV on MP or HP in order to estimate the size of the following parts of a leaf)

a) diameter of a **vascular bundle** and OR b) length and width of **palisade mesophyll cell**

The Stem
-A plant's stem has 2 main functions, they are…

1) ***Physical Support***

2) Transportation of water, nutrients and sugars

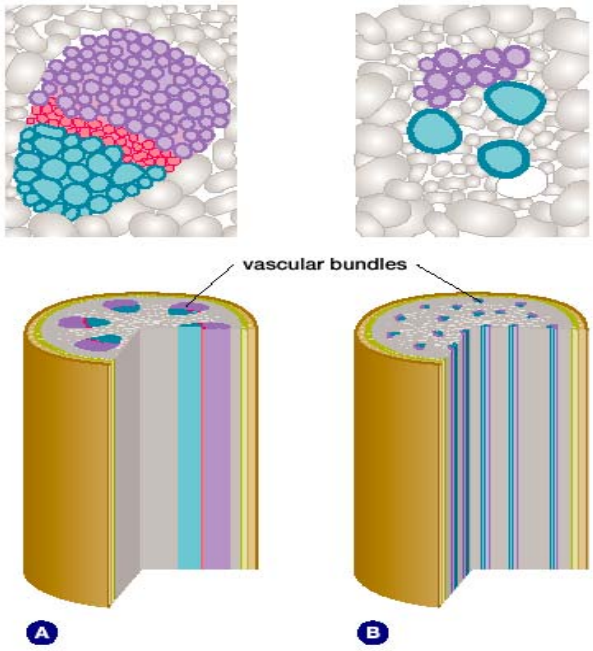


Figure 14.15 Locate the vascular bundles in the stem cross-sections of a typical dicot (A) and a typical monocot (B).

Stems contain most of a plant's xylem tissue. As xylem cells grow, they form long, straw like tubes or vessels. The cells then die, but their thick cell walls remain behind, forming long fibrous "pipes" through which water can flow.

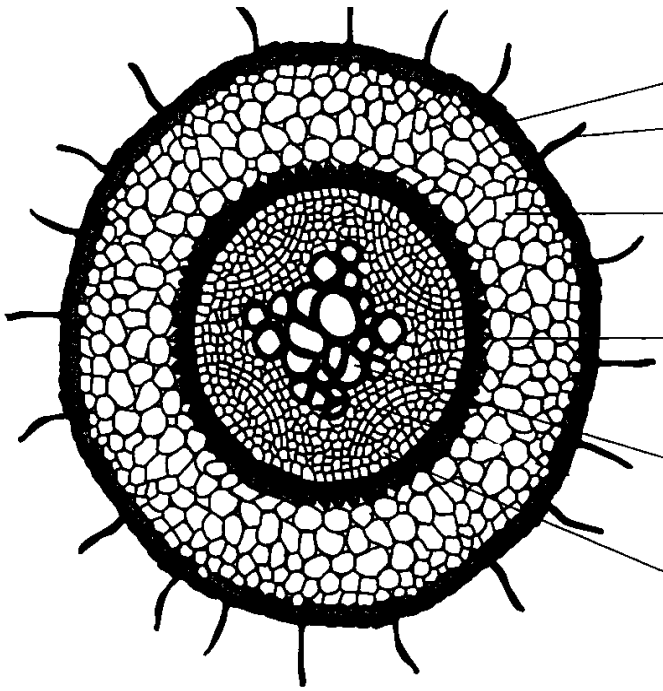
Xylem vessels are grouped with phloem vessels in vascular bundles. This further strengthens the stem's ability to support the plant.

Diagram A represents the arrangement of xylem and phloem in a Dicot plant

Diagram B represents the arrangement of xylem and phloem in a Monocot plant

The Root
Roots anchor a plant to the ground and allow the plant to take up water and minerals from the soil.

Label the following diagram and include the **function of each part**.



