PEAC
PRIVATE EDUCATION ASSISTANCE COMMITTEE
Trustee of the Fund for Assistance to Private Education

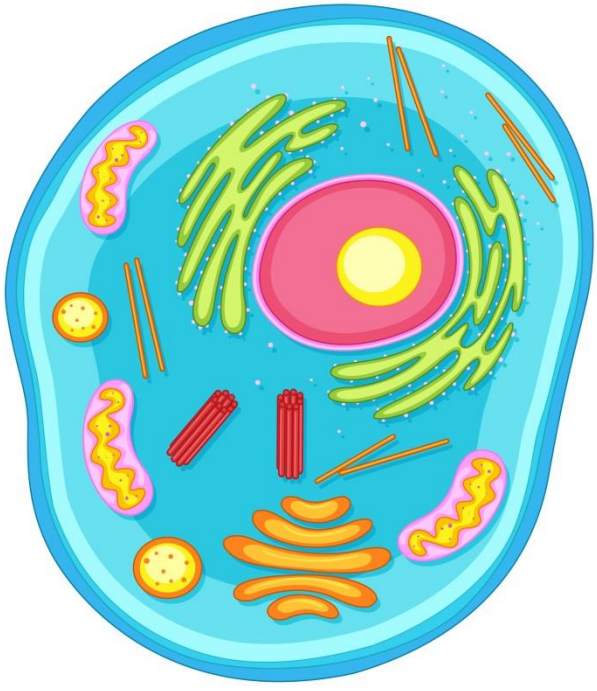
DepED
DEPARTMENT OF EDUCATION

2016

LEARNING MODULE

Science G7| Q3

Living Things and Their Environment



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NOTICE TO THE SCHOOLS

This learning module (LM) was developed by the Private Education Assistance Committee under the GASTPE Program of the Department of Education. The learning modules were written by the PEAC Junior High School (JHS) Trainers and were used as exemplars either as a sample for presentation or for workshop purposes in the JHS In-Service Training (INSET) program for teachers in private schools.

The LM is designed for online learning and can also be used for blended learning and remote learning modalities. The year indicated on the cover of this LM refers to the year when the LM was used as an exemplar in the JHS INSET and the year it was written or revised. For instance, 2017 means the LM was written in SY 2016-2017 and was used in the 2017 Summer JHS INSET. The quarter indicated on the cover refers to the quarter of the current curriculum guide at the time the LM was written. The most recently revised LMs were in 2018 and 2019.

The LM is also designed such that it encourages independent and self-regulated learning among the students and develops their 21st century skills. It is written in such a way that the teacher is communicating directly to the learner. Participants in the JHS INSET are trained how to unpack the standards and competencies from the K-12 curriculum guides to identify desired results and design standards-based assessment and instruction. Hence, the teachers are trained how to write their own standards-based learning plan.

The parts or stages of this LM include Explore, Firm Up, Deepen and Transfer. It is possible that some links or online resources in some parts of this LM may no longer be available, thus, teachers are urged to provide alternative learning resources or reading materials they deem fit for their students which are aligned with the standards and competencies. Teachers are encouraged to write their own standards-based learning plan or learning module with respect to attainment of their school's vision and mission.

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SCIENCE 7

Module No. 3: Living Things And Their Environment

Lesson 1: Parts and Functions of Living Things

Introduction and Focus Questions

Have you ever played basketball? Or at least watched a basketball game? A basketball team is made up of individuals with different responsibilities, but with one goal – to score more points (baskets) than the opponent. In the same way, our bodies are made up of individual parts that interact and work together to perform essential functions and keep us alive. The organization and interaction of the important structures found in living things are the topics you will encounter in this module.

As you go through the lesson, think about this question: **How do the different parts and functions of an organism keep an organism alive and healthy? How do microorganisms perform essential life functions?**

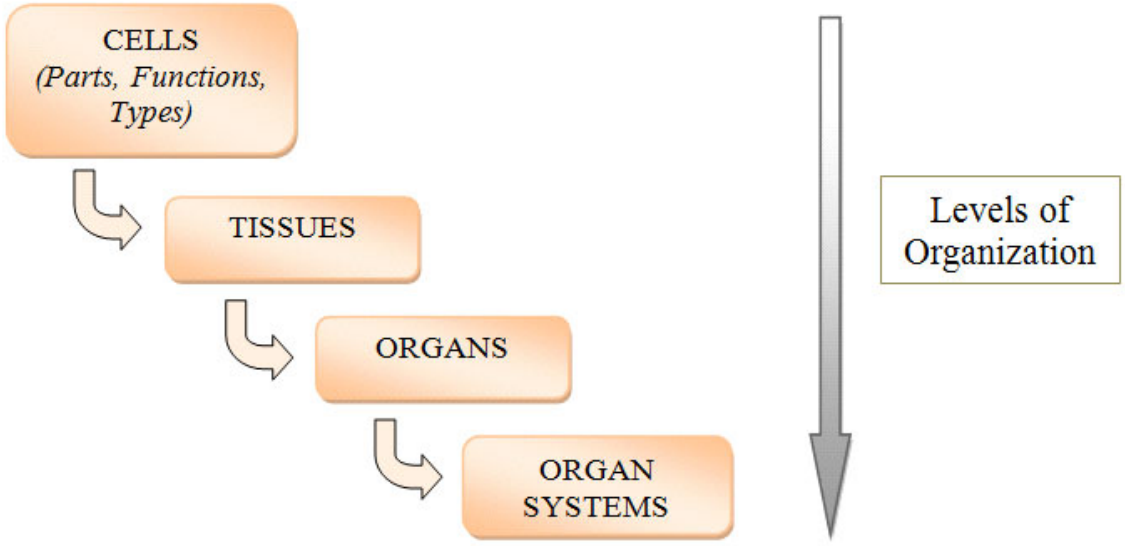
LESSON COVERAGE:

In this lesson, you will go through the following topics:

Title	You'll learn to…	Estimated Time
Parts and Functions	• Explain why the cell is considered the basic structural and functional unit of all organisms. • Differentiate plant and animal cells according to presence or absence of certain organelles. • Identify beneficial and harmful microorganisms.	8 hrs.
Levels of Organization and Coordination	• Differentiate cells, tissues, organs, and organ systems from each other. • Explain how the different structures are organized to carry out certain functions.	8 hrs.

Concept Map of the Lesson

Here is a simple map of the toopics you will cover in this lesson:



Expected Skills

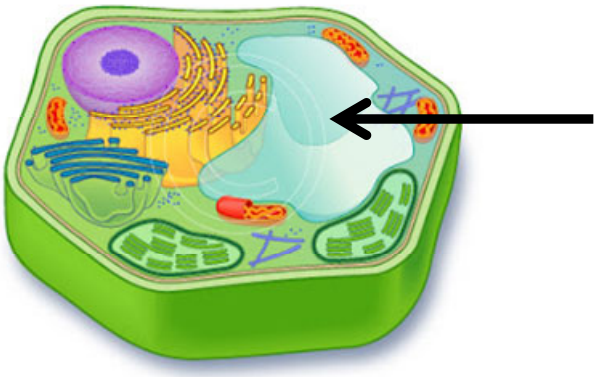
To do well in this lesson, you need to remember and do the following:

1. Read the instructions carefully before starting anything.
2. Complete all the activities and worksheets.
3. Look up the meaning of words that you do not know.
4. You will frequently come across discussion questions as you go through different lessons. Keep a notebook (or use the Notepad) where you can write (and revise) your answers to these questions. Use also the notebook to jot down short notes, draw diagrams, and summarize what you have just read.
5. For worksheets and reports that need to be submitted, use the provided checklist and rubric to evaluate your work before submission.
6. Allow time for relaxation and recreation when you are mentally tired. Make a time table to schedule your study and recreation.

PRE-ASSESSMENT:

Let's find out how much you already know about this module. Click on the letter that you think best answers the question. Please answer all items. After taking this short test, you will see your score. Take note of the items that you were not able to correctly answer and look for the right answer as you go through this module.

1. The organelle pointed by the arrow has which of the following functions?



   A. control center of the cell
   B. site of metabolic processes
   C. storage of nutrients and water
   D. synthesizer of proteins

2. When looking at thin or transparent cells or tissue sections such as onion or amoeba cells, you must decrease the amount of light that passes through the specimen. Which of the following should be done to decrease the light intensity?
   A. Adjust the fine focusing knob.
   B. Move the body tube downward.
   C. Reduce the iris diaphragm aperture.
   D. Switch to high power objective (HPO).

3. Which of the following sets of organelles can be found in all plant, animal, and bacterial cells?
   A. cell membrane and ribosome
   B. cell wall and chloroplast
   C. cytosol and vacuole
   D. nucleus and mitochondria

4. A certain microorganism has cell wall as its outermost protective layer. The presence of chloroplasts and chlorophyll in its cell indicates that it is capable of photosynthesis. However, there is no nuclear membrane to enclose its DNA. This microorganism is most likely a/an:
   A. algae
   B. bacterium
   C. fungus
   D. protozoa

5. Which pair of organ systems is involved in providing nutrients to every part of the body?
   A. immune system & digestive system
   B. digestive system & circulatory system
   C. circulatory system & respiratory system
   D. respiratory system & immune system

6. The liver and the pancreas produce substances that help in digestion; these substances come into contact with food by way of the
   A. large intestine.
   B. stomach.
   C. esophagus.
   D. small intestine.

7. The _____ branches into the left and right bronchi to conduct air into and out of the lungs.
   A. trachea
   B. alveolus
   C. ventricle
   D. bronchiole

8. A strong _____ allows our bodies to resist different kinds of diseases that we may be exposed to.
   A. reproductive system
   B. muscular system
   C. immune system
   D. skeletal system

9. An animal cell had its nucleus removed by means of a fine glass tube. The cell was not damaged. It was put in a solution that induces cell division. For one day, it continued to survive, but it did not undergo cell division. An intact cell used as a control divided twice in that time. What can you conclude from this experiment about the role of nucleus in the cell?
   A. The nucleus controls the cell's activities.
   B. The nucleus is essential for cell division.
   C. The nucleus is essential for life to continue.

D. The nucleus contains the genetic material.

10. Regarding cell type, which one of the following is unlike the others?
    A. a human heart muscle cell
    B. cell of the green plant, *Elodea*
    C. *Streptococcus* bacterial cell
    D. the unicellular eukaryote, *Paramecium*

11. A group of students wants to study the effect of temperature on the growth of microorganisms. Three test tubes are labelled A, B, and C respectively. Each test tube is filled with 10 ml of freshly prepared nutrient broth. Using a sterile glass rod, some culture of the microorganism *Bacillus subtilis* are transferred into test tubes A, B, and C, then stoppered immediately. The appearance of the broth in each tube is observed and recorded. Test tube A is put in the refrigerator; Test tube B in a water bath set at 80°C; and Test tube C is kept at room temperature. After two days, the test tubes are taken out. The appearance of nutrient broth in each test tube is observed and recorded.

Test Tube	***Temperature (°C)***	***Appearance of nutrient broth at the beginning***	***Appearance of nutrient broth after two days***
A	5	Clear	Clear
B	80	Clear	Clear
C	30	Clear	Cloudy

What can be concluded from this experiment?
    A. Microorganisms grow and multiply rapidly in extremely low or high temperatures.
    B. Microorganisms grow and multiply rapidly in moderately warm conditions such as room temperature.
    C. The growth of microorganisms is affected by temperature.
    D. The growth of microorganisms is not affected by temperature.

12. A girl was noticed to make wheezing sounds and labored breathing as seen when her shoulders would raise every time she inhaled. From these observations, one can be thought of suffering from
    A. constipation.
    B. arthritis.
    C. asthma.
    D. cold.

13. Patricia learned from class that voluntary movements (*walking, reaching, etc.*) are under the control of the somatic nervous system. Upon viewing a YouTube video of a motor nerve injury patient, she was not surprised to see that the patient
    A. was able to juggle a soccer ball with his feet.
    B. mentioned that he was not experiencing any digestive problems.
    C. was doing sit-ups to strengthen his abdominal muscles.
    D. needed to be in a wheelchair to move around from place to place.

14. While playing basketball, Jack felt like he broke his ankle, but the doctor says he tore a ligament instead. What did he tear?
    A. the connective tissue that attaches muscle to bone
    B. the connective tissue that joins two bones
    C. the bags of fluid that allows smooth movement of a joint
    D. the cartilage that lines the end of a bone

15. Stem cells differ from other kinds of cells in the body. All stem cells—regardless of their source—have three general properties: they are capable of dividing and renewing themselves for long periods; they are unspecialized; and they can give rise to specialized cell types.

    All of the following are potential therapeutic uses of stem cells **except**
    A. Alter an adult individual's genetic make-up
    B. Generate new cells for the immune system
    C. Repair damage to heart muscles after a heart attack
    D. Replace neurons after an accident

16. Antibiotics are also known as antibacterials. They are drugs used to treat infections caused by bacteria. Microorganisms, however, are capable of evolving resistance to antibiotics, i.e., they are able to survive exposure to such drugs over time. Which of the following practices will most likely lead to the development of antibiotic resistance in pathogenic bacteria?
    A. Using the entire prescription as recommended by doctor
    B. Buying and taking *over-the-counter* antibiotic drugs*
    C. Proper disposal of unused and out-of-date medications
    D. Taking antibiotics only as directed by your doctor

17. An epidemic has recently stricken your locality. This is the first time that such disease affected your area. The health office in your locality is in urgent need of pertinent information about the causes of the epidemic and is looking for ways to solve the problem. As a health worker, you were tasked to gather such information. Which of the following is the best form of presentation?
    A. Audio-visual presentation
    B. Brochure
    C. Case study

D. Poster

18. A treadmill is a good exercise machine for the circulatory and respiratory systems because
    A. its correct use demands substantial effort from the heart and the lungs.
    B. it makes the large muscles of the legs contract at the same time.
    C. it is a good stress test as performed in hospitals.
    D. it stresses the heart without stressing the lungs.

19. During your boy scout camping, you noticed that you have been having difficulty moving your bowels. You told yourself that maybe you should choose carefully the kinds of food that you will eat in your next meal. So when dinner came,
    A. You loaded on carb-rich foods like pasta, rice, and mashed potatoes.
    B. You decided to take in pineapples, mangoes, and vegetable salad.
    C. You zeroed in on hotdogs, bacon, and other processed meats.
    D. You had several bags of chips with different dips.

20. Your little brother just had a heavy meal and was lying in bed when he complained of difficulty breathing. To your knowledge, he has no lung-related problems at all. Since you were the only ones at home during that time,
    A. you decided to perform the Heimlich maneuver on your brother while he was lying in bed.
    B. you cupped his back repeatedly to loosen the phlegm.
    C. you gave him several glasses of water so he could breathe more easily.
    D. you asked him to sit up or walk around if it was possible.

LESSON 1.2: PARTS AND FUNCTIONS

EXPLORE

Let's start the module by recalling what you know about the parts and functions of living things.

Activity 1.1: Anticipation-Reaction Guide

Given below are statements about cells and microorganisms. Decide whether the statement is correct or not. Click on the button that corresponds to your answer. You need only to accomplish the ***Before the Lesson*** column. Click on "Save" to save your response.

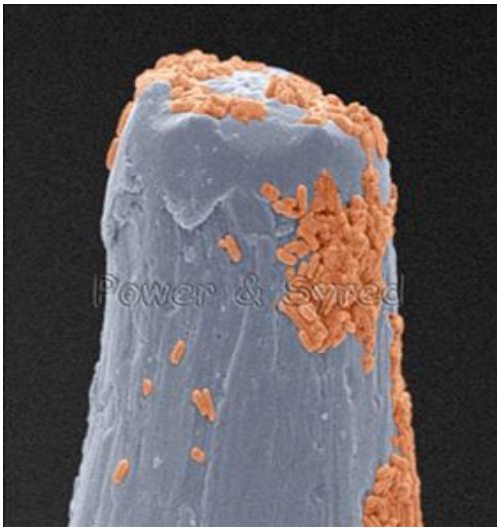
Before the Lesson		Statements	After the Lesson	
YES	NO		YES	NO
O	O	1. The cell is the smallest unit capable of performing all life functions.	O	O
O	O	2. Cells are circular, hollow structures that serve as building blocks of living things.	O	O
O	O	3. The two types of cells are plant cells and animal cells.	O	O
O	O	4. There are various types of microscopes to serve different purposes.	O	O
O	O	5. The structures in living things are organized to carry out related functions.	O	O
O	O	6. All living things are made up of cells, tissues, organs, and organ systems.	O	O
O	O	7. Bacteria do not have cells, and need animals and humans in order to live.	O	O
O	O	8. Microorganisms such as bacteria are harmful to health and environment because they are sources of diseases and pollution.	O	O

Are you confident with all your answers? You'll discover the right responses to the statements as you go through the activities for this lesson.

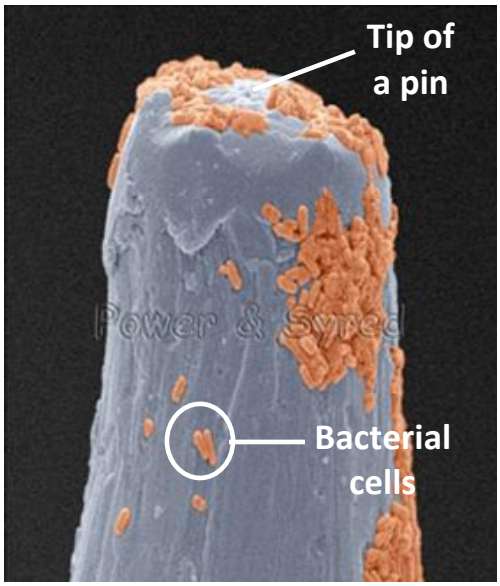
Activity 1.2: Picture Analysis

Think about the following question: ***How small can a living organism be?***

Now look at the picture below. What do you think is shown in the picture?



Look at the orange oval structures in the picture. They are actually **bacterial cells** on the **tip of a pin.** These cells have been magnified many times so that we can see them.



A bacterium is a living organism. And it's many times smaller than the tip of a pin!

Answer the following discussion questions:

1. How can such a tiny cell do so much?
2. What is the cell's structure and how is it related to its functions?
3. How do the different parts and functions of a microorganism like bacteria work together to keep it functioning?

End of Explore

You just tried finding out how much you presently know about cells and microorganisms. You'll get to learn more about their **parts and functions** as we move on to the next part. You'll also find out the answers to the questions presented above.

FIRM-UP

Your goal in this section is to learn and understand key features of the cell. You will be introduced to the parts, functions, and organization of the cell. You will also look at how microorganisms perform life functions and survive despite their small size.