Epidermis-outer layer, protection of root

Root Hair-water and mineral absorption

Cortex-can be used for storage of sugars

Endodermis, inside this is **pericycle**
-controls the transport of minerals b/w cortex and vascular tissues
-Pericycle-water can enter but cannot exit

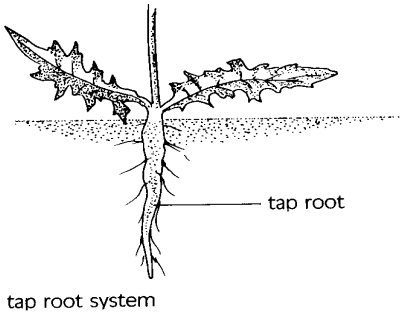
Xylem-transports water

Phloem-transports sugars that have been produced

Types of Roots

Define **Tap Root**:
-***One main root***

List Characteristics of a Tap Root:

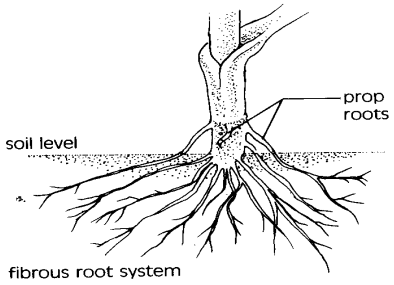


tap root system

One main root, grows larger and thicker than the rest, allows plant to grow far underground for water
-anchors plant to ground

Define **Fibrous Root**
-lots of many smaller roots

List Characteristics of a Fibrous Root:

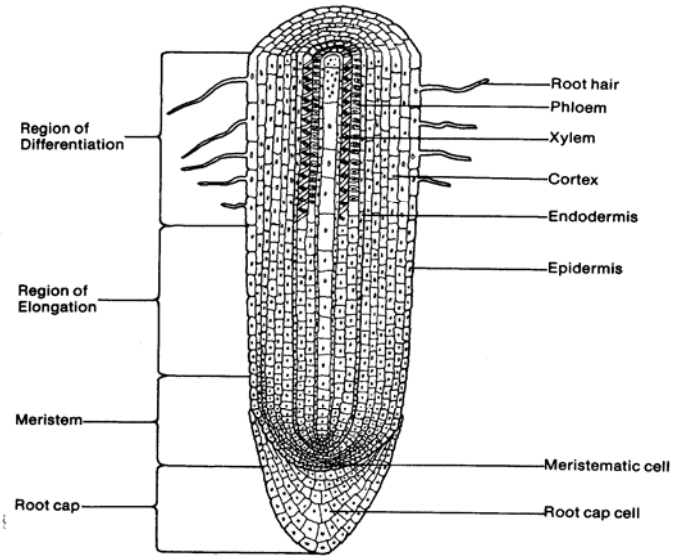


fibrous root system

Many small roots, spreads out horizontally near the surface of the soil
-stabilize the soil and help prevent erosion and landslides

The second major role of the root is nutrient transport:

a) Roots absorb water for **photosynthesis**
b) Roots replace water lost by **transpiration**
c) Roots absorb water to maintain **turgor** pressure
d) Roots absorb dissolved **minerals**
e) Roots store **sugars** in the form of **starch**



Root Tip Zones

Root cap – forms a **protective covering** for the delicate meristematic tissues

Meristematic Zone - region of actively dividing **unspecialized** cells (**mitosis**)

Elongation Zone - cells, **enlarge**, pushing the root tip **forward**

Maturation Zone - **cell differentiation; u**nspecialized cells develop into **specialized** cells

<u>Colour Activity</u>:
1) Colour the root cap yellow
2) Colour meristematic cells green
3) Colour the region of elongation light blue
4) Colour the region of differentiation red
5) Identify 3 different types of specialized cells

Illnesses in Plants

Just like humans and animals, plant tissues and organs can be attacked by bacteria and viruses. Not all viruses cause harm to the plant. For example the Rembrandt tulips get their attractive and distinctive stripes fro a virus transmitted from plant to plant. Other viruses such as the tobacco mosaic virus (TMV) are highly destructive, attacking the leaves of tomato, potato, pepper and cucumber plants. TMV often lowers crop yields dramatically.

Plants are also susceptible to developing cancer. Plant galls are similar to tumors. Galls are produced by the abnormal growth of cells, usually in response to infection by another organism. One major difference between plant and human tumors is that galls do not normally spread to other tissues and is seldom fatal.

2

1

3

Label the pictures above with the correct illness listed below by writing in the correct number:

1) A **virus** transmitted from plant to plant
2) **Galls** produced by the abnormal growth of cells
3) **TMV** attacks the leaves of plants, highly destructive

Question: Of the three descriptions listed above which one is the least destructive?

Question: Are ALL viruses/bacteria bad for plants? Yes / No **Explain**

NO … as shown with the above diagram of the tulip, a virus causes the tulip to have different colours but does not harm the plant otherwise.