As the concepts become clear to you through the different activities, always think about the answers to these questions: ***How does structure relate to function in living systems? How do microorganisms perform essential life functions?***

Activity 1.3: Development of the Cell Theory: A Timeline

Have you tried making a timeline of the memorable events in your life? Timelines help us easily see how things or events change or progress over time. Click on the link below to learn about how the discovery of the cells and the development of the cell theory came about.

http://www.timetoast.com/timelines/23002 - development of cell theory

While going through the timeline, please be guided by the following questions:

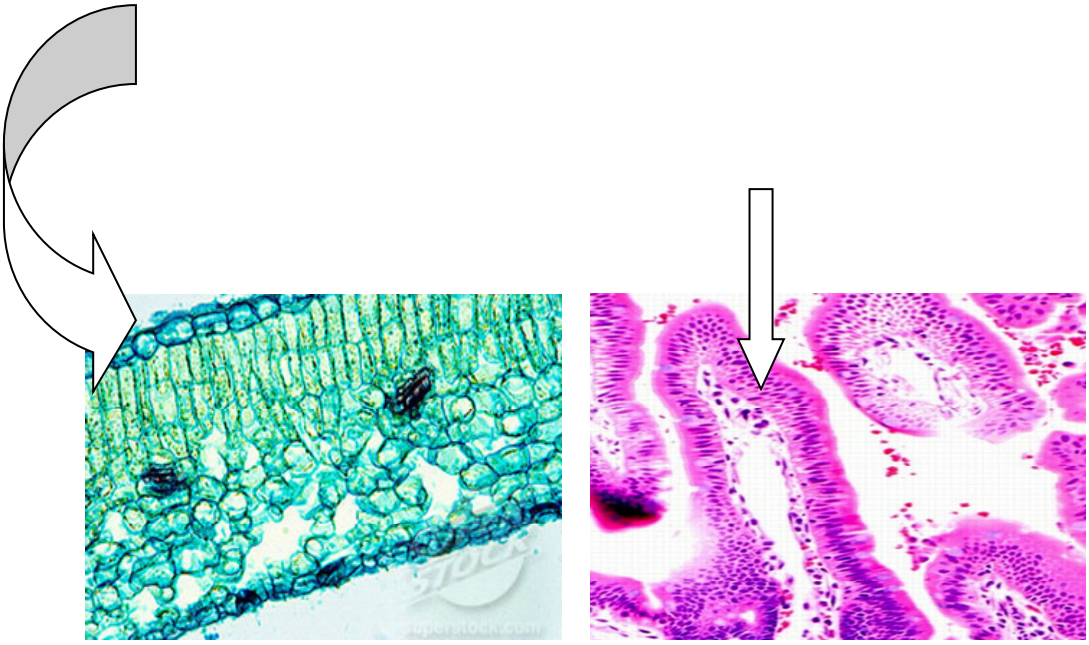
1. Who are the scientists involved in the discovery and development of the cell theory? What are their contributions?
2. How important are their contributions to what we presently know about the cell?
3. What does this situation tell us about how theories are developed in Science?

To summarize, the **cell theory** states that:

1. *A cell is the basic unit of life.* This means that nothing smaller than the cell is alive. An organism with only one cell (unicellular organism) exhibits all the characteristics of life. No smaller unit exists that is able to grow, take in food, respond to its environment, and reproduce.

2. *All living things are made up of cells.* A unicellular organism is necessarily a cell. Other organisms are more complex. For example, gumamela (*Hibiscus*) plant and rabbit are multicellular. The figures

below show that a gumamela leaf is composed of many cells, and the intestinal lining of a rabbit is also composed of cells.



Cells have distinct forms – a bone cell looks quite different from a nerve cell, and they both look quite different from the cell of a gumamela leaf. The cells that make up a multicellular organism are specialized in structure and function. You'll know more about different cell types in the next topic.

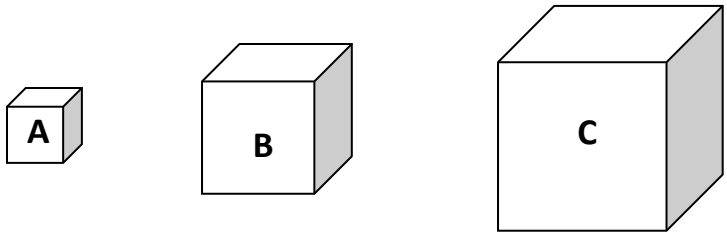
3. *New cells arise only from pre-existing cells.* Remember that part of the timeline where the idea of *spontaneous generation* was disproved? Living things do not come from non-living things. In the same way, cells can only come from other cells.

Activity 1.4: Analogy

Cells are very small structures. Have you ever asked: ***Why are cells so small? Is the size related to the function?***

For example, which has smaller cells, plants or animals? *Why do you think so?* Do smaller animals have smaller cells than bigger animals?

To find out, try this activity about surface area-to-volume ratio of cubes. Consider three cubes A, B, and C of sides 1 cm, 2 cm, and 3 cm, respectively. Each cube represents a cell.



Complete the following table:

Cube	Surface area (cm^2)	Volume (cm^3)	Surface area: volume
A			
B			
C			

What happens to the surface area to volume ratio as the cube (cell) becomes bigger?

Your calculations should show that as the cell becomes bigger, the surface area to volume ratio **decreases**. The smallest cell of the same shape has the largest surface area to volume ratio.

A cell needs a surface area large enough to allow sufficient nutrients to enter and to rid itself of wastes. Small cells, not large cells, are more likely to have this adequate surface area. We would expect then that cells which perform lots of activities have to remain small.

Some cells specialize in absorption. The intestinal cells for example need to have increased surface area to absorb more digested foods. Thus, you will notice in the image below that its structure consists of *surface foldings*.

Nerve cells and some large plant cells are long and thin to be able to perform better their functions in relaying signals (nerve cells) and conduction (some plant cells).

Go back then to the question: ***How does structure relate to function in living systems?***

Activity 1.5: Operating Virtual Microscopes

Read the following carefully:

From previous activities, it should be clear to you that cells are very small and they cannot be seen by the naked eye. Therefore, tools are used to better study them. One such tool is a **microscope**. Below is an image of a compound light microscope, or student's microscope.

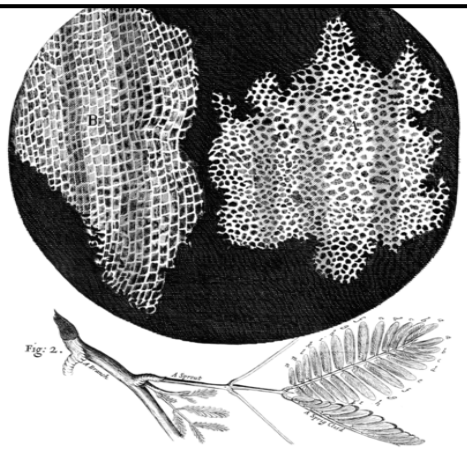
Click on the microscope to learn about the compound light microscope, its uses, and parts.

Exercise 1.1.

Make sure you can recall the parts and functions of the microscope as you take the following **online quizzes**:

http://www.biologycorner.com/microquiz/# - naming the parts of the microscope
http://nhscience.lonestar.edu/biol/dropdrag/microscope2.htm - matching microscope parts with their functions

You should notice that the cells look empty and appear hollow. However, you will find out later that there are even smaller structures that can be found **inside the cell.** To be able to view and study these cellular parts, other types of microscopes were invented.



Learn more about the different types of microscope through the following interactive site:

http://www.sciencelearn.org.nz/Contexts/Nanoscience/Sci-Media/Animations-and-Interactives/Meet-the-Microscopes - learn about 4 different types of microscope. You will act as a research assistant who will be working with different microscopes to assist scientists with their research

How are the different parts of the microscope related to its functions?

Activity 1.6: Use of Multimedia Interactives

Recall that some microscopes have very high magnification and resolution that enable scientists to view and study even smaller structures that can be found inside the cell.

The cell operates as a **system**. It is made up of structures/organelles that work together to keep the cell functioning. ***How do the different parts and functions work together to keep an organism alive and healthy?***

A. Cell Parts and Functions

Click on the following sites to know the different parts of a cell:

http://www.ibiblio.org/virtualcell/ - virtual cell web page

http://learn.genetics.utah.edu/content/begin/cells/insideacell/ - tour inside a cell

Exercise 1.2.

Summarize what you learned by completing the following table:

Cell Structure/Organelle	Function

You can also try to complete this online quiz:
http://www.sheppardsoftware.com/health/anatomy/cell/cell_quiz.htm - quiz on the parts and functions of a cell

Go over the different parts of a cell and their functions again. ***Can you cite specific examples where you have seen how the structure is related to its function?*** Enumerate as many examples as you can. ***How is the function of an organelle related to the other organelles?***

B. Comparing Plant and Animal Cells

Come up with tentative answers to the following questions:

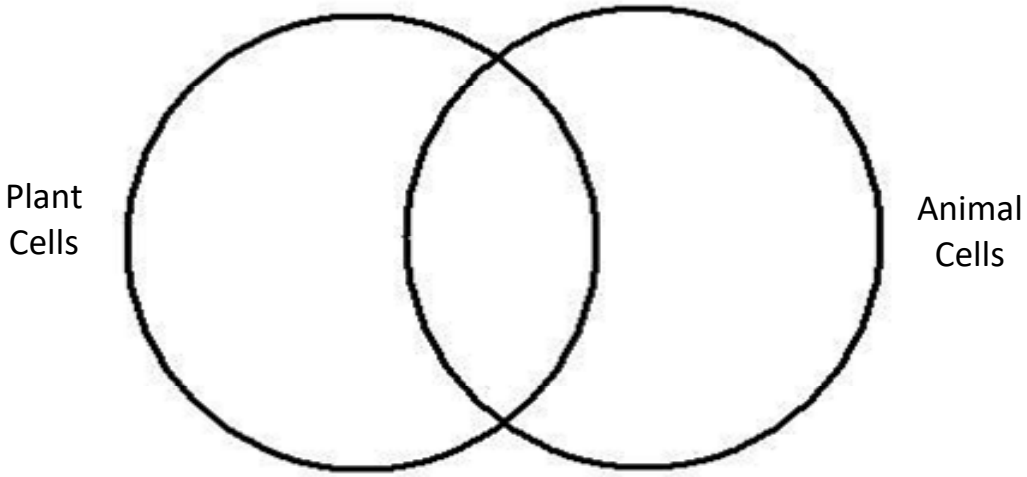
1. What structures in animals are not found in plants? On the other hand, what structures in plants are not found in animals?
2. What activities can be performed by animals which cannot be done by plants? On the other hand, what activities can be performed by plants which cannot be done by animals?
3. What are the reasons for these differences?
4. ***Do you think cell structure has something to do with the differences between plants and animals? Explain.***

Click on the link and learn about the difference between plant and animal cells:

http://www.cellsalive.com/cells/cell_model.htm - comparing plant and animal cells

Exercise 1.3.

Make a Venn diagram to compare and contrast animal and plant cells in terms of the presence or absence of certain organelles.



Go back to the four questions given at the start of this activity on comparing plant and animal cells. ***Do you think cell structure has something to do with the differences between plants and animals? Explain.***

C. Comparing Prokaryotic and Eukaryotic Cells

Prokaryotic cells (*pro*, before, and *karyon*, nucleus) are so named because they lack a membrane-bound nucleus. **Eukaryotic cells** (*eu*, true, *karyon*, nucleus), on the other hand**,** possess a nucleus. Prokaryotic cells are very small in size as compared to eukaryotic cells. Aside from this, there are other important differences between the two types of cell.

Find out these differences through this interactive site:

http://www.wiley.com/legacy/college/boyer/0470003790/animations/cell_structure/cell_structure.htm - prokaryotic and eukaryotic (animal and plant cells) cells

Exercise 1.4.

To check your understanding, accomplish the following task:

Research on the structure of the following:

1. *Elodea* leaf cells
2. *Streptococcus* cell
3. *Paramecium* cell

Find enough information to be able to complete this table. Click on “Submit” to check your answers.

Cell	Shape	Present or Absent? (P or A?)					Prokaryotic or Eukaryotic?
		Cell Wall	Cell Membrane	Nucleus	Cyto-plasm	Vacuoles	
Elodea							
Streptococcus							
Paramecium							

Answer Key:

Cell	Shape	Present or Absent? (P or A)					Prokaryotic or Eukaryotic?
		Cell Wall	Cell Membrane	Nucleus	Cyto-plasm	Vacuoles	
Elodea	Cuboidal	P	P	P	P	P	Prokaryotic
Streptococcus	Spherical	P	P	A	P	A	Eukaryotic
Paramecium	Elongated	P	P	P	P	P	Eukaryotic

Questions:

1. Based on your observations, do all cells have
a. the same shape?
   b. the same structure inside?
   c. nucleus?
   d. cell wall?
   e. cell membrane?
2. What structures are common to all cells?
3. Why do cells have different shapes and structures?
4. What makes it possible for prokaryotic cells to survive and function despite the absence of a nucleus and other membrane-bound organelles?

End of Firm-Up

In this section, the discussion was about the cell – the basic structural and functional unit of living things. You learned about the cell's structure, function, and types. You also tried to explore how cells can be studied using different microscopes.
Go back to the previous section and compare your initial ideas with the discussion. How much of your initial ideas are found in the discussion? Which ideas are different and need revision?

Now that you know the important ideas about this topic, let's go deeper by moving on to the next section.

DEEPEN

Now that you have learned about the structure of different types of cells, your goal in this section is to take a closer look at how this structure allows organisms to perform essential life functions. **How are the parts organized to carry out certain functions? How do the different parts and functions of an organism keep an organism alive and healthy?**

You'll also learn more about how microorganisms perform life functions, survive, and affect more complex organisms.

Activity 1.7: Webpage Reading – Common Microorganisms

During your previous activity (Activity 1.6), you are given this question: ***What makes it possible for prokaryotic cells to survive and function despite the absence of a nucleus and other membrane-bound organelles?***

Now you will understand how prokaryotic and unicellular organisms like bacteria perform essential life functions. You will also look at and learn about some eukaryotic microorganisms.

As you go through the following webpages, think about the following question: ***How do microorganisms perform essential life functions?***

http://users.rcn.com/jkimball.ma.ultranet/BiologyPages/E/Eubacteria.html - information about bacteria
http://www.mcwdn.org/Animals/PROTOZOA.html - protozoa
http://tolweb.org/notes/?note_id=52 – algae (protists with chloroplasts)
http://www.wisc-online.com/Objects/ViewObject.aspx?ID=bio304 – fungi kingdom

Exercise 1.5.

Complete the following table. You may consult other references or read more webpages.

Microorganism	Characteristics	Special/Unique structures that allow the organisms to perform life functions	Effects to higher organisms and the environment	
			Benefits	Harm
Bacteria				
Protozoa				
Algae				
Fungi				

Activity 1.8: Systems Analysis

Now, let us look more deeply at multicellular organisms. Plants, animals, and humans are considered more complex organisms. Cells with related function are grouped into tissues; similar tissues form organs; and related organs work together in an organ system. It is important to remember that the different parts of our body are interdependent. Body systems do not function in isolation. They interact in order to keep the organism functioning.

Recall that the cell operates as a system. It is made up of parts that work together to perform the various cellular processes. Cells are the building blocks of life. They are the simplest units that have all the characteristics of life. Many chemical reactions occur continually inside your cells to keep you alive. Thus, we can look at the cell as a chemical factory.

- It takes in raw materials.
- Then, it processes these materials to make new molecules.
- These molecules can either be used by the cell itself or transported to other parts of the body. For example, cells inside the pancreas make a hormone called ***insulin***. Insulin is transported to the liver and muscles, where it causes the liver and muscles to convert glucose to glycogen for storage.

For your task:

1. Review the different parts of the cell and their corresponding functions.
2. Describe how the parts affect one another.
3. Read the following article about the effect of environmental stress on cell structure and function.
   http://www.hawkeshealth.net/community/archive/index.php/t-4412.html

   Identify one cellular organelle that is affected by environmental stresses. Describe the change in that part.
4. Formulate a ***hypothesis*** to explain what might happen to the whole cell as a result of the change you described previously.

After completing the systems analysis, please take time to rethink your answers to the following questions: ***How are the parts organized to carry out certain functions? How do they work together to keep the organism functioning and surviving?***

Activity 1.9: Article Analysis

Have you ever heard of **stem cells**? The discovery of stem cells is considered a major scientific breakthrough. Find out more information about stem cells by quickly going over this site:

http://stemcells.nih.gov/info/basics/ - stem cell basics

Apart from stem cells, all other cells of multicellular organisms become **specialized**. They develop into particular types that carry out specific functions. For example, the human body has liver cells, muscle cells, nerve cells, and skin cells. A plant has xylem cells, phloem cells, and root hair cells.

How is cell structure related to cell function? Examples:

- Why are nerve cells long and thin?
- Why is nucleus absent in red blood cells?
- Why are there more mitochondria present in muscle cells than in skin cells?
- What are the organelles included in the *endomembrane system?* How do their structures allow them to coordinate and communicate with each other and manufacture necessary cellular products?

Let us now go back to stem cells. If specialized cells perform particular functions for an organism, what benefit can we gain from unspecialized cells like stem cells? You probably read about their potential uses especially in the field of medicine. The article found in the link below tells about one of stem cells' many potential benefits:
http://www.naturalnews.com/020935_stem_cell_research_cells.html - *Stem Cells Used to Grow Human Liver in the Laboratory*

Use the following questions as guide for your analysis:

1. How did the scientists involved in the study made use of stem cells?
2. What is the potential impact of the discovery to the field of medicine?
3. What does the situation in the article tell us about the ***organization of cells*** in the human body?

Is the human body simply a collection of cells that come in different shapes and sizes?

Your answer should be **NO.** In more complex organisms, cells of similar function group together to form tissues; similar tissues form organs; and organs performing related functions make up organ systems.

This level of organization is not found among unicellular organisms (like the prokaryotes and some microorganisms that you encountered from previous activity).

End of Deepen

In this section, the discussion was about the organization and structure of the different cellular structures in order to perform important functions. You also looked at how microorganisms survive despite having simpler structures.

What new realizations do you have about the topic? What new connections have you made for yourself? What questions do you still have?

Now that you have a deeper understanding of the topic, you are ready to do the tasks in the next section.

TRANSFER

Your goal in this section is apply your learning to real life situations. You will be given a practical task which will demonstrate your understanding.

Activity 1.10: Anticipation-Reaction Guide

Given again are statements about cells and microorganisms. Decide whether the statement is correct or not based on what you learned and understood from the lessons. Click on the button that corresponds to your answer. You now need to accomplish the ***After the Lesson*** column. Click on the link to open the chart and click "Save."

Before the Lesson		**Statements**	**After the Lesson**	
YES	NO		YES	NO
O	O	1. The cell is the smallest unit capable of performing all life functions.	O	O
O	O	2. Cells are circular, hollow structures that serve as building blocks of living things.	O	O

		Cells come in different shapes, not only circular; and there are even smaller structures and organelles found inside the cell.		
O	O	3. The two types of cells are plant cells and animal cells. *You may have thought that only plants and animals have cells. Fact is all living things, including microorganisms, have one or more cells. Cells may also be classified as prokaryotic or eukaryotic.*	O	O
O	O	4. There are various types of microscopes to serve different purposes.	O	O
O	O	5. The structures in living things are organized to carry out related functions.	O	O
O	O	6. All living things are made up of cells, tissues, organs, and organ systems. *Remember that some organisms have only one cell. Some organisms, despite having many cells, retain the cellular level of organization and do not have tissues and organs.*	O	O
O	O	7. Bacteria do not have cells, and need animals and humans in order to live. *You may think that all bacteria are parasitic and dependent upon other living things to survive. That is not true for all bacteria.*	O	O
O	O	8. Microorganisms such as bacteria are harmful to health and environment because they are sources of diseases and pollution. *It's common misconception that bacteria always cause bad things. Many of them are actually ecologically important and are essential components of many food products.*	O	O

Compare your answers before and after the lesson. ***What new knowledge and understandings have you gained about how parts relate to function in living things?***

Activity 1.11: Research Work

Gather three to five recent and related research articles about the **cell**. Make use of various sources – journals, magazines, and internet.

TASK

Make a summary of each article. Then, put together and synthesize the information found in the different researches you gathered. From your synthesis, justify how the study of cells can help improve the lives of many organisms, e.g. promotion of proper nutrition and healthful habits.

End of Transfer

In this section, your task was to relate the importance of studying the cells in the improvement of the quality of life.

How did you find the task? How did the task help you see the real world use of the topic?

Write a reflective journal following this format:

What I Did	***What I Learned***	***How I Can Use It***	***What Surprises I Experienced***

You have completed this lesson. You can now move on to the next lesson for this module.

Lesson 1.2 Levels of Organization and Coordination

EXPLORE :

You learned from the previous lesson that organisms are not merely collections of parts and structures that perform specific functions. Rather, these parts are **organized** to carry out a goal. In this lesson, you will learn more about the **levels of organization** in multicellular organisms, with particular focus on the human body. Let's begin the module by clarifying the importance of organization in living systems.

Activity 2.1: KWL Chart

Below is a KWL chart. It will help you check your understanding of the lessons. For now, fill in the **K** and **W** column with your ideas regarding the question: ***Why must there be levels of organization in all organisms? How does it help keep an organism alive and healthy?*** Click on "Save" to save your response.

What I **K**now	What I **W**ant to Know	What I **L**earned

Activity 2.2: Webpage Reading

How is life organized around cells? The webpage you will find in the link below gives a review of the previous lesson about the cell as the basic unit of life, and a preparation for the upcoming lesson on levels of organization:

http://www.learner.org/courses/essential/life/session1/closer1.html - levels of organization built around the cell

Answer the following questions:

1. Why is the cell the basic unit of structure and function in living things?
2. How is life organized around cells?

3. Do all organisms, from simplest to the most complex, follow the same levels of organization? Why or why not?

End of Explore:
You started exploring the different levels of organization in organisms and tried to determine its importance. Find out if your ideas are correct as we move on to the next part. You'll also learn the answers to the questions presented above.

FIRM-UP

From cellular level of organization, you now move on to tissues, organs, and organ systems. Your goal in this section is to learn and understand how different organs and organ systems work. How do the organ systems coordinate to keep the organism alive? Be sure to determine the roles and importance of each system.

As you go through the different organ systems of the body, continuously ask yourself these questions: **How is structure related to function? Why must there be levels of organization in all organisms?**

Activity 2.3: Collaborative Learning

Make a list of the important organs found in our bodies. What made you say they are important? Look at the first organ you listed. Do you think it can perform its function well even without the other organs in your list?

In this activity, you will work together ***with other online learners,*** just like how our organs work together to keep us alive. Assign one body system to each learner; you are expected to study well the system assigned to you.

Then, put together the information that each learner has gathered. Make a table to show similarities and differences among the body systems while considering its functions as well as organs involved. Make sure everyone is involved in deciding how your final output (table) will look like.

Questions:

1. In what ways are the body systems similar? In what ways are they different?
2. Do these similarities and differences contribute to the main goal of keeping the organism healthy? How?
3. Were you able to see how one organ's structure is related to its function? Give examples.

Activity 2.4: Video Viewing

Learn more about the different organs and organ systems by watching these videos:

http://www.youtube.com/watch?v=Hgm8-xeiBpA – major organs in the human body

For auditory learners: http://www.youtube.com/watch?v=vL2XZji-Uco – body systems rap

After viewing the video, make a two-column chart that focuses on the major organ of each system that was mentioned as well as its corresponding function.

Organ	***Function***

Exercise 2.1.

Check how well you learned the different body systems through the following online quizzes:

http://www.proprofs.com/quiz-school/story.php?title=organ-systems

http://www.biology4kids.com/extras/quiz_systintro/index.html

Activity 2.5: Systems Analysis

Several organs work together for the organ system to function efficiently. What happens if one of the organs fail to function?

Find out the answers by performing this task:

End of Firm Up:
In this section, the discussion was about the different organ systems and their functions.

Go back to your KWL chart. How much of your initial ideas are found in the discussion? Which ideas are different and need revision?

Now that you know the important ideas about this topic, let's go deeper by moving on to the next section.

1. Consider the following situation:
   *The human lungs are made up of millions of tiny, thin-walled sacs called **alveoli.** These sacs increase the surface area of the lungs for efficient gas exchange.*

   Emphysema is a disease closely linked with cigarette smoking. It occurs when the alveoli lose elasticity. Air becomes trapped in the alveoli, causing them to eventually stretch and rupture.

2. Identify the organ system that is affected. Identify the part that is not functioning well. Discuss how this malfunction can affect the whole organ system and the organism. *Follow the steps in conducting **systems analysis** that you did during the study of cell structure and function. This time though, think in terms of organs working together in an organ system, and different organ systems interacting to keep the organism functioning.*

3. Make a summary of your analysis by writing a **paragraph** that explains how emphysema:
   - causes difficulty in breathing;
   - affects the removal of carbon dioxide from the blood and the delivery of oxygen to cells. *What other organ systems are affected when carbon dioxide is not removed from the blood, and oxygen not delivered to cells? Discuss thoroughly your answer to this question.*

Remember the last time you exercised. What are your body's responses to exercise?
You probably answered the following:

- increased heart rate and breathing rate (Why?)
- muscles hurt (Why?)
- sweating (What is the effect of sweating to our bodies?)
- flushing (Why does this happen?)

What organ systems are worked out when you exercise? Explain. Relate your answer to why exercise is good for our bodies.

DEEPEN

Your goal in this section is to take a closer look at organization by learning how organ systems interact. Pay closer attention to the interdependence of the body systems. **How are the different systems organized to carry out life functions? How do the parts work together to keep our bodies healthy?**

Activity 2.6: Formulating a Generalization

Think about these questions: *What levels of organization have you learned so far? What is/are the benefit(s) of organizing structures of the same function? If there are levels of organization, does it contribute to keeping our bodies healthy and well-functioning?*

Enrich your ideas by looking at this link:
http://www.nature.com/scitable/content/biology-is-studied-at-many-levels-of-35665 - levels of organization in the study of Biology

Using the link above, and the questions as guide, make a **generalization** as to ***why there are levels of organization***.

Exercise 2.2.

It's now time to assess your understanding of the levels of organization and interactions among organ systems.

A. Explain the differences in the following sets of words:
    1. cell – tissue
    2. organ system – organ
    3. digestion – respiration
    4. absorption – excretion
    5. alveoli – villi

B. Explain how each set of organ systems **interact** to perform related function. You can either write your explanation, or explain through simple diagrams.
    1. Digestive system and Circulatory system
    2. Circulatory system and Respiratory system
    3. Nervous system and Muscular system
    4. Digestive system and Excretory system

Activity 2.7: Case Analysis

Our bodies are complex structures made up of many parts. Good health depends upon the proper functioning of all these parts.

Read the following case:

Reading

After being overweight during his entire college life, a 22-year old male decided to go to the gym to lift weights in order to achieve his ideal weight. Because of this, he also decided to take a lot of vitamin C and spinach. He believes that these will not only strengthen his bones as he performs his weight training in the gym, but protects himself from injury as well. Together with the weight training, he also figured out that he should also watch what he eats.

Six months since he started his weight training, all he had was spinach salad during his meals. Lately, he noticed a discomfort on the small of his back which eventually developed into pain. This caused him to stop going to the gym and made him consult a doctor. Even before seeing the doctor, he was already suspecting that the weight training that he's been doing caused the back pain. After the interview with the doctor, he was surprised that the doctor wanted him to undergo a urinalysis. He had no idea why the doctor would want his urine checked when his reason for the consultation was the back pain that was probably caused by lifting weights.

When the urinalysis results came out, the doctor immediately noticed the high level of RBC (red blood cells) that was much higher than the normal, acceptable value. The doctor explained that this could indicate the formation of salt crystals in his kidneys. If the condition worsens, he could have kidney stones. All of the "ingredients" for a kidney stone formation were there. His diet, together with the vitamin C supplements, will lead to chemical reactions that form calcium salts. The doctor also explained to him that the condition is quite common in his age group. After prescribing some medications, he was then referred by the doctor to a dietician to help him eat the right foods as he tries to lose weight.

Use the sample case above to guide you as you perform this task:

Blood tests help doctors check for certain diseases and conditions. They also help check the function of your organs and show how well treatments are working.

*A blood test is done to Patient X. The test was done before eating, and revealed a **high** level of sugar.*

Is Patient X healthy?
What tissues or organs are malfunctioning?

*Make an **analysis** of patient X's possible condition. Supplement your analysis with relevant research.*

Once you are done with your analysis, make a self-assessment of your work. *What are the best points of my analysis? What are the parts that caused me difficulty and may need improvement? How did this activity help me make better sense of the concepts I'm learning?*

Then, go back to the question: How do the different parts and functions of an organism keep an organism alive and healthy?

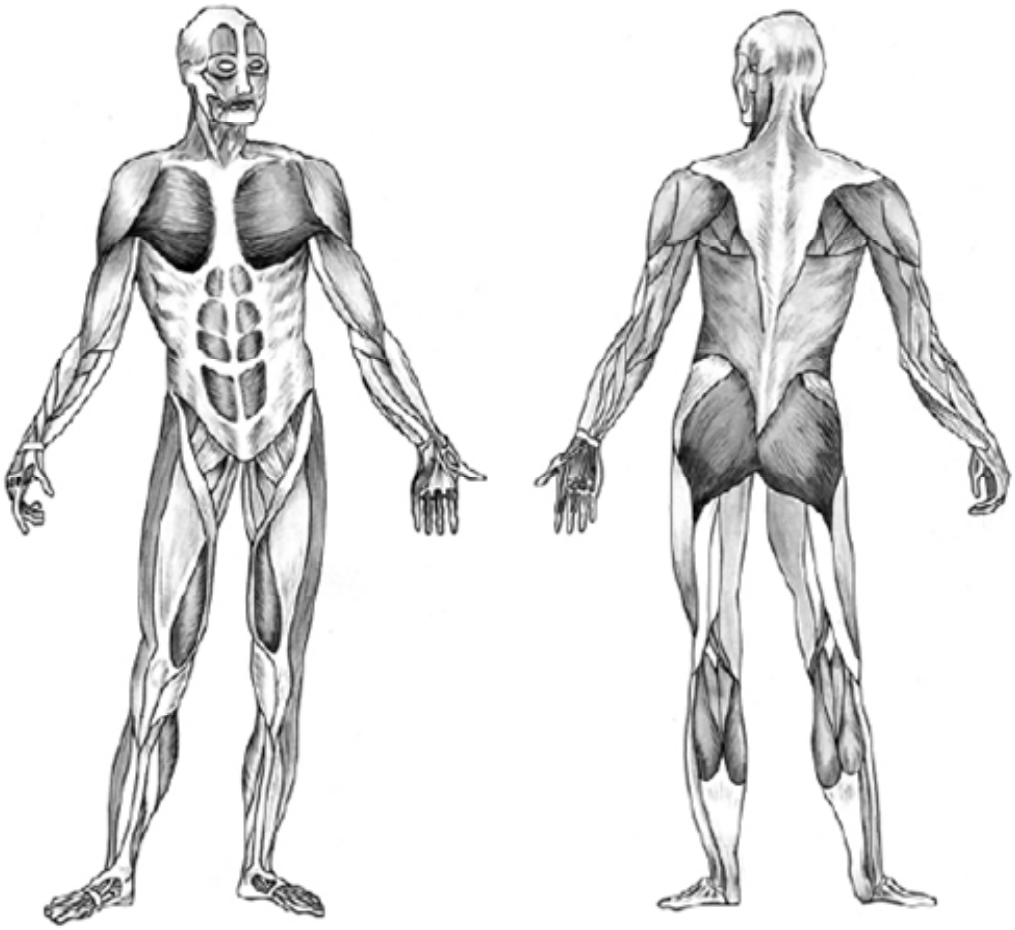
Activity 2.8: "Muscles mean movement."

Source: *Our Human Body* Classroom Activities, Activity 10 p. 164
http://museumvictoria.com.au/pages/2314/our-human-body-classroom-1-13.pdf

No part of our body moves without muscles. Muscles move the food in our intestines and they make the muscular irises in our eyes open and close to adjust to the light. Cardiac muscle, found in our heart, and smooth muscle found in our digestive tract and blood vessels, moves without our conscious involvement. Skeletal muscles are the muscles attached to bones. These muscles move when we consciously make the decision to move them. Skeletal muscles often work in pairs, one contracting and the other relaxing in turn, to move bones at our joints.

What to do:
Perform each of the actions overleaf, very slowly. Feel the muscles that are tensing up as you do them. ***Color in each of the muscles that contract with each movement onto the diagrams found below. (***Print out the diagrams, color them, and submit to your teacher during your next meeting.)

1. Bend your knee and lift it up in front of your body. Imagine there is tacky glue sticking your foot to the ground.
2. Imagine you are lifting a very heavy jug off a table and up towards your mouth.
3. Imagine you are putting the heavy jug back on the table.
4. Plant your feet on the ground side by side. Imagine that a very strong wind is blowing into your face almost blowing you over but you are standing up against it.
5. Imagine you are kicking a football in slow motion.
6. Imagine you are rowing a very heavy boat by pulling the oars back against the water in slow motion.
7. Lift your heels off the ground and carefully roll your weight onto the front of your feet like a dancer.
8. Drop your chin on to your chest then slowly lift your head up so that you are looking straight ahead of you.
9. Imagine that you are about to bowl a bowling ball in slow motion and you are swinging your arm backwards for the bowl.



What actions can you think of that use other muscles in your body?

Work in groups of 3 or 4 to choose a song and make up an aerobics routine. Choose ten different muscles in the body and think of exercises that moves each of them. Present your aerobics routine to the class and make sure you call out which muscles you are exercising as you do each new movement.

Process questions:

1. How is the use of oxygen maximized when performing aerobic exercises?
2. Can the routines of an aerobic exercise happen without our conscious control?
3. Considering your answers to the questions above, what value does one system have in relation to the other systems? Why?

End of Deepen:
In this section, you looked closely at how organs and organ systems interact to maintain proper functioning of the body.

What new realizations do you have about the topic? What new connections have you made for yourself? What questions do you still have?

Now that you have a deeper understanding of the topic, you are ready to do the tasks in the next section.

TRANSFER

Your goal in this section is apply your learning to real life situations. You will be given a practical task which will demonstrate your understanding.

Activity 2.9: KWL Chart

Integrate all the concepts you learned by filling in the L column of this KWL chart. Write your final answers to the question: ***Why must there be levels of organization in all organisms? How does it help keep an organism alive and healthy?*** Click on the link to open the chart and click "Save."

What I **K**now	What I **W**ant to Know	What I **L**earned

Activity 2.10: Concept Mapping

Use a concept map to show the interconnectedness among the different systems of the body for an individual to function efficiently.

Activity 2.11: Transfer Task

TASK

The municipal health office in your town is gathering information about the common medical conditions affecting its residents. You and 4 other health workers in your barangay are tasked to complete a case study about any common health problem in your area.

You will do actual observations, interviews, and research about the chosen case. After the period of investigation, you are to submit a written report of the case study to the members of the municipal health office.

Your case study is expected to: demonstrate your understanding of structures and functions; contain sound analysis and recommendations based on research and observation.

RUBRIC: Case Study

STANDARDS → SCALE ↓	Understanding	Analysis, Evaluation, and Recommendations	Communication	Content
Exemplary 4	Demonstrates in-depth understanding of the topic	Presents an insightful and thorough analysis of most issues identified; Supports diagnosis and opinions with strong arguments and evidence; Presents detailed, realistic, and appropriate recommendations supported by the information presented and concepts from the reading; Supplements case study with	Analysis and explanations are clearly written; makes effective use of grammar, spelling, and vocabulary; extremely well-organized; thoroughly documents all sources of information	Provides exhaustive and reliable background information about the area; Information provided is clearly relevant to the objective of the study

		extensive and relevant research		
STANDARDS → SCALE ↓	**Understanding**	**Analysis, Evaluation, and Recommendations**	**Communication**	**Content**
Accomplished 3	Demonstrates acceptable understanding of the topic	Presents a thorough analysis of most issues identified; Supports diagnosis and opinions with reasons and evidence; Presents specific, realistic, and appropriate recommendations supported by the information presented and concepts from the reading; Supplements case study with relevant research	Analysis and explanations are indicated; demonstrates correct use of grammar, spelling, and vocabulary; well-organized; documents all sources of information	Provides accurate background information; Information provided is related to the objective of the study
Developing 2	Demonstrates partial understanding of the topic	Presents a superficial analysis of most issues identified; Supports diagnosis and opinions with limited reasons and evidence; Presents realistic, and appropriate recommendations supported by the information presented and concepts from the reading; Supplements case study with limited research	Analysis and explanations are insufficient; inconsistent use of grammar, spelling, and vocabulary; poorly-organized; limited documentation of sources	Provides unrelated background information; Some information are not relevant to the objective of the study

Beginning 1	Demonstrates erroneous understanding of the topic	Presents an incomplete or erroneous analysis of issues identified; Supports diagnosis and opinions with few reasons and limited evidence; Presents recommendations with little, if any, support from the information presented and concepts from the reading; Supplements case study, if at all, with incomplete research	Analysis and explanations are erroneous; wrong use of grammar, spelling, and vocabulary; lacks organization; no documentation of sources	No background information;

End of TRANSFER:

In this section, your task was to make a case study about the health problems that are affecting your locality. ***Through the task, were you able to see how the different parts and functions of an organism keep an organism alive and healthy?***

How did you find the performance task? How did the task help you see the real world use of the topic?

Reflect on your experiences in the entire module. You may use the following guide questions:

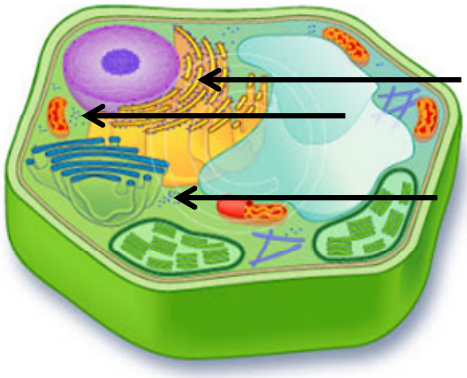
- *What is/are the most important lesson/s you learned in this module?*
- *What activities did you find most engaging? Why?*
- *What activities did you find difficult and frustrating? What have you done to accomplish them?*
- *What are now your insights and realizations about keeping your body healthy?*

You have completed this module. Before you go to the next module, you have to answer the following post-assessment questions.