Section 2.2 Plant Organ Systems … Start on page 70

The two organ systems in a plant are; Root System and Shoot System

Define the two systems:

-**Root System:**

-all roots that lie below the surface, taking in water and minerals from soil, constantly growing to keep pace with plants need

-Shoot System:

-supporting plant, performing photosynthesis, transporting water nutrients and sugars

The root and shoot systems are connected by the flow of water of water, nutrients, and various hormones through vascular bundles that contain xylem and phloem. Maintaining this flow is essential for the plant's ability to survive.

Moving Water Through the Systems:
-Water means everything to plants. Plants can survive without soil under certain circumstances, but they cannot survive without water. If there is too little water in the soil, nutrients cannot be taken up by the roots. This is because the nutrient molecules need to be dissolved in water in order to be absorbed and move up the xylem in the form of sap. If the supply of water to the leaf is insufficient, photosynthesis cannot take place. If too much water is in the soil there can be a negative effect. If the spaces between soil molecules are filled with water, there will not be enough room for oxygen. Under these conditions, the root cells will not get enough oxygen for cellular respiration. Keeping water balanced and moving through a plant is thus vitally important.

How does water move between cells?
CHECK OUT the EGG Demo:

Define the term **Osmosis**: ***Movement of water from an area of high concentration to an area of low concentration***

Situation	**Egg in Vinegar**	**Egg in Water**	**Egg in Corn Syrup**
Describe Appearance	-yellowish in colour, whitish membrane	Larger in size, hard	Small in size, wrinkly
Explanation of Appearance	No change in size	Water is absorbed into the egg *High conc of water outside of egg, therefore water moves into egg	Water has moved out of the egg and the egg has shrunk *high conc of water in egg than in syrup, therefore water exits the egg

How does water and nutrients move in or up a plant?
-Water moves up and through a plant through two processes…. **Root Pressure** (Push from Below) and **Transpiration** (Pull from Above)

Root Pressure: water is taken in by the roots and creates a pressure in the xylem cells.
The **2 conditions** in which root pressure predominately occurs are…

1) ***At night when transpiration is low***

2) ***Soil is very moist***

Transpiration: water is evaporated through the leaves of a plant. **What must open in order for water to exit the leaves? __*STOMATA via the Guard Cells Changing shape*_____**

Water itself has some amazing qualities. **Define the following terms** and explain how they enable water to move up and through incredibly tall plants.

-**Cohesion**
-ability of water molecules to cling to each other
-Holds the water column in the xylem together

-Adhesion
-water molecules to stick or adhere to surfaces
-fights against gravity

***The rate of transpiration is controlled by the amount of _WATER VAPOUR in the Leaves___.**

Describe the pathway water enters a plant from the soil. See figure 2.23.

-Water enters the root via osmosis, and enters through the root hairs. Water travels though the cortex and through the endodermis and pericycle and into the xylem tissue where it is pushed upwards via root pressure the other parts of the plant.

<u>CHECK OUT the Celery Demo:</u>

Question: What factors affect the movement of water through stalks of celery?

	Prediction *-Predict which celery situation will have water move up the fastest*	**Explanation**	**Observe**	**Explanation**
Celery Stalk with NO leaves			-The vascular bundles are all blue/dyed	Through root pressure/adhesion and cohesion the water molecules move up the stalk
Celery Stalk with Leaves			-The stalk has dyed veins, the leaves are also dyed	The leaves continue to undergo transpiration and has sucked up the dyed water
Celery Stalk with Leaves covered with a bag			-The stalk has dyed veins, but the leaves are not dyed	The humidity in the bag caused transpiration to not occur, therefore water was not sucked up the plant

<u>MICROSCOPE Activity</u> – **Measuring the size of Guard Cells in Leek/Spinach Leaves**
-Obtain a sample of Leek Leaf or Spinach Leaf
-Gently peel the cuticle layer from the leaf and place it on a microscope slide
-Add a drop of water on the cuticle layer and position a cover slip on top
-On low power view the cuticle layer and locate the guard cells
-Focus on a guard cell and view under medium or high power as appropriate

-**Sketch the guard cells and estimate the size of the guard cell on a piece of blank paper.**

OPTION: Using a salt solution, add a few drops of salt solution and bring the solution across the cuticle layer. **How do the guard cells change when exposed to the salt solution?**