POST-ASSESSMENT:

It's now time to evaluate your learning. Click on the letter of the answer that you think best answers the question. Your score will only appear after you answer all items. If you do well, you may move on to the next module. If your score is not at the expected level, you have to go back and take the module again.

1. What would most likely happen to the cell if the structures pointed by the arrow were not functioning?



   A. The cell produces antibodies.
   B. There is uncontrolled cell division.
   C. The synthesis of enzymes stops.
   D. Wastes will accumulate.

2. What structures could most likely be observed in cells in the low-power field of a compound light microscope?
   A. Cell walls and chloroplasts
   B. Golgi bodies and mitochondria
   C. Lysosomes and DNA
   D. Ribosomes and endoplasmic reticulum

3. Which of the following sets of organelles can be found in both plant and animal cells?
   A. cell membrane and cell wall
   B. nucleus and mitochondria
   C. ribosomes and centriole
   D. vacuole and chloroplast

4. A certain unicellular organism is heterotrophic, i.e. it cannot make its own food molecules and must get them from other organisms. It possesses a cell wall which is made up of a carbohydrate called chitin. This microorganism is most likely a/an:
   A. algae
   B. bacterium
   C. fungus
   D. protozoa

5. Which pair of organ systems ensures that our bodies are supplied with the needed nutrients?
   A. immune system & digestive system
   B. digestive system & circulatory system
   C. circulatory system & respiratory system
   D. respiratory system & immune system

6. The liver and the pancreas are also digestive organs even though they don't come into contact with food; these organs produce substances that chemically digest food by way of the
   A. large intestine.
   B. stomach.
   C. esophagus.
   D. small intestine.

7. Air travels into and out of the lungs as the _____ branches into the left and right bronchi.
   A. trachea
   B. alveolus
   C. ventricle
   D. bronchiole

8. A strong immune system allows our bodies to resist different kinds of _____ that we may be exposed to.
   A. organisms
   B. situations
   C. diseases
   D. organs

9. Certain cells of the immune system, called *plasma cells,* produce large numbers of special proteins, called antibodies, which are important in fighting off infections. The plasma cells make large numbers of these antibody proteins and "secrete" them, releasing them outside the cell. Which among the following organelles is most likely to be highly developed in plasma cells?
   A. Golgi apparatus
   B. Mitochondria

C. Nucleus
D. Vacuole

10. Regarding cell type, which one of the following is unlike the others?
    A. a human skin cell
    B. cell of the photosynthetic green algae
    C. *Coleus* plant cells
    D. leaf cells of aratilis

11. A group of students wants to study the effect of pH on the growth of microorganisms. Three test tubes are labelled A, B, and C respectively. Each test tube is filled with 10 ml of freshly prepared nutrient broth. Five drops of hydrochloric acid are added to test tube A; 5 drops of sodium hydroxide to test tube B; and distilled water to test tube C. Using a sterile glass rod, some culture of the microorganism *Bacillus subtilis* are transferred into test tubes A, B, and C, then stoppered immediately. The appearance of the broth in each tube is observed and recorded. All tubes are kept in a cupboard in the laboratory. After two days, the test tubes are taken out. The appearance of nutrient broth in each test tube is observed and recorded.

Test Tube	***Content of test tube***	***pH condition***	***Appearance of nutrient broth at the beginning***	***Appearance of nutrient broth after two days***
A	Nutrient broth + Hydrochloric acid	Acidic	Clear	Clear
B	Nutrient broth + Sodium hydroxide	Alkaline	Clear	Clear
C	Nutrient broth + Distilled water	Neutral	Clear	Cloudy

What can be concluded from this experiment?
    A. Microorganisms grow and multiply rapidly in acidic conditions.
    B. Microorganisms grow and multiply rapidly in alkaline conditions.
    C. Microorganisms grow and multiply rapidly in neutral conditions.
    D. The growth of microorganisms is affected by pH.

12. While waiting for your turn to see the doctor, a girl was rushed into the clinic and was said to be suffering from an asthma attack. From what you know about asthma, you would expect to observe from the girl
    A. complaints of joint pains.
    B. complaints of stomach ache.
    C. whistling sound when breathing.

D. flailing arms and legs.

13. Patricia learned from class that voluntary movements (*walking, reaching, etc.*) are under the control of the somatic nervous system. Her friend recently got involved in a road accident and was diagnosed to have a motor nerve injury, Patricia was not surprised to see that her friend
    A. was able to walk around the hospital room unassisted.
    B. mentioned that she was not experiencing any digestive problems.
    C. was doing squats to strengthen her thigh muscles.
    D. needed to be in a wheelchair to move around from place to place.

14. While executing some of his ballet moves, Jack felt like he broke his ankle, but the doctor says he tore a ligament instead. What did he tear?
    A. the connective tissue that attaches muscle to bone
    B. the connective tissue that joins two bones
    C. the bags of fluid that allows smooth movement of a joint
    D. the cartilage that lines the end of a bone

15. Read the excerpt below:

    Placental Stem Cells Demonstrate High Therapeutic Potential
    Scientists report that placental stem cells with important therapeutic properties can be harvested in large quantities from the fetal side of human placentas (called the chorion).
    The chorion is a part of the afterbirth and is normally discarded after delivery, but it contains stem cells of fetal origin that appear to be pluripotent, able to differentiate into different types of human cells, such as lung, liver, or brain cells.
    Functional placental stem cells can be isolated from either fresh or frozen term human placentas. (www.stemcellresearchnews.com)

    Having read the excerpt, which can you suggest as the best thing to do with the *chorions*?
    A. Discard them after delivery.
    B. Give them back to the mother.
    C. Store them for future therapeutic needs.
    D. Transplant the stem cells to the new born.

16. Antibiotic resistance happens when an antibiotic has lost its ability to effectively control or kill bacterial growth. The bacteria targeted become 'resistant' and continue to multiply despite the presence of the antibiotic. Which of the following practices will help prevent antibiotic resistance in pathogenic bacteria?
    A. Flush out-of-date or unused medications down the toilet.
    B. Stop taking the antibiotics once you feel better.
    C. Take antibiotic drugs only as directed by your doctor.
    D. Take the antibiotics longer than the prescribed days.

17. An epidemic has recently stricken your locality. This is the first time that such disease affected your area. The health office in your locality is in urgent need of pertinent information about the causes of the epidemic and is looking for ways to solve the problem. As a health worker, you were tasked to complete a case study about the disease. Which of the following should you keep in mind as you complete your study?
    A. You should be able to conduct interview to *all* the members of the community affected by the disease.
    B. You should be able to pinpoint, through rigid investigation of cases, who the source of the epidemic is.
    C. You should carefully make an analysis of the case based on actual observations and relevant research.
    D. You should, in your discussion, make use of highly technical terms to make your study more convincing.

18. Using a treadmill is the right choice as an exercise machine for the circulatory and respiratory systems because
    A. its correct use demands substantial effort from the heart and the lungs.
    B. it makes the large muscles of the legs contract at the same time.
    C. it is a good stress test as performed in hospitals.
    D. it stresses the heart without stressing the lungs.

19. Your mother was getting worried because your 3-year old brother had been crying since the night before and complained of pain as he clutched his stomach. So in your next meal,
    A. you advised him to load on pasta, rice, and mashed potatoes.
    B. you encouraged him to take in pineapples, mangoes, and vegetable salad.
    C. you gave him big servings of hotdogs, bacon, and other processed meats.
    D. you prepared several bags of chips with different dips for him.

20. Your little brother just came from a birthday party and told you that he had a heavy meal. He was lying in bed and was noticeably having difficulty breathing. To your knowledge, he has no lung-related problems at all. Since he asked you to do something to relieve him of his present condition,
    A. you decided to perform the Heimlich maneuver on your brother while he was lying in bed.
    B. you cupped his back repeatedly to loosen the phlegm.
    C. you gave him several glasses of water so he could breathe more easily.
    D. you asked him to sit up or walk around if it was possible.

GLOSSARY OF TERMS USED IN THIS MODULE:

algae Type of protist that carries on photosynthesis; unicellular forms are a part of phytoplankton, and multicellular forms are called seaweed.
bacterium Microorganisms that contain prokaryotic cells and have their own unique genetic, biochemical, and physiological characteristics
cell Smallest unit that displays the properties of life
cell membrane Membrane surrounding the cytoplasm that functions to regulate the entrance and exit of molecules from the cell
cell theory One of the major theories of biology; states that the cell is the basic unit of life, organisms are made up of cells, and cells come only from pre-existing cells.
cell wall Structure that surrounds a plant, protistan, fungal, or bacterial cell and maintains the cell's shape and rigidity.
cytoplasm Contents of a cell between the nucleus and the plasma membrane that contains the organelles.
eukaryotic cell (eukaryote) Type of cell that has a membrane-bounded nucleus and membranous organelles.
fungi Saprotrophic decomposer; body is made up of filaments called hyphae that form a mass called a mycelium.
hypothesis Supposition that is formulated after making an observation; it can be tested by obtaining more data, often by experimentation.
insulin Hormone secreted by the pancreas that lowers the blood glucose level by promoting the uptake of glucose by cells and the conversion of glucose to glycogen by the liver and skeletal muscles.
muscular system System of muscles that produces movement, both within the body and of its limbs; principal components are skeletal muscle, smooth muscle, and cardiac muscle.
nucleus Membrane-bounded organelle that contains chromosomes and controls the structure and function of the cell.
organ Combination of two or more different tissues performing a common function.
organelle Small membranous structure in the cytoplasm having a specific structure and function.
organism Individual living thing.
organ system Group of related organs working together.
prokaryotic cell (prokaryote) Organism that lacks the membrane-bounded nucleus and membranous organelles typical of eukaryotes.
protozoa Heterotrophic, unicellular protist that moves by flagella, cilia, or pseudopodia, or is immobile.
stem cells Biological cells found in all multicellular organisms, that can divide (through mitosis) and differentiate into diverse specialized cell types and can self-renew to produce more stem cells.

surface-area-to-volume ratio Ratio of a cell's outside area to its internal volume.
tissue Group of similar cells that perform a common function.
urinalysis Array of tests performed on urine; one of the most common methods of medical diagnosis.
vacuole Membrane-bounded sac, larger than a vesicle; usually functions in storage and can contain a variety of substances.

WEBSITE RESOURCES AND LINKS IN THIS MODULE:

http://www.timetoast.com/timelines/23002 - development of cell theory

http://www.microscope-microscope.org/basic/microscope-parts.htm - introduction to the compound light microscope

http://www.biologycorner.com/microquiz/# - naming the parts of the microscope

http://nhscience.lonestar.edu/biol/dropdrag/microscope2.htm - matching microscope parts with their functions

http://www.sciencelearn.org.nz/Contexts/Nanoscience/Sci-Media/Animations-and-Interactives/Meet-the-Microscopes - learn about 4 different types of microscope

http://www.ibiblio.org/virtualcell/ - virtual cell web page

http://learn.genetics.utah.edu/content/begin/cells/insideacell/ - tour inside a cell

http://www.sheppardsoftware.com/health/anatomy/cell/cell_quiz.htm - quiz on the parts and functions of a cell

http://www.cellsalive.com/cells/cell_model.htm - comparing plant and animal cells

http://www.wiley.com/legacy/college/boyer/0470003790/animations/cell_structure/cell_structure.htm - prokaryotic and eukaryotic (animal and plant cells) cells

http://users.rcn.com/jkimball.ma.ultranet/BiologyPages/E/Eubacteria.html - information about bacteria

http://www.mcwdn.org/Animals/PROTOZOA.html - protozoa

http://tolweb.org/notes/?note_id=52 – algae (protists with chloroplasts)

http://www.wisc-online.com/Objects/ViewObject.aspx?ID=bio304 – fungi kingdom

http://www.hawkeshealth.net/community/archive/index.php/t-4412.html - effect of environmental stress on cell structure and function

http://stemcells.nih.gov/info/basics/ - stem cell basics

http://www.naturalnews.com/020935_stem_cell_research_cells.html - *Stem Cells Used to Grow Human Liver in the Laboratory*

http://www.learner.org/courses/essential/life/session1/closer1.html - levels of organization built around the cell

http://www.youtube.com/watch?v=Hgm8-xeiBpA – major organs in the human body

http://www.youtube.com/watch?v=vL2XZji-Uco – body systems rap

http://www.proprofs.com/quiz-school/story.php?title=organ-systems – quiz on body systems

http://www.biology4kids.com/extras/quiz_systintro/index.html - quiz on animal systems

http://www.nature.com/scitable/content/biology-is-studied-at-many-levels-of-35665 - levels of organization in the study of Biology

http://museumvictoria.com.au/pages/2314/our-human-body-classroom-1-13.pdf - "Muscles mean movement" activity and worksheet

Image Credits:

http://plantali.blogspot.com/ - image of a plant cell
http://www.psmicrographs.co.uk/bacteria-on-a-pin-point-/science-image/12190d - bacteria on a pinpoint
http://wifelysteps.com/2006/03/20/gumamela-dreaming/ - gumamela plant
http://www.wallcoo.net/animal/rabbit/html/wallpaper29.html - rabbit
http://www.superstock.com/stock-photos-images/1566-399492 - dicotyledon mesophyll cells
http://mbio.asm.org/content/2/1/e00338-10/F4.large.jpg - intestinal cells of rabbit
http://db2.photoresearchers.com/preview/SB9765.html - surface foldings of small intestine
http://compoundlightmicroscope.org/ - compound light microscope
http://www.molecularstation.com/molecular-biology-images/504-cell-biology-pictures/26-hooke-cell-cork.html - Hooke's cork cells

Lesson 2: Heredity: Inheritance and Variation

Introduction and Focus Questions

Why is it that neither you nor your siblings look exactly the same as your parents? Right now, you might be well aware of some hints of your father – *and even your mother* – not just in the way you look, but even with some mannerisms or behavior. It is possible that the same is true between you and your siblings, but why is it that you don't look exactly like any of them when you have the same parents?

You will find answers to this question in this lesson. You will learn about the varied ways that organisms reproduce. ***Why are there different types of reproduction?***

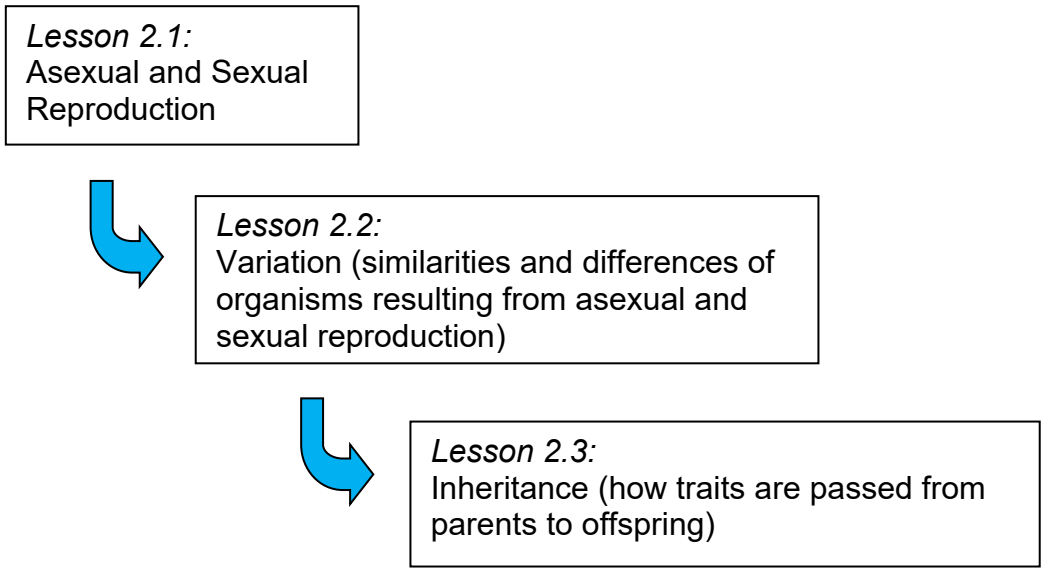
LESSON COVERAGE:

In this lesson, you will go through the following topics:

Title	You'll learn to…	Estimated Time
Types of Reproduction	• Compare asexual and sexual reproduction. • Describe the process of fertilization.	2 hours
Variation	• Differentiate offspring resulting from asexual reproduction with that from sexual reproduction in terms of similarities to parents.	4 hours
Inheritance	• Determine how traits are passed from parent to offspring.	4 hours

Concept Map of the Lesson

Here is a simple map of the topics you will cover in this lesson:



Expected Skills

To do well in this lesson, you need to remember and do the following:

a) *Identify and remember the key terms in each lesson. Take note of the examples given.*
b) *Read and study carefully the resources and online links.*
c) *Answer all questions and exercises as best as you can.*
d) *Take down notes as you go along.*

PRE-ASSESSMENT:

Let's find out how much you already know about this module. Click on the letter that you think best answers the question. Please answer all items. After taking this short test, you will see your score. Take note of the items that you were not able to correctly answer and look for the right answer as you go through this module.

1. Which cell structure is responsible in passing on traits from parent to offspring?
    a. centrioles
    b. chromosomes
    c. lysosomes
    d. vacuoles

2. What biological process leads to an increase in the population of species?
    a. circulation
    b. digestion
    c. reproduction
    d. respiration

3. Which cellular process leads to an increase in the number of cells and is used for growth and repair?
    a. meiosis
    b. mitosis
    c. osmosis
    d. photosynthesis

4. Which organic molecule is said to be involved in the passing on of traits from parents to offspring?
    a. carbohydrates
    b. fats
    c. nucleic acids
    d. proteins

5. Which cellular process leads to an increase in the number of cells but a decrease in the number of chromosomes contained by each?
    a. meiosis
    b. mitosis
    c. osmosis
    d. photosynthesis

6. Which will not influence variation in the genes?
    a. chromosome number
    b. crossing over
    c. meiosis
    d. random mating

7. What is the male reproductive part of a plant?
    a. flower
    b. petals
    c. pistil
    d. stamen

8. What is the female reproductive part of a plant?
    a. flower
    b. petals
    c. pistil
    d. stamen

9. A mutated plant bears flowers with no stamen. This plant can have fertilization if
    a. egg cells are cross-pollinated to it.
    b. a longer style is grown to the ovaries.
    c. the stigma is removed from it.
    d. pollen is cross-pollinated to it.

10. An organism that was formed through asexual reproduction
    a. will be exactly the same as the parent.
    b. will have little similarities with the parent.
    c. will have some similarities with the parent.
    d. will have no similarities with the parent.

11. An organism formed by way of asexual reproduction
    a. will respond to the environment the same way as its parent.
    b. will have new responses to the environment compared to its parent.
    c. can be assumed to belong to the kingdom plantae.
    d. can be assumed to belong to the kingdom protista.

12. Asexually-reproducing organisms are similar to sexually-reproducing organisms
    a. in that their offspring are exactly alike as the parents.
    b. in that both are expected to increase the population.
    c. in that male and female gametes are required in the process.
    d. in that mutations are equally expected in both types of reproduction.

13. Plants that reproduce sexually
    a. must be mobile in order to perform the process effectively.
    b. might use underground stems, modified leaves, and the like.
    c. rely on the flower parts to perform the reproductive process.
    d. are exclusively found only in warm, tropical regions of the Earth.

14. During asexual and sexual reproduction,
    a. the nucleus of a cell plays a vital role.
    b. the most important cell structure would be the chromosomes.*
    c. centrioles and spindle fibers ensure that traits are passed on efficiently.
    d. it is only plants that fully depend on the centrioles and spindle fibers.

15. You attended a symposium that promoted forest conservation and preservation. According to the botanist giving the talk, asexual reproduction
    a. is well-suited for mangroves in a coniferous forest.
    b. is well-suited for acacias in an underwater forest.
    c. is ideal in an environment with minimal changes in condition.
    d. is ideal in an environment with continuously fluctuating conditions.

16. You found out that a certain shrub in your neighborhood has a scent that can effectively keep away mosquitoes from your house. Because of this, you would want to grow more of it while making sure that the said effect against mosquitoes is kept. You therefore decided
    a. to propagate it via asexual reproduction.
    b. to transfer some of its pollen to the flowers of a similar-looking shrub.
    c. to transfer the ovaries to the same shrub.
    d. to add fertilizer in the plot where the shrubs will be planted.

17. Basti was nominated to head their barangay's *clean and green* program. He determined that his top priority should be to put up a vegetable garden in every vacant lot in the community. With the vegetable seeds they have at hand, he decided to increase the amount of plants by
    a. collecting old mirrors to reflect more sunlight where the seeds will be planted to facilitate photosynthesis.
    b. increasing the distance of the planted seeds from each other so less soil will be used up by each.
    c. learning how each species reproduce and considering the manner in which they will be propagated.
    d. adding sugar to the water and pesticide solution that is sprayed onto the vegetable seeds.

18. During your educational tour in a strawberry research institute in Baguio, you were shown different strawberry species. Strawberries are classified as stolons, or plant species that can increase in number using only one main plant. From the information that you have gathered in the tour, you could generalize that

a. the new strawberry plants that will develop from the main plant are identical to it in terms of all its traits.
b. the new strawberry plants that will develop from the main plant would have half of its traits come from the main plant.
c. strawberries can be grown effectively in the Philippines only in research institutes.
d. strawberries are species that grow buds in order to grow new plants.

19. While you walked through the Makiling Botanic Garden, you noticed a tree with remnants of many flowers but no fruit or seed developing. There are no other trees like this one within the confines of the sprawling garden. What could explain this occurrence?
    a. It is a female tree and no male trees of the same species are near enough for pollination to happen.
    b. It is a tree that requires exposure to salt water similar to the mangrove.
    c. It is a male tree that requires another male tree in order to perform cross-pollination.
    d. It is a female tree and no other female trees can be used to transfer the ovaries from one tree to another.

20. For your dream house, you would want to grow grass on your lawn. From observation, you noticed that grass flowers do not have petals nor sepals. Grass flowers reproduce sexually. In order for your plan to materialize,
    a. you would put up a house in a windy neighbourhood.
    b. you would purchase butterflies from a butterfly farm for pollination.
    c. you would spray nectar on the flowers to attract pollinators.
    d. you would purchase butterflies and spray the flowers with nectar.

EXPLORE

:

Let's start the module by understanding some terms in reproduction. You'll also look at the two modes of reproduction – asexual and sexual.

Activity 1: KWL Chart

Below is a KWL chart. It will help you check your understanding of the lessons. For now, fill in the **K** and **W** column with your ideas regarding the following questions: ***Why are there different types of reproduction?*** Click on "Save" to save your response.

What I **K**now	What I **W**ant to Know	What I **L**earned

Activity 2: Video viewing

You will be watching video clips on asexual and sexual reproduction. Just click on the following links:

http://www.youtube.com/watch?v=wfbhwq95Duc (*asexual reproduction*),
http://www.youtube.com/watch?v=J6akNYlkehY (*asexual reproduction*),
http://www.youtube.com/watch?v=kaSIjIzAtYA (*sexual reproduction*),
http://www.youtube.com/watch?v=RuYrFwDuYn0&feature=related (*sexual reproduction*)

Answer the following questions:

- What similarities and differences can be stated from the two types of reproduction?
- ***Why are there different types of reproduction?***

End of Explore
You have just given your initial ideas on the types of reproduction after watching the video clips. Let's now find out what science says about the questions you answered by doing the next part.

FIRM-UP :

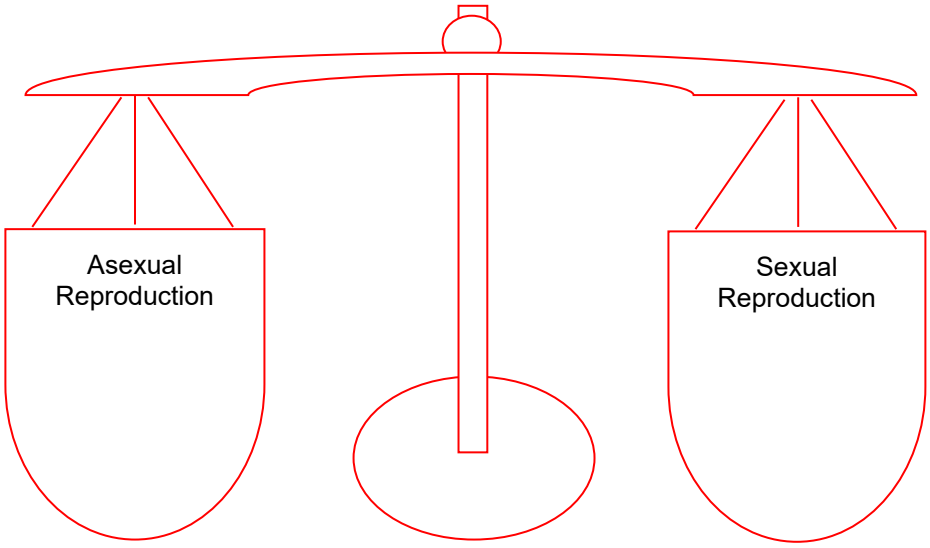
Your goal in this section is to learn and understand key concepts in asexual and sexual reproduction. You will also broaden your ideas regarding other similarities and differences among organisms that use sexual or asexual reproduction.

Activity 3: Webpage reading

Why must there be different types of reproduction? Find out answers to this question by reading the following:

"*Sex is Costly, So Why Don't Animals Reproduce Asexually?*"
http://suite101.com/article/sex-is-costly-so-why-dont-animals-reproduce-asexually-a334616#ixzz1y7t9dSQM

Compare the two modes of reproduction – asexual and sexual – by enumerating their advantages and disadvantages. Use the "*weighing scale graphic organizer*" given below:



Questions:

1. Why must there be different types of reproduction?
2. Why do some organisms undergo asexual reproduction? Sexual reproduction?
3. Does one type of reproduction "weigh" more than the other? Why or why not?

For your enrichment, read this webpage on evolution and learn how sexual reproduction plays an important role in the process:
http://www.ibguides.com/biology/notes/evolution

Activity 4: Video viewing

The main difference between asexual and sexual reproduction is that the latter requires the union of gametes from two parents. How is that made possible during sexual reproduction? Find out by watching the following clips:

You will be watching video clips on the process of fertilization both for plants and animals. Just click on the link: *Plant reproduction: Methods of Pollination*
http://www.youtube.com/watch?v=RuYrFwDuYn0

http://www.youtube.com/watch?v=vXNaTRs83hE

Fertilization refers to the union of gametes from two parents. You've seen from the videos how this is accomplished in plants and humans.

However, consider the following situations. Determine how different each situation is to the process you've seen from the videos.

- Female salmons deposit unfertilized eggs in the substrate and the male will swim by and fertilize them. (To know more, read about ***external fertilization.***)
- The roundworm *Caenorhabditis elegans* is a hermaphrodite – this animal produces both sperm and eggs. Thus, it can self-fertilize. Eggs develop in the hermaphrodite body, and are then laid. (To know more, read about ***self-fertilization and parthenogenesis***)
- Watch this video on intrauterine insemination (IUI): http://www.youtube.com/watch?v=qCdIiLLF0vw

Process Questions:

1. What do the above situations tell us about fertilization and sexual reproduction? How is reproduction related to the environment of the organism? Why can't there be only one form of reproduction?
2. Does sexual reproduction always require genital contact? If your answer is no, in what other ways can the union of gametes happen?

End of Firm-Up

In this section, you tried to look at more ways by which we can differentiate asexual and sexual reproduction. You also learned how fertilization takes place.

Go back to the previous section and compare your initial ideas with the discussion. How much of your initial ideas are found in the discussion? Which ideas are different and need revision?

DEEPEN :

Your goal in this section is to take a closer look at variation. How can sexual reproduction bring about variation? You'll also learn about some aspects of inheritance. How are the traits of the parents passed on to the offspring? You will also be able to know how the type of reproduction affects the traits that will be inherited by the offspring.

Activity 5: Webpage reading

Click on the following link to learn about inheritance and acquired characteristics:

"Hey, where did you get that from?" http://betterlesson.com/lesson/37917/3-3-introduction-to-heredity#/document/155585/3-3-inherited-versus-acquired-traits-reading-doc?from=tree&lessonID=37917

Questions to answer based on the reading:

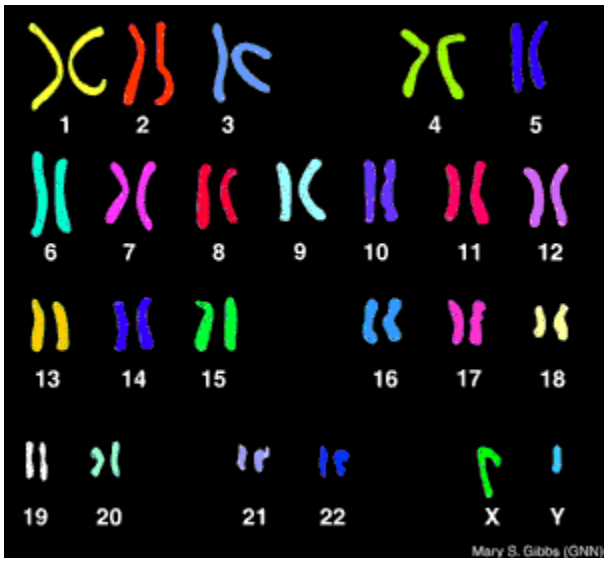
1. Name two traits you inherited from your parents.
2. Name two traits you acquired throughout your life.
3. List five traits that are inherited in animals (any animal or group of animals you can think of)
4. List at least three traits that are acquired in animals (any animal or group of animals you can think of)
5. Can you list more than 4 traits that are inherited in plants? Why would these be the traits? What is the advantage of having them?
6. Can plants acquire traits? If so, list all that you can think of and determine the purpose of having them.

Activity 6: Karyotyping

From the previous activity, you learned about inherited and acquired traits. *How are these traits passed from the parents to the offspring?*

The answer lies inside the cell. The cell's nucleus contains the genetic material, DNA, packed in structures called chromosomes. It is the genetic material, packaged into chromosomes, that is passed to the offspring during reproduction.
How does that happen during sexual and asexual reproduction? Find out by doing the succeeding activities.

Take a look at the picture below:



http://www.medicinafetala.ro/wp-content/uploads/2010/10/karyotype.gif

The picture shown above is a karyotype. It is an organized profile of a person's chromosomes. The elongated structures are the chromosomes. In a karyotype, chromosomes are arranged and numbered by size, from largest to smallest.

This arrangement helps scientists quickly identify chromosomal alterations that may result in a genetic disorder. A normal human karyotype has 46 chromosomes. A disorder or abnormality is detected if the karyotype shows too many or too few chromosomes, missing pieces of chromosomes, or mixed-up pieces of chromosomes. *How can a cell end up with too many or too few chromosomes?*

To answer that question, you need to know how human cells normally get 46 chromosomes. Watch the animation about **meiosis** found in this link:

http://learn.genetics.utah.edu/content/begin/traits/predictdisorder/

Meiosis is the cell division process that produces egg and sperm cells (gametes).

To test your understanding, do this *cut-and-paste karyotyping activity:*

1. Print this **pdf** of the chromosomes: http://learn.genetics.utah.edu/content/begin/traits/karyotype/karyotype_paper.pdf
2. Cut the chromosomes out. Then arrange them in pairs.

Answer the following questions after doing the activity:

1. What did you notice with the resulting chromosome set in the karyotype?
2. Why must chromosomes pair up with specific chromosomes and not just any chromosome in the set?
3. What does each member of the chromosome pair represent?

Activity 7: *Why are there differences in inherited traits?*

You are asked to do an exercise on meiosis by forming haploid gametes from the candy chromosomes. In your family, you are the eldest of 3 sisters; you have straight hair and light skin tone. On the other hand, both your younger sisters have wavy hair and fair complexion. In this exercise, you must be able to show how traits are randomly combined.

Analysis questions:

1. If another child will be born into this family, is it possible to have another type of hair? Skin tone?
2. If yes, why do you say so? If no, explain why you think it is so.
3. What do you think is the importance of having traits combine randomly?

Below are links for a karyotype that shows one possible outcome if a mistake happens during the random combination of chromosomes. In particular, it shows the medical condition called Down syndrome, which occurs in 1 every 700 births.

http://3.bp.blogspot.com/_fbXoeoCa5FQ/THB6bB10mmI/AAAAAAAAAEY/pu4FMFWbsSk/s400/0syndrome+down+3.gif

http://www.healthoncare.com/wp-content/uploads/2012/07/Trisomy-21.jpg

In this next activity, you will apply your understanding of random combination of traits from the previous activities on karyotyping and inheritance of traits. This will allow you to predict the next generation offspring by putting into consideration the concepts on dominance and recessiveness of traits.

Activity 8: *Angry Birds Genetics*

In the popular video game *Angry Birds*, there are 5 kinds of birds with different appearances and characteristics (traits).

1. You are to predict the possible offspring that would be produced by choosing any 2 of the 5 birds to represent the parents. Students will provide the alleles of a possible offspring using the candy chromosomes as well as the phenotype (observable traits) of the offspring.

Parent 1		Parent 2		Offspring	
Genotype	Phenotype	Genotype	Phenotype	Genotype	Phenotype

Angry Bird	Traits*
1. Black 	Color is dominant over all colors. Beak is recessive.
2. Yellow 	Color is dominant to red and white. Beak is dominant to blue and black.
3. Blue 	Color is dominant to yellow and white. Beak is dominant to red and black.
4. Red 	Color is dominant to white. Beak is dominant to yellow and black.
5. White 	Color is recessive. Beak is dominant over all shapes and sizes.

Perform a cross of the resulting offspring. Determine the new set of offspring that will result from this cross.

Parent 1		Parent 2		Possible Offspring	
Genotype	Phenotype	Genotype	Phenotype	Genotype	Phenotype

**Disclaimer*: *Traits that have been used in this exercise are only hypothetical and for genetics exercise purposes only.*

How are the traits of the parents passed on to the offspring?

End of Deepen

In this section, the discussion was about heredity and variation, and how traits are passed from parents to offspring. How similar, or different can organisms be as a result of sexual or asexual reproduction? How are the traits inherited via asexual reproduction? Sexual reproduction? ***Why should different organisms perform different types of reproduction?***

Different organisms require different types of reproduction; the factors for such may involve: the size of the organism, as this determines the energy needed for the process, the mobility of the organism, in terms of the need to find a mate or otherwise, as well as the environment, which may influence the suitable type of reproduction for a certain species.

What new realizations do you have about the topic? What new connections about **reproduction, heredity, and variation** have you made for yourself?

Now that you have a deeper understanding of the topic, you are ready to do the tasks in the next section.

TRANSFER :

Your goal in this section is apply your learning to real life situations. You will be given a practical task which will demonstrate your understanding.

Activity 9: KWL Chart

Integrate all the concepts you learned by filling in the L column of this KWL chart. Write your final answers to the question: ***Why must there be different types of reproduction?*** Click on the link to open the chart and click "Save."

What I **K**now	What I **W**ant to Know	What I **L**earned

Activity 10: Webpage reading on Plant Asexual Reproduction

Read the information/reports about plant propagation found in the following links:

1. www.irri.org
2. http://www.bpi.da.gov.ph/report.php
3. http://www.fao.org/docrep/005/ac451e/ac451e07.htm

From the links given above, choose one report that can be improved. Identify specific points that may need further improvement. Write your justifications.

Activity 11: Transfer Task

You will investigate various methods of vegetative propagation in plants and determine the advantages of both sexual and asexual reproduction for the survival and variability of the plant kingdom.

TASK

You are a member of the Sangguniang Kabataan environmental committee. As such, you have been tasked to help ensure that the open spaces in the barangay become "green" by propagating different plant species.

Your committee will submit a recommendation containing a list of plant species which you believe is best to grow in that area. Together with the list, your committee will indicate suitable methods in propagating the said plant species. The SK chairperson will approve budget requests for seedlings based on the committee's recommendations. The recommendations found in their report will be evaluated based on content, practicality of recommendation, and organization.

RUBRIC: REPORT

STANDARDS → SCALE ↓	Content	Practicality of recommendation	Organization
Exemplary 4	Provides exhaustive and reliable background information about the area; Information provided is clearly relevant to the objective of the study	The recommendations given were in line with the goals of the barangay and appropriate to its financial capabilities, highly detailed in terms of the areas where seeds can be planted, what seeds can be planted, and the estimated cost of the whole project.	Details of the recommendation are placed in a logical order and their presentation effectively keeps the interest of the reader.
STANDARDS → SCALE ↓	**Content**	**Practicality of recommendation**	**Organization**
Accomplished 3	Provides accurate background information; Information provided is related to the objective of the study	The recommendations given were in line with the goals of the barangay and appropriate to its financial capabilities.	Details are placed in a logical order, thereby helping the reader understand the report without difficulty.
Developing 2	Provides unrelated background information; Some information are not relevant to the objective of the study	The recommendations given were in line with the goals but too expensive for the financial capability of the barangay.	Some details are not in a logical or expected order, and has the potential to confuse the reader.

Beginning 1	No background information	The recommendations given were not in line with the goals of the barangay.	Many details are not in a logical or expected order. There is little sense that the writing is organized.

End of TRANSFER:

In this section, your task was to make a recommendation containing a list of suitable plant species and best methods of propagating them.

How did you find the performance task? How did the task help you see the real world use of the topic?

You have completed this lesson. Before you go to the next lesson, you have to answer the following post-assessment questions.

POST-ASSESSMENT:

It's now time to evaluate your learning. Click on the letter of the answer that you think best answers the question. Your score will only appear after you answer all items. If you do well, you may move on to the next module. If your score is not at the expected level, you have to go back and take the module again.

1. Which cell structure ensures that the characteristics of the parent/s are passed on to the offspring?
    a. centrioles
    b. chromosomes
    c. lysosomes
    d. vacuoles

2. _____ is the biological process that will result to an increase in the population of species.
    a. circulation
    b. digestion
    c. reproduction
    d. respiration

3. _____ is responsible in the growth of an organism as well as repair of worn out or injured parts due to an increase in the number of cells.
    a. meiosis
    b. mitosis
    c. osmosis
    d. photosynthesis

4. Among the molecules that make up an organism, which is said to be involved in the passing on of traits from parents to offspring?
    a. carbohydrates
    b. fats
    c. nucleic acids
    d. proteins

5. Which cellular process has the ability to increase the number of cells yet results to a decrease in the number of chromosomes contained by each?
    a. meiosis
    b. mitosis
    c. osmosis
    d. photosynthesis

6. The following are factors that can lead to gene variation, except
    a. chromosome number
    b. crossing over
    c. meiosis
    d. random mating

7. The _____is the male reproductive part of a plant.
    a. flower
    b. petals
    c. pistil
    d. stamen

8. The _____is the female reproductive part of a plant.
    a. flower
    b. petals
    c. pistil
    d. stamen

9. If a plant has an unusual condition wherein stamens are not formed, fertilization in this plant can occur only if
    a. egg cells are cross-pollinated to it.
    b. a longer style is grown to the ovaries.
    c. the stigma is removed from it.
    d. pollen is cross-pollinated to it.

10. If an organism is exactly the same as its parent,
    a. the organism was formed via asexual reproduction.
    b. the organism was formed via sexual reproduction.
    c. it has traits that came from 2 sets of different chromosomes.
    d. it did not receive chromosomes from its parent.

11. An organism formed by way of _____ will respond to the environment the same way as its parent.
    a. asexual reproduction
    b. sexual reproduction
    c. combining genes from plants and protists
    d. combining genes from plants and fungi

12. The common thing between asexually-reproducing organisms and sexually-reproducing organisms is
    a. that their offspring are exactly alike as the parents.
    b. that both are expected to increase the population.
    c. that male and female gametes are required in the process.
    d. that mutations are equally expected in both types of reproduction.

13. Plants that depend on pollination
    a. must be mobile in order to perform the process effectively.
    b. might use underground stems, modified leaves, and the like.
    c. rely on the flower parts to perform the reproductive process.
    d. are exclusively found only in warm, tropical regions of the Earth.

14. During asexual and sexual reproduction,
    a. the nuclear membrane begins to thicken to protect the ribosomes.
    b. the most important cell structure would be the chromosomes.
    c. cell plate and spindle fibers ensure that traits are passed on efficiently.
    d. it is only plants that fully depend on the cell plates and spindle fibers.

15. You attended a symposium that promoted forest conservation and preservation. According to the botanist giving the talk, asexual reproduction
    a. is well-suited for mangroves in a coniferous forest.
    b. is well-suited for acacias in an underwater forest.
    c. is ideal in an environment that does not require too much adaptive capability in plants.
    d. is ideal in an environment with regularly fluctuating conditions based on animal migratory patterns.

16. You found out that a certain shrub in your neighborhood has a scent that can effectively keep away mosquitoes from your house. Because of this, you would want to grow more of it while making sure that the said effect against mosquitoes is kept. You therefore decided to do the following, except
    a. to propagate it using its stems.
    b. to transfer some of its pollen to the pistil of a similar-looking shrub.
    c. to propagate it using its stolons.
    d. to propagate it using its runners.

17. Basti was nominated to head their barangay's *clean and green* program. He determined that his top priority should be to put up a vegetable garden in every vacant lot in the community. With the vegetable seeds they have at hand, he decided to increase the amount of plants by
    a. putting a roof over the newly-planted seeds to facilitate photosynthesis.
    b. decreasing the distance of the planted seeds from each other while increasing the number of seeds per spot.
    c. learning how each species reproduce and considering the manner in which they will be propagated.
    d. spraying distilled water and pesticide solution onto the vegetable seeds.

18. During your educational tour in a strawberry research institute in Baguio, you were shown different strawberry species. Strawberries are classified as stolons, or plant species that can increase in number using only one main

plant. From the information that you have gathered in the tour, you could generalize that

a. the new strawberry plants will have traits no different from the main plant from where it was grown.
b. the new strawberry plants that will develop from the main plant would have half of its traits come from the main plant.
c. strawberries benefit from insect pollinators since they are stolons.
d. strawberries have colourful pollen that would attract various animals.

19. While you walked through the Makiling Botanic Garden, you noticed a tree with remnants of many flowers but no fruit or seed developing. There are no other trees like this one within the confines of the sprawling garden. What could explain this occurrence?
    a. It is a female tree and no male trees of the same species are near enough for pollination to happen.
    b. It is a tree that requires a forest fire to allow its seeds to be spread.
    c. It is a female tree that requires another female tree in order to perform cross-pollination.
    d. It is a female tree and no other female trees can be used to transfer the ovaries from one tree to another.

20. For your dream house, you would want to grow grass on your lawn. From observation, you noticed that grass flowers do not have petals or sepals. Grass flowers reproduce sexually. In order for your plan to materialize,
    a. you would put up a house in a windy neighborhood.
    b. you would cut stems and plant them on the ground.
    c. you would cover the grasses to dampen the winds blowing on flowers.
    d. you would purchase butterflies and spray the flowers with nectar.

GLOSSARY OF TERMS USED IN THIS MODULE:

reproduction – biological process that leads to the formation of new offspring; may be sexual or asexual

sexual reproduction – reproductive process that necessitates the union of egg and sperm cell; leads to the formation of offspring with variations in traits

asexual reproduction – chromosomes provided by only one parent, thus offspring formed will be exactly alike to the parent

Inheritance – how traits are passed from parents to offspring

karyotype – an arrangement of homologous chromosomes to show how parents contribute to the traits of the next generation offspring

haploid – half the number of chromosomes compared to body cells of an organism

gametes – sex cells; contain half the number of chromosomes compared to body cells

dominant traits – are expressed whether the genotype is homologous (*both alleles are dominant*) or heterozygous (*one allele is dominant while the other is recessive*)

recessive traits – are masked by dominant traits when the genotype is heterozygous; expressed only in the homologous form (*both alleles are recessive*)

WEBSITE RESOURCES AND LINKS IN THIS MODULE:

http://www.youtube.com/watch?v=wfbhwq95Duc - asexual reproduction

http://www.youtube.com/watch?v=J6akNYIkehY - asexual reproduction

http://www.youtube.com/watch?v=kaSIjIzAtYA - sexual reproduction

http://www.youtube.com/watch?v=RuYrFwDuYn0&feature=related - sexual reproduction

http://suite101.com/article/sex-is-costly-so-why-dont-animals-reproduce-asexually-a334616#ixzz1y7t9dSQM – "*Sex is Costly, So Why Don't Animals Reproduce Asexually?"*

http://www.youtube.com/watch?v=RuYrFwDuYn0 - Plant reproduction: Methods of Pollination

http://www.youtube.com/watch?v=vXNaTRs83hE – human fertilization

http://betterlesson.com/lesson/37917/3-3-introduction-to-heredity#/document/155585/3-3-inherited-versus-acquired-traits-reading-doc?from=tree&lessonID=37917 – *"Hey, where did you get that from?"*

http://scigjt13.files.wordpress.com/2011/03/karyotype.gif

http://learn.genetics.utah.edu/content/begin/traits/predictdisorder/ - animation about meiosis

http://3.bp.blogspot.com/_fbXoeoCa5FQ/THB6bB10mmI/AAAAAAAAAEY/pu4FMFWbsSk/s400/0syndrome+down+3.gif

http://www.ibguides.com/biology/notes/evolution - sexual reproduction and evolution

http://learn.genetics.utah.edu/content/begin/traits/karyotype/karyotype_paper.pdf - cut and paste karyotyping activity

http://www.medicinafetala.ro/wp-content/uploads/2010/10/karyotype.gif - karyotype

http://3.bp.blogspot.com/_fbXoeoCa5FQ/THB6bB10mmI/AAAAAAAAAEY/pu4FMFWbsSk/s400/0syndrome+down+3.gif – Down Syndrome karyotype

http://www.healthoncare.com/wp-content/uploads/2012/07/Trisomy-21.jpg - Down Syndrome baby

www.irri.org – official website of International Rice Research Institute

http://www.bpi.da.gov.ph/report.php - Annual report of the Bureau of Plant Industry

http://www.fao.org/docrep/005/ac451e/ac451e07.htm - Cashew Propagation Report by the United Nations through the Food and Agriculture Organization

Lesson 3: INTERACTIONS OF LIVING THINGS WITH THEIR ENVIRONMENT

Introduction and Focus Questions

Have you ever been part of a team sent out for a mission? What was the impact of your contribution to the achievement of the team's goal? What were the problems or consequences of one team member's absence or inefficiency? Each one of us is part of a bigger whole; each organism is vitally linked to everything else in its environment. The different interactions occurring within our environment and their effect on the stability and balance of nature are the lessons you will learn from this module.

As you go through this module, think of the following questions: ***How do living things affect the environment? Do living things help or harm the environment? How can there be harmony between living things and the environment?***

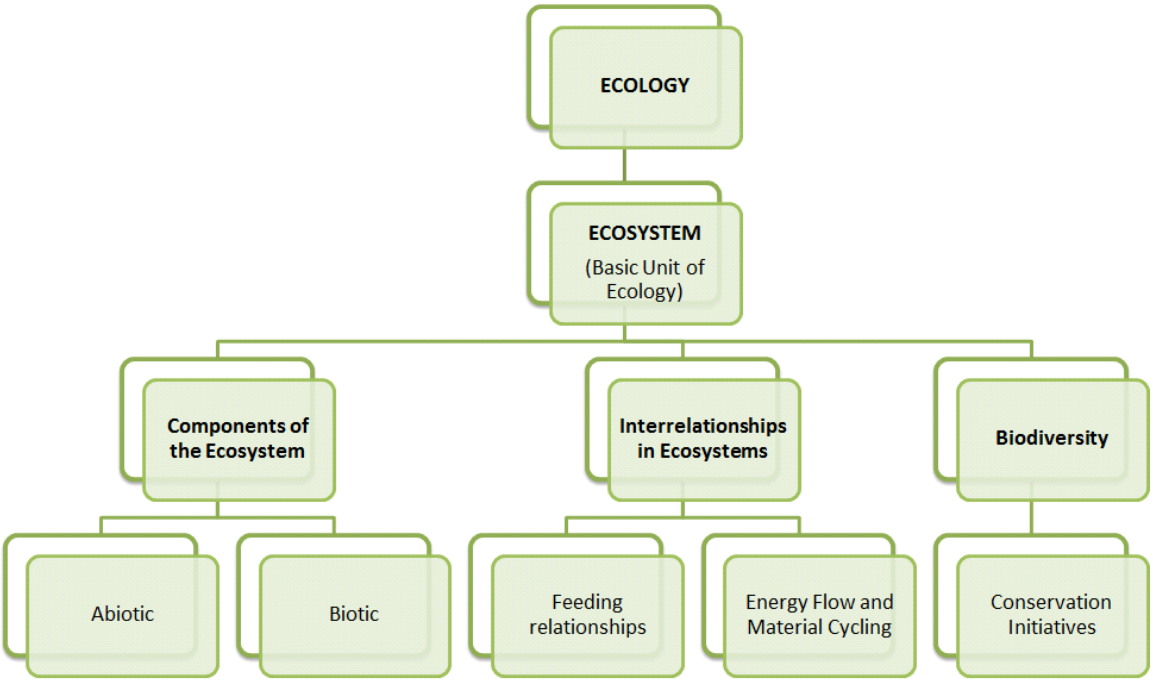
MODULE COVERAGE:

In this lesson, you will go through the following topics:

Title	You'll learn to…	Estimated Time
Basic Units of Ecology	• Describe the levels of organization in the study of ecology. • Identify which of the things found in the environment are biotic or abiotic.	4 hrs.
Interrelationships in Ecosystems	• Explain how the different interrelationships between organisms and their environment affect the stability of an ecosystem.	10 hrs.
Biodiversity Conservation Initiatives	• Discuss the different threats and pressures facing Philippine biodiversity. • Explain the importance of individual and collective actions on biodiversity conservation.	8 hours

Concept Map of the Module

Here is a simple map of the lessons you will cover in this module:



Expected Skills

To do well in this module, you need to remember and do the following:

7. Read the instructions carefully before starting anything.
8. Complete all the activities and worksheets.
9. Look up the meaning of words that you do not know.
10. Keep a notebook (or use the Notepad) where you can write (and revise) your answers to discussion questions, jot down short notes, draw diagrams, and summarize what you have just read.
11. Use the provided checklist and rubric to evaluate your work in worksheets and reports before submitting it.
12. Allow time for relaxation and recreation when you are mentally tired. Make a time table to schedule your study and recreation.

PRE-ASSESSMENT:

Let's find out how much you already know about ecology and its related concepts. Click on the letter that you think best answers the question. Please answer all items. After taking this short test, you will see your score. Take note of the items that you were not able to correctly answer and look for the right answer as you go through this module.

1. Which of the following statements best summarizes the scope of ecology?
   A. Biological and physical components of the environment
   B. Interaction of organisms with their environment
   C. Interdependence of all living things on Earth
   D. Relationship of organisms with other organisms

2. A group of individuals of different species occupying a particular area is called what?
   A. Biosphere
   B. Community
   C. Ecosystem
   D. Population

3. Which group represents a population?
   A. All the vertebrates living in the Philippines
   B. All the *Homo sapiens* living in the Philippines
   C. All the plant and animal species found in the Philippines
   D. All the flowering plants found in the Philippines

4. A certain plant requires moisture, oxygen, carbon dioxide, light, and minerals in order to survive. This shows that a living organism depends on
   A. abiotic factors.
   B. biotic factors.
   C. material cycling.
   D. symbiotic relationships.

5. Which of the statements most correctly describes **ecological niche**?
   A. It is the place where the organism lives.
   B. It is the sudden change in an ecosystem.
   C. It is the organism's functional role in the community.
   D. It refers to the interactions occurring in an ecosystem.

6. What are organisms that feed on both plants and animals called?
   A. Carnivores
   B. Detritivores
   C. Herbivores

D. Omnivores

7. What type of ecological relationship occurs between the organisms in the given picture?

A. Commensalism
B. Competition
C. Mutualism
D. Parasitism

For numbers 8-9, refer to the example of an aquatic food chain given below:

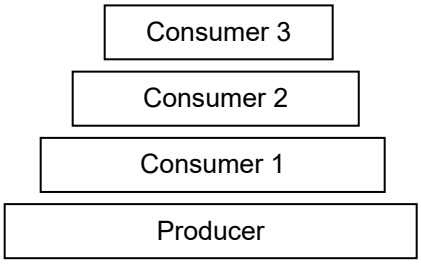
Algae and floating plants → *Aquatic crustaceans* → *Fish* → *Raccoons*

8. Which of the organisms is a secondary consumer?
A. Algae and floating plants
B. Aquatic crustaceans
C. Fish
D. Raccoons

9. What is the most likely scenario if we exhausted the fishery through over-fishing, and fish is no longer part of the food chain?
A. Algae and other floating plants will increase in number.
B. Many aquatic crustaceans will go hungry and die.
C. The population of raccoons will increase.
D. There will be overpopulation of crustaceans.

10. The most likely result of a group of squirrels relying on limited resources would be
A. a great diversity of food for squirrels.
B. an increase in the number of squirrels.
C. competition between the squirrels.
D. increased habitats for the squirrels.

11. Which statement concerning the energy in the pyramid below is **correct**?



A. The producer organisms contain the least amount of stored energy.
B. Stored energy decreases from consumer 2 to consumer 3.
C. Consumer 3 contains the greatest amount of stored energy.
D. Stored energy increases from the producer to consumer 1.

12. *Lemna* sp. is a free-floating aquatic plant. A certain experiment investigated the effect of change of pH on the population growth rate of *Lemna*. The following were the results when the plants were immersed in different pH conditions for five days:

Beaker	**Condition (pH)**	**Number of plants**	
		Beginning of experiment	**End of experiment**
A	Acidic	20	17
B	Alkaline	20	15
C	Neutral	20	27

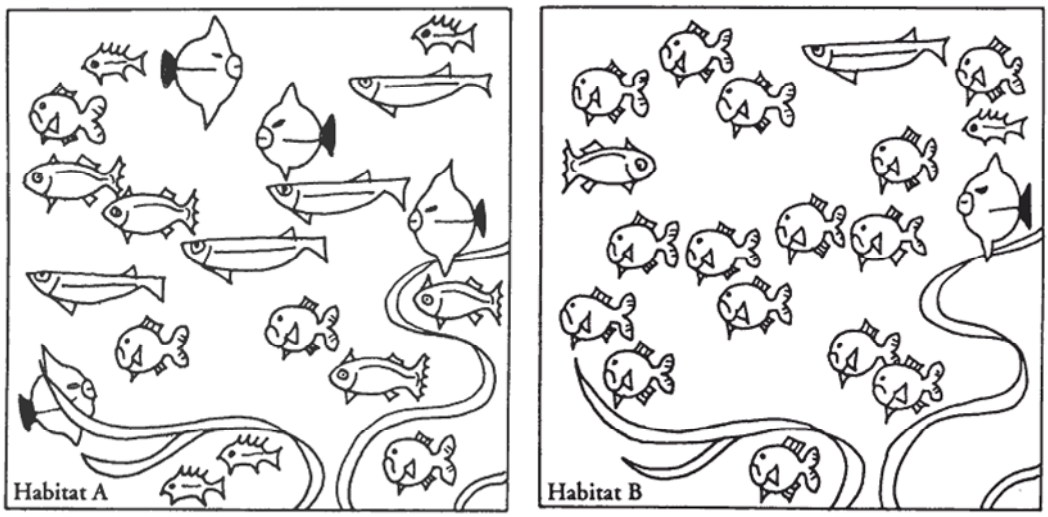
Based from the result of the experiment, in which of the following will the *Lemna* plant grow best?

A. Lake with pH 7.2
B. Pond with pH 8.8
C. River with pH 4.7
D. Sea with pH 8.4

13. Which of the following situations will cause the greatest pressure to biodiversity and will directly lead to biodiversity loss?

A. Conversion of forests to agricultural lands
B. Increasing greenhouse gases in the atmosphere
C. Introduction of non-native species to a tropical forest
D. Overconsumption of crops and fruits

14. Refer to the following illustrations:



Which of the following statements is **true** about the two habitats?

A. Habitat A has greater biodiversity than Habitat B.
B. Habitat B has higher species richness than Habitat A.
C. Habitat A has higher species density than Habitat B.
D. Habitats A and B have equal biodiversity indices.

15. A new type of fuel gives off excessive amounts of smoke. Before this type of fuel can be widely used, what would an ecologist want to know?

A. If it has an effective mechanism of producing energy
B. If the fuel will be widely accepted by consumers
C. How its smoke will affect the environment
D. How much will it cost to produce the fuel

16. In June of 1983, a reddish brown patch was observed in a body of water in Samar Islands. This was not reported and nobody attached any significance to it. A few days later, a total of 13 families were presented at the Samar Provincial Hospital with signs and symptoms of numbness, tingling sensation around the lips, tongue, and throat, vomiting, and difficulties in breathing after consuming an evening meal of boiled mussels. If you were the investigator of the said case, what would you have concluded?

A. The patch indicates an explosion of algal population, and a toxin is passed on from the algae to the mussels to humans.
B. The patch indicates proliferation of algae which compete with fishes and other shellfishes for oxygen and other resources.
C. The red brown patch is an indication of how badly polluted the water is, and how it is affecting organisms that depend on water.
D. The reddish brown patches are chemical toxins that contaminated the water, and poisoned the mussels and humans consequently.

17. You are a member of a group of nutritionists/dieticians that want to start a campaign with the slogan, *"Eat lower on the food chain – it is good for the planet."* The said campaign aims to increase people's awareness as to how their food preferences affect the ecosystem, and to suggest creative ways of planning a diet that is not ecologically damaging. You want to be able to convince as many people as possible--people of varying ages and professions. Which the following is the best form of presentation?
    A. Case study
    B. Health primer
    C. Public advisory
    D. Scientific paper

18. A non-government organization advocates protection of endemic/endangered species. As a member, your research team is tasked to assess the biodiversity of your locality, citing its various endemic/endangered species in relation to the ecosystem of the place, and then craft a proposed endemic/endangered flora and fauna protection and conservation bill. What should be the characteristics of your bill so that it will be convincing to the government officials?
    A. comprehensive, cost-efficient, and innovative
    B. cost-efficient, practical, and persuasive
    C. scientific, innovative, and comprehensive
    D. scientific, persuasive, and practical

19. As a response to the country's problems on biodiversity, the Republic Act No. 7586 is enacted. The act is providing for the establishment and management of national integrated protected areas system in the Philippines. You are a member of the *Conservation International-Philippines,* tasked to identify and delineate potential protected areas in the country. Which of the following justifications will you **first** consider in determining key biodiversity areas?
    A. The area is filled with economically-important and export-quality fruits, fishes, and trees.
    B. The area is habitat to many rare, endemic, and endangered species of plants and animals.
    C. The area is home to indigenous cultural communities that has distinct customs and traditions.
    D. The area provides opportunities for public enjoyment through recreation and tourism.

20. You and your friends decided to visit Coron Island in Palawan as a summer getaway. As an advocate of ecotourism, which of the following activities will you **not** recommend to your friends?

A. Diving and snorkelling at Kayangan Lake and hot spring
B. Purchasing animal skins and feathers as souvenirs
C. Taking pictures of karst limestone formations in the island
D. Watching Coron's birds – Palawan Hornbill and cockatoo

EXPLORE

Let's begin by gathering your thoughts about the relationship of living things with their environment.

Activity 1: I-R-F Chart

Given below is an I-R-F sheet. Fill in the first column (**I** column) of the I-R-F sheet with your ideas and answers to the following questions: ***Do living things help or harm the environment? How can there be harmony between living things and the environment?*** Click on "Save" to save your response.

I Initial	**R** Revised	**F** Final

Activity 2: Picture Analysis

Take a close look at this first picture. Describe what you see.

Now look at this second picture. How is it different from the first picture? How is it similar?

Soprano soloist Annie Luis performs with the Philippine Philharmonic Orchestra (PPO) at the National Center for Performing Arts (NCPA) on Saturday, August 13.

In the process of you analyzing and describing the pictures, you may have thought of the words *harmony, balance, interdependence, relationship, and interaction.* In this third picture, come up with as many examples of situations that illustrate the concepts of harmony, relationship and interaction.

illustration by Jeff Grader / property of Delta Education

Questions to Answer:

4. Why are harmonious relationships important in nature?
5. What could happen if the balance is upset?
6. ***How can there be harmony between living things and the environment?***

End of Explore

You just tried finding out different relationships occurring in nature. You'll get to learn more kinds of relationships as we move on to the next part. You'll also find out the answers to the questions presented above.

FIRM-UP

Your goal in this section is to learn and understand key concepts in ecology. You will be introduced to different terms that are important in the study of interrelationships. Be sure to distinguish one term from another.

As the concepts of ecology and the environment become clear to you through the succeeding activities, do not forget to think about how living things relate to them. ***Do living things help or harm the environment? How can there be harmony between living things and the environment?***

Activity 3: Introduction to Ecology

Read thoroughly the following material. Pause once in a while to answer the *check-up questions.*

Reading 1

In Greek, the term "Ecology" means "house" or "place to live". **Ecology** is the study of how organisms interact with one another and with their physical and chemical environment. It is concerned with the biology of groups of organisms and with functional processes on the land, in the oceans and freshwater, and in the air.

The table below summarizes the realm of ecology:

Biosphere ⇧ **Ecosystems** ⇧ **Communities** ⇧ **Populations** ⇧ **Organisms**	- all of the Earth's ecosystems together - community of different species interacting with one another and with their non-living environment of matter and energy 1. - populations of all the different species occupying a particular place 2. - group of individuals of the same species occupying a given area at the same time 3. - any form of life

Can you give one example each of an organism, a population, a community, and an ecosystem?

Reading 1

Species is a group of organisms that resemble one another in appearance, behavior, chemistry, and genetic structure. Each species can breed with one another to produce fertile offspring under natural conditions.

The word 'ecosystem' refers to the whole community of organisms and their environment taken as a single functioning unit. Today, the term means the basic functional unit in ecology. It contains organisms, populations, and communities, each having unique properties and influence on each other.

Ecosystem also represents an order of systems below the so-called biosphere, and that a collection of similar ecosystems makes up the conceptual notion of a biome.

There are both natural and man-made ecosystems. Natural ecosystems range from giant biomes like forests, to regional ecosystems like mountains and lakes, to the smallest tide pools and mud puddles. Man-made ecosystems, on the other hand, are products of land development, such as lakes, ponds, canals, parks and gardens. Others, such as farms, orchards and vegetable gardens, are agriculturally-based.

Whether created for recreation, food, irrigation or observation (such as an aquarium or ant farm), man-made ecosystems are always designed to suit an outside purpose. Natural ecosystems, on the other hand, are self-contained and exist only to perpetuate their own survival.

Man-made ecosystems are far less complex than natural ecosystems. They have little organic diversity and their food webs are relatively simple.

Natural ecosystems are self-regulatory, meaning that they don't require any outside assistance to function. Without the intervention of people, man-made ecosystems would decay and die.

1. Can you think of examples of natural and man-made ecosystems found in your area?
2. Do you think that the words balance, stability, harmony, and interaction can be associated with ecology and ecosystem? In what ways?

Exercise 1
Summarize your reading through a definition frame:

Definition Frame for Ecology	
Term: the subject to be defined	
Set: the general category in which the term belongs	
Gross characteristics: those characteristics that separate the term from other elements in the set	

<u>Activity 4</u>: Field Activity – *Explore an Ecosystem*

You were able to define ecology and distinguish its different units from each other. Now, are you ready to see **ecology in action**? For this next activity, you may refer to your completed definition frame and see how the concepts you've read and written come alive in nature.

Procedures:

1. Look for an unmanaged area near your place.
2. Use a string to partition a segment of your chosen area.
3. Examine closely the area.
4. List down all living things observed in the area.
5. List down the non-living factors that you think contributes to the survival of the living things.

Answer the following analysis questions:

1. What are the living things found in your area? Identify them and infer their possible roles.
2. How are the survival needs of the living things in your area met?
3. Cite one physical factor in the area that can change. If this physical factor changes, will it affect the whole area? How?

The **environment** of an organism relates to the features (including physical, chemical and biological) that are significant to its existence. They are:

- abiotic characteristics such as atmospheric gases, temperature, fire and wind, and components such as mineral nutrients and water;
- food, or nutrients required for the organism;
- living habitat wherein to rest, sleep, hide and reproduce;
- and even other organisms of the same species and of other species.

1. What are the components of the environment where you are in at the moment?
2. Is your environment peaceful and balanced? Does it support all your needs?

Abiotic components refer to the non-living factors such as pH, temperature, light intensity, humidity, topography, and microclimate. A **habitat** is the place where an organism or population lives. The habitat should be complete with all abiotic factors necessary for the survival of the organism.

Biotic components refer to all the living organisms found in the ecosystem. Each organism has a functional role in its community. This is called **ecological niche.** It could be the species' status in terms of

its activities, its rate of metabolism and growth, its effect on other organisms with which it has contact, or its ability to modify important operations in the ecosystem.

Think of one example for each of the abiotic and biotic components. Then, think of an interaction that could be occurring between the two components. ***Does this interaction have anything to do with maintaining harmony between living things and the environment?***

Exercise 2.

After reading about and exploring the different units of ecology and the ecosystem, let's check on how well you can distinguish important ecological concepts and terms.

Match the terms in Column A with their descriptions in Column B. Click on "Submit" to check your answers.

Column A	Column B
Abiotic	Functional role of an organism
Ecological Niche	Group of different species interacting with each other and with their physical environment
Ecosystem	Group of similar species living in an area
Habitat	Non-living component
Population	Place where an organism lives

End of Firm-Up

In this section, the discussion was about the realms of ecology and the basic concepts to be remembered about the ecosystem.

If you will recall, ecosystem refers to the whole community of living things and its environment, taken as a **single functioning unit.** How can living things and the environment function together efficiently? ***In what ways do living things help the environment? In what ways do they harm the environment?***

DEEPEN

Your goal in this section is to take a closer look at some aspects about the ecosystem. Pay closer attention now to how the living components of the ecosystem affect the nonliving components and the rest of the environment. ***How can there be harmony between living things and the environment?*** Let's deal with this question more deeply in the next section.

Activity 5: Situation Analysis

Read carefully the situation given below. Click on selected terms to learn more about them.

Reading 2

The Philippine Eagle Center located at Malagos, Calinan, Davao City is home to about 36 Philippine Eagles (*Pithecophaga jefferyi*), 18 of which are captive-bred. The site is located at a preserved watershed area of the Davao City Water District. The area is maintained by the Philippine Eagle Foundation, a private, non-profit organization dedicated to saving the Philippine Eagle and its rainforest habitat. The species is endangered because of modifications in their natural environment. This is the reason they are confined to this man-made park. The budget for the maintenance of the park is high, but it is able to maintain its operation with the help of many foundations, private corporations, and individuals who advocate eagle preservation.

However, it is also a fact that there are many urban poor in the city who need the same support as the eagles. It is estimated that the financial support afforded to the Eagle Foundation is enough to support a Gawad Kalinga community in the nearby area.

Answer the following questions to help you analyze the situation given above:

1. Pretend that you are an ecologist who is one of the sponsors of the Philippine Eagle Foundation. Justify why you have to prioritize the eagle project over the homeless human population.
2. What are the implications of your decision?
3. The Philippine Eagle Center is a managed ecosystem. Suggest some measures to maintain ecological balance in the park. How can harmonious relationships be maintained between the eagles and their new habitat? How can it be maintained between the

residents and their community? Can the eagles and the urban poor living in the same city co-exist harmoniously?

Activity 6: I-R-F Chart

Go back to the previous section and compare your initial ideas with the discussion. How much of your initial ideas are found in the discussion? Which ideas are different and need revision? Revise your I-R-F by accomplishing the second column (R column) of the I-R-F sheet. Click on the link to open the chart and click "Save."

I Initial	**R** Revised	**F** Final

End of Deepen

In this section, the discussion was about the basic units of ecology. It gives you a general picture of the living things and their environment.

What new realizations do you have about the topic? What new connections have you made for yourself? What questions do you still have? Fill-in the **Learned, Affirmed, Challenged cards** given below.

Learned	***Affirmed***	***Challenged***
What new realizations and learning do you have about the topic?	*What new connections have you made? Which of your old ideas have been confirmed / affirmed?*	*What questions do you still have? Which areas seem difficult for you? Which do you want to explore*

(note to the editor and stylists: There is deliberately no transfer section here. Student clicks Next and Lesson 2 shows up)

Module 5: Interactions of LivingThings with their Environment> Lesson 2: Interrelationships in Ecosystems

EXPLORE

<u>Activity 1</u>: Picture Analysis

Take a look at another set of picture and answer the same set of questions you tried answering at the start of the module.

Answer the following discussion questions:

1. Why are harmonious relationships important in nature?
2. What could happen if the balance is upset?

How can there be harmony between living things and the environment?

End of Explore

You'll get to learn more kinds of relationships occurring in the ecosystem as we move on to the next part. You'll also find out the answers to the questions presented above.

FIRM-UP :

Your goal in this section is to learn about the different relationships within the ecosystem. How do these relationships affect the environment? Do the interactions bring positive or negative impact? ***Do living things help or harm the environment?***
You will also look at energy flows and material cycles in the ecosystem, and you will describe how these relationships affect the balance of nature. You then go back to the question: ***How can there be harmony between living things and the environment?***

Activity 2: Laboratory Activity

Read carefully the experiment given below. Answer all questions and fill in all data blanks.

I. Objectives:

- Determine the type of interaction occurring between rice and corn planted in the same field.
- Identify the effect of this interaction on the growth of the plants.

Based on the objectives, write a ***problem statement*** *for this experiment:*

II. Problem Statement:

_____

Next, formulate your hypothesis:
III. Hypothesis:

_____

IV. Materials:

- Three seedling trays (2 m x 1 m each), garden soil, corn seedlings (not less than 1,200), and rice seedlings (not less than 1,200)

V. Procedure:

1. Three seedling trays with garden soil are labeled as A, B, and C.
2. The seedlings are planted at a distance of 5 cm from each other in each tray as shown in the figure below:

R	R	R	R	R
R	R	R	R	R
R	R	R	R	R
R	R	R	R	R
A				

C	C	C	C	C
C	C	C	C	C
C	C	C	C	C
C	C	C	C	C
B				

R	C	R	C	R
C	R	C	R	C
R	C	R	C	R
C	R	C	R	C
C				

Key: R = rice; C = corn

3. Each tray is watered daily with the same amount of water for a month.
4. After one month, 10 plants are picked at random from each tray and the height of each plant is measured.
5. The results are recorded and presented in a table below.

Having read the procedure, identify the experimental variables:
Independent (Manipulated) variable:

_____
Dependent (Responding) variable:

_____
Control (Fixed) variable:

_____

Why are variables important in any experimental procedure?

_____

VI. Results:

Seedling Tray/ Type of plants	Height of plants (cm)										
	1	2	3	4	5	6	7	8	9	10	Mean
A (rice)	36.3	34.7	36.1	35.0	35.1	35.0	36.1	36.3	35.7	36.0	35.63
B (corn)	40.2	41.3	39.4	40.8	44.2	38.6	39.3	41.4	42.0	40.8	40.80

C (rice)	25.7	26.0	26.3	24.8	25.0	25.4	25.3	26.1	23.8	24.2	25.26
C (corn)	45.1	44.0	46.3	46.0	46.4	45.8	45.0	45.0	45.7	44.9	45.42

Draw an appropriate graph for the data:

VII. Discussion:

Write a thorough interpretation and discussion of the results of the experiment. Use the following questions as guide:

- *Describe the growth and height of plants in each tray.*
- *What is the difference between the growth of plants in Trays A and B and that in Tray C?*
- *Infer the possible interactions occurring between the plants placed in Trays A, B, and C.*
- *How does the presence of other organisms of the same kind, or of a different kind, affect the growth of the plants?*
- *How do living things affect other living things? How do they affect the environment?*

VIII. Conclusion

From the results and discussion, formulate a conclusion.

Activity 3: Ecological Relationships

Recall that the ecosystem refers to the whole community of organisms and their physical environment. There are two basic components: biotic and abiotic. These components are interacting with each other – biotic components interact with the abiotic components, or with the other biotic components. Let's first go through the interrelationships between **both** biotic components.

In the experiment that you examined, what type of relationship do you think have occurred among rice plants, among corn plants, and between rice and corn plants?

We call this biotic relationship **competition.** It is the type of interaction between organisms living in the same habitat and competing for **limited resources.** Plants compete for water, light, nutrients, and space. Animals compete for food, space, and breeding mates.

*What other types of **competition** in ecosystems can you think of?*

The barracuda and the shark may also compete for the same food such as the small fishes, and this is another example of competition.

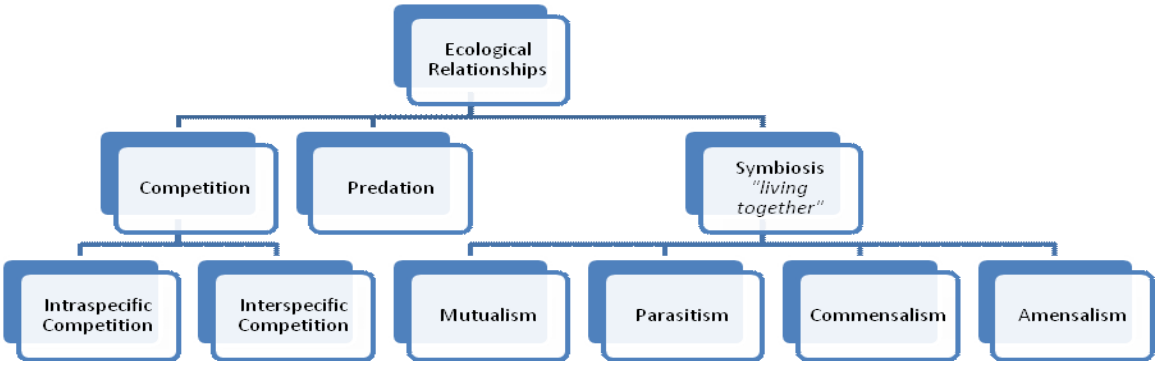
There are two types of competition: **intraspecific** and **interspecific** competition. Intraspecific competition refers to the competition among organisms of the **same species**. Interspecific competition refers to competition among organisms of **different species.**

Go back to the experiment and find out which situations represent intraspecific and interspecific competition. Then, answer the following questions:

1. Is competition important to maintaining a harmonious relationship between living things and the environment? Why or why not?
2. Can you consider humans as a great **threat and competitors** to other organisms in the ecosystem? In what way?

You have just learned one type of relationship. There are other types of biotic interactions. Most of these relationships are **feeding relationships**. Read the next material to learn more about these relationships.

To have you guided, below is a graphic summary of the different relationships occurring in nature:



Reading 3

Have you ever imagined life without your relatives, neighbors, and friends? Life could be very incomplete and boring. It is the interactions you have that give life to your everyday activities. Organisms interact with one another in many ways. The relationships may benefit one and harm the other, benefit both or harm both. When organisms live in close association with one another, they are said to have a ***symbiotic relationship***.

Examine the diagram below. Have you ever seen this underwater? Well, if you live close to the sea, you must be familiar with this. *Do you know of any relationship that exists between the organisms in this picture?*

This picture shows the presence of corals and algae. Are you familiar with algae? They are commonly called seaweeds. They belong to kingdom Protista, and are photosynthetic. In this type of relationship, the corals provide shelter for the algae that live on the body of the polyps. The algae in return give nourishment to the corals. This type of symbiotic relationship is called ***mutualism.*** Individuals in this relationship all benefit from the association established. There is a close association with each other.

The next picture shows a diagram of a leech sucking blood from the arm of a man. Have you seen one like this before? Were you afraid? In the province, it is common to see leeches attached to the skin of carabaos, cows and other animals.

Do you know the type of relationship that exists between the leech and the man in the picture? A parasite is an organism that depends on the host for food. In this case, which one is the parasite? Why do you say so? If your answer is leech you are right! Leeches are ectoparasites that depend on the host's blood for food. They produce an anticoagulant called ***hirudin*** that prevents clotting while blood is being sucked. In this case, the man is the host and is harmed. The harm done to the host may range from slight to extreme.

Parasitism

Examine the next diagram. What do you see? Have you been to a place with this type of trees/plants? If you have experienced taking a walk in a forest, you must be familiar with this. The plant in the diagram is locally known as the bird's nest. It usually grows among the trunks of trees in thick forests. You will observe that many big trees are hosts to smaller plants like ferns, mosses and the like.

This figure illustrates **commensalism,** a symbiotic relationship where one individual benefits from another without causing harm to the other.

The type of relationship that exists between the ferns (or other plants) and the tree is called commensalism. The tree provides the support to the ferns, but it does not gain or lose anything.

Can you suggest other examples of this type of relationships? Have you seen a blue crab with a sea anemone on its back? This is also another example of commensalism. Here, the crab is the host and the guest is the sea anemone. In this case, the sea anemone gets a free ride from the crab and free food as well! Sea anemones are attached to a substrate and they are not mobile. Thus they attach themselves to a

host such as the crab which moves from one place to another. Some scraps of food from the crab may also reach the sea anemone at the back. The crab is neither harmed nor benefited in this case. This relationship is shown in the picture below.

A crab with sea anemone concealed at the back

Now, let us consider other biotic relationships that exist in nature.

Predation

Take a look at the picture below. Can you predict what will happen next?

A predator is usually a big animal

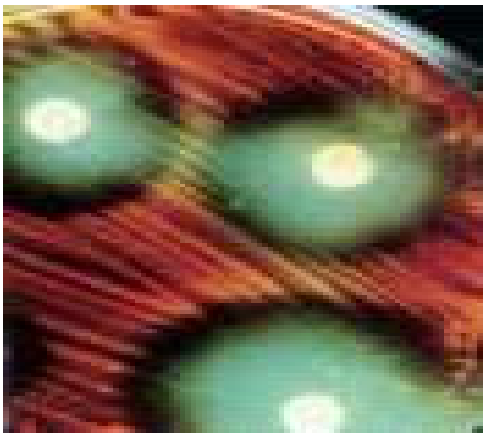
What type of relationship is this? Can you guess? The picture shows a shark going after the small fishes to eat them. The small fishes are helpless! In this type of relationship, the shark is the predator, much bigger and more powerful, while the small fishes are the prey. They are directly attacked by the predator. This relationship is called **predation**. Do you know of other examples of this type of relationship?

Amensalism

Do you know that there are organisms that may live together only for some time because one species secretes a toxic or lethal substance that could kill the other species? Are you familiar with some of them? A certain species of ***Artemisia*** (damong maria) secrete a substance that can kill the grasses that may grow around them. This is an example of amensalism.

It has been found in laboratories that bacteria cannot be grown mixed with other species of fungi or mold which in this case emit substances that are lethal to the bacteria.

Look at the diagram below. This is an example of a bacterial culture with fungi. The two may live together for some time. However, if the fungi will secrete toxic substances, eventually, no bacteria will survive and only the fungi will remain. This is called **allelopathy**. It involves the production and release of chemical substances by one species that inhibit the growth of another. Allelopathic substances range from acids to bases to simple organic compounds.



An example of Allelopathy

Answer the following exercises to see how much you have learned.

Exercise 1.

Fill out the table below with correct information about the given ecological relationships.

TYPE OF RELATIONSHIP	EFFECT ON BIOTIC COMPONENTS		*HOW DO THE RELATIONSHIPS OF LIVING THINGS AFFECT THE ECOSYSTEM AS A WHOLE?*
	Component 1	*Component 2*	
Intraspecific Competition			
Interspecific Competition			
Mutualism			
Parasitism			
Predation			
Commensalism			
Amensalism			

Exercise 2. (https://dnet01.ode.state.oh.us)

Figure out the relationships on each card. Drag it on the sheet under one of the symbiotic relationships: Predator-Prey, Parasitism, Mutualism or Commensalism. Click on "Submit" to check your answers.

Bacteria **Human Intestines**	**Moss** **Trees**	**Dogs** **Fleas**	**Squirrels** **Trees**
Whales **Barnacles**	**Butterfly** **Flower**	**Figs** **Fig Wasps**	**Remora** **Sharks**
Owl **Mice**	**Field Digger Wasp** **Fly**	**Clown Fish** **Sea anemone**	**Venus flytrap** **Insects**

Rafflesia plant **Vine**	**Ants** **Acacia Trees**	**Tapeworm** **Mammal**	**Trees** **Orchids**
Human head **Lice**	**Trees** **Mistletoe**	**Yucca moth** **Yucca plant**	**Eagle** **Rabbit**

Commensalism	Mutualism	Parasitism	Predator/Prey

Answers

Commensalism
Moss +; Trees 0
Squirrels +; Trees 0
Whales 0; Barnacles +
Sharksuckers (remora) +; Sharks 0
Trees 0; Orchids +

Mutualism
Bacteria +; Human intestines +
Butterfly +; Flower +
Ants +; Acacia Tree +
Yucca plant+; Yucca moth +
Figs+; Fig Wasps+
Clown Fish +; Sea Anemone +

Parasitism
Fleas +; Dogs-
Trees-; Mistletoe +
Human -; Lice +
Field Digger Wasp+; Fly –
Tapeworm+; mammal –
Rafflesia plant+; Vine –

Predator/Prey
Owl +; Mouse –
Venus Fly Trap +; Insect –
Eagle +; Rabbit –

Activity 4: Internet Exploration

Now that you have learned about the different biotic relationships, let's see how these feeding relationships occur within the ecosystem through the **food chain** and **food web**.

Click on the links to learn about food chain and food web.

As you navigate through the web pages, be guided by the following questions:

1. What is the source of energy for ecosystems?
2. Differentiate the following terms: herbivores, omnivores, carnivores, detritivores, and decomposers.
3. After having constructed several food chains through the activities, formulate your own definition of a food chain.
4. How is a food chain different from a food web?
5. How does a change in one population in the food chain affect the other populations?
6. What is bioaccumulation? How is it related to the food chain and the food web?

Here are the websites you will explore. Click on all additional links and perform all activities:

http://www.vtaide.com/png/foodchains.htm - information and activities about food chain and food web

http://www.ecokids.ca/pub/eco_info/topics/frogs/chain_reaction/play_chainreaction.cfm - interactive site about food chain; also provides information about bioaccumulation

Activity 5: My Food Chain

As you may have learned, we human beings take active part in the food chains and food webs of the ecosystem where we belong. Through this next activity, you'll get to see what kind of food chain you participate in, or build.

Make a **list** of the food you ate for breakfast, lunch, and dinner. Trace the probable links in the food chain that lead up to you eating each food.

Questions to Answer:

1. Which are producers?
2. Which use producers as their source of food?
3. Which eat another consumer?
4. If the number of persons who eat the same kind of food that you ate increases, what will happen to your food web?
5. What will happen to your food web if you will decide to change your feeding habit from being omnivorous to herbivorous?

You may be thinking by now that interactions only happen among living things. Bear in mind that interactions within ecosystems are **not** limited to interactions happening among biotic components only. These biotic components, the organisms, have to interact with the abiotic components of the ecosystem too. Simply put, living things have to interact with their non-living environment.

What abiotic components are necessary for the survival of organisms in the biosphere? Enumerate as many examples as you can. ***How do living things affect the environment and its abiotic components? Do living things help or harm the environment?*** These are questions that you should find answers to in the next activity.

In this next activity, you will be focusing on relationships occurring between the biotic and abiotic components of the ecosystem. Particularly, you will focus on two abiotic factors: **energy and nutrients.**

Activity 6: Video Analysis

Watch the video found in this link to see how energy and nutrients enter the ecosystems:

http://www.youtube.com/watch?v=o_RBHfjZsUQ – Energy Flow and Nutrient Cycles in the Ecosystem

Questions to Answer:

1. How is energy from the Sun transferred from one biotic component to the next?
2. How are nutrients transferred from one biotic component to the next?

3. Differentiate the movement of energy and movement of nutrients in the ecosystem.

In an ecosystem, **energy flows** through a food chain from one organism to the next. **Nutrients**, on the other hand, move in a **cycle** through the ecosystem.

Let's see through this next video what happens to the amount of energy transferred from one organism to another.

http://www.youtube.com/watch?v=kqUFvd0J1ds&feature=related – Energy Flow

Questions to Answer:

1. Do organisms release energy? In what form?
2. What are trophic levels in the food chain?
3. Why can energy flow be represented as energy pyramids?
4. What is the 10% rule? If there are 10,000 J of energy acquired by the producer, how much energy is received by the primary, secondary, and tertiary consumers?
5. Why **can't** the 100% of energy be transferred from one organism to the next?

This time, look at how nutrients move in a cycle within the ecosystem. See how it is different from the movement of energy.

http://www.youtube.com/watch?NR=1&feature=endscreen&v=Bh1nUCD7aaE – Nutrient Cycles

Questions to Answer:

1. How do different elements move in a cycle?
2. What are the ways by which carbon is acquired by the organism or released to the environment?
3. What could happen if too much CO_2 is released to the environment?

Open the links below to learn more about the different nutrient cycles.

Use the following questions as guide to your exploration:

1. What are the important nutrients that move in a cycle in the ecosystem?
2. What are situations which prove to you that these nutrients go through a cycle? Cite as many as you can.

http://www.classzone.com/books/ml_science_share/vis_sim/em05_pg20_nitrogen/em05_pg20_nitrogen.swf - Nitrogen cycle

http://earthguide.ucsd.edu/earthguide/diagrams/watercycle/ - Water cycle

http://www.epa.gov/ogwdw/kids/flash/flash_watercycle.html - Water cycle

http://www.sumanasinc.com/webcontent/animations/content/phosphorouscycle.swf - Phosphorus cycle

Exercise 3.

Diagram the difference between the movement of energy and nutrients (materials) within the ecosystem.

Discuss how this movement of energy and nutrients contribute to ecosystem balance. ***How can there be harmony between living things and the environment?***

Activity 7: I-R-F Chart

Summarize your newly-acquired learning by adding **more** information to the second column (**R column)** of the I-R-F sheet. Click on the link to open your previous chart. Don't forget to click "Save" once you're done.

I Initial	**R** Revised	**F** Final

End of Firm Up:
In this section, the discussion was about the various interrelationships occurring in the ecosystem.

Relate these interrelationships to the balance of nature. ***How do the interactions help maintain the balance of nature and the harmony between living things and their environment?***

Now that you know the important ideas about this topic, let's go deeper by moving on to the next section.

DEEPEN

Your goal in this section is to take a closer look at some current issues about interrelationships within ecosystems. We, humans, are important components of the ecosystem. Many negative occurrences in the environment, however, are attributed to human activities. Let's look at how different activities affect the stability of an ecosystem.

Activity 8: Situation analysis

Reading 4

Read carefully the recent news clip given below:

Starfish outbreak threatens corals in Negros
by Carine Asutilla, ABS-CBN News Central Visayas
Posted at 12/02/2011 10:42 PM, www.abs-cbnnews.com

MANILA, Philippines – Photographs taken by divers in Barangay Siit, Siaton, Negros Oriental showed dead corals, and the cause of death are crown-of-thorns starfish.

Jamie Ingram, owner of a diving resort, is worried over the degradation of the coral reef, which is the main tourist attraction in the area. He has spent P40,000 as payment for those who have caught the starfish.

"We got the local fishermen involved, we got them to dive and put a bounty on the crown-of-thorns, we are paying them per piece.

Unfortunately, we are not seeing the end of the battle yet," said Ingram.

The said starfish are nocturnal and attack only at night. In one night, over 14,000 starfish were collected.

"Ito 'yung corals na kinain ng starfish. Kaya kailangan talagang kunin na mga ito para na rin sa kabuhayan namin. Saan nalang kaya maninirahan ang mga isda kung sira na lahat ng corals?" said fisherman Francisco Diaz.

Because of the huge number of starfish, the Department of Environment and Natural Resources (DENR) has declared an outbreak in the area. Marine biologist Anabele Barillo is worried because hectares of coral reef are in danger.

"One of the reasons actually ay 'yung pagkawala ng predator niya na triton shells. The past years, kinokolekta ito ng mga fishers natin beyond the capability of nature to recover. Another reason could be attributed to solid and liquid waste na nandoon sa coastal area," said Barillo.

The last time an outbreak was declared in the area was in 1997.

The DENR is now checking the extent of the damage caused by the crown-of-thorns starfish.**-- ANC**

Questions to Answer:

1. What are the interactions involved in the above situation? Determine ALL interactions.
2. What happened to the **balance and harmony** in their interactions? What are its effects and consequences?

3. What was the solution done by the locals regarding the problem? How would you assess their solution? What better long-term solution can you offer?

Exercise 4.

Draw a **food web** showing solutions to the starfish outbreak.

Here's another news clip. Read carefully and answer the analysis questions.

Reading 5

Illegal logging blamed for Cagayan de Oro flash floods
by: Andreo C. Calonzo December 18, 2011 9:20pm,
http://www.gmanetwork.com

Rampant illegal logging activities in the mountains of northern Mindanao may have caused the heavy flooding during the onslaught of tropical storm Sendong last Friday evening to early Saturday, a local official said Sunday.

Mayor Vicente Emano of Cagayan De Oro City, one of the areas heavily affected by the storm, said the disaster that hit his constituents could have been prevented if illegal logging activities in the mountains surrounding the city were stopped a long time ago.

"*Palagi na ho akong nagsasalita na ihinto itong illegal logging pero hanggang ngayon hindi pa rin nahihinto. Nagpapatuloy pa rin*," he said in an interview over GMA News TV.

He added that the dwindling forest cover in the area could no longer prevent rainwater from the mountains from flowing downstream to rivers, causing flash floods in low-lying areas.

"*Hindi naman gaano kalakas ang ulan dito. Ang nangyari nito, 'yung buhos n'ung ulan doon sa bundok, nag-flash flood. Pagdating dito, bigla na lang laki ng ilog namin… Ang nangyayari rito, wala na nakakapigil na mga kahoy sa tubig galing sa bundok*," Emano said.

Emano proposed that a moratorium on all logging activities in northern Mindanao should be declared after the disaster caused by Sendong, which killed more than 300 people, many of them children.

A total of 332 people have been confirmed dead due to flash floods caused by Sendong, based on latest data from the National Disaster Risk Reduction Management Council (NDRRMC) as of Sunday afternoon. The Philippine National Red Cross, however, has already pegged Sendong's death toll to 521.

Last February, President Benigno Aquino III declared a total log ban in the country, but illegal logging activities continue in northern Mindanao.

The Department of Environment and Natural Resources (DENR) office in the region said last month that it was able to confiscate some P4 million worth of timber from illegal loggers in the area from February to November this year.

With the news articles as reference, re-think your ideas and answers to the following questions:

1. ***Do living things help or harm the environment?***
2. ***How can there be harmony between living things and the environment?***

End of Deepen:

In this section, the discussion was about the different interactions occurring in the ecosystem. Ecological relationships are crucial to maintaining the balance of nature and stability of ecosystems.

What new realizations do you have about the topic? What new connections have you made for yourself? What questions do you still have? Fill-in the **Learned, Affirmed, Challenged cards** given below.

Learned	***Affirmed***	***Challenged***
What new realizations and learning do you have about the topic?	*What new connections have you made? Which of your old ideas have been confirmed / affirmed?*	*What questions do you still have? Which areas seem difficult for you? Which do you want to explore*

Now that you have a deeper understanding of the topic and the relevant issues associated with maintaining balance of nature, you are ready to do the task in the next section.

TRANSFER

Your goal in this section is to apply your learning to real life situations. You will be given a practical task which will demonstrate your understanding of interrelationships in ecosystems.

You are to conduct an **experimental inquiry** about certain environmental problems occurring within our ecosystems.

TASK

Choose **one** from among the following ecosystems:

- Forest ecosystem
- Lake, pond, or swamp ecosystem (Lentic ecosystem)
- Farm ecosystem
- Urban ecosystem (cities, towns, and urban strips created by humans)

Below are the steps that you will follow:

1. Observe closely your chosen ecosystem. *Follow the procedures of the field activity (Explore an Ecosystem) done during the early part of the module.* Particularly, observe for irregularities that may lead to a problem in the ecosystem.
2. Explain what you have observed. What theories or rules could explain what you have observed?
3. Based on your explanation, make a prediction or hypothesis.
4. Set up a ***simple experiment or activity*** to test your prediction or hypothesis.
5. Explain the results of your experiment in light of your explanation. If necessary, revise your explanation or prediction, or conduct another experiment.

Write all your answers in the provided *Experimental Inquiry Worksheet.* Click “Save” to keep a copy of your work.

Observation/Problem:
Explanation / Theories Involved:
Hypothesis:
Experiment to test hypothesis:

Results:
Discussion:
Conclusion:

Questions to stimulate experimental inquiry:

a. How do the living things present affect the ecosystem?
b. How does the environment affect the living things in the area?

End of Transfer:

In this section, your task was to complete an experimental inquiry.

How did you find the task? How did the task help you see the real world use of the topic?

You have completed this lesson. You can now move on to the last lesson for this module.

EXPLORE

:

Activity 1: Picture Analysis

Compare and contrast the two pictures:

What interactions are affected by forest denudation?

What are the consequences of upsetting the balance of nature? Go to this link and read a blog about the effects of deforestation:

Reading 6 http://lyrfutures08.wordpress.com/category/effects/

End of Explore

You just finished trying to identify certain negative effects of upsetting the balance of nature, more specifically deforestation. One *of the effects of deforestation is* ***loss of biological diversity****. Learn more about biodiversity in the next part of this lesson. Meanwhile, relax and see this video about how rich the biodiversity is in the Philippines:*

http://www.youtube.com/watch?v=FTJYMMhXHxs – Haribon's TVC about Biodiversity Conservation

FIRM-UP

Your goal in this section is to learn what biodiversity is, its importance, and the measures and initiatives taken to conserve it.
Harmony in nature is upset with the loss of biodiversity. Therefore, as you progress through this section, always think about situations that prove to you how that statement is true. Also, think about ways to restore that harmony. ***How can we maintain the harmony between living things and the environment?*** You will also critically examine existing laws on biodiversity conservation in this section. That should give you enough ideas on how we can better protect and manage our ecosystems.

Activity 2: Internet Exploration

Prior to internet exploration, accomplish the *anticipation-reaction guide* provided below. Place your answers in the 2nd column BEFORE clicking on the links. Then, AFTER browsing through the provided links, write your answers on the 3rd column.

Questions	Answers Before Exploration	Answers After Exploration
What is Biodiversity?		
Why is biodiversity important?		
What are the present threats to biodiversity?		
How does balance of nature preserve biodiversity?		

Click on the following link to learn more about biodiversity. Make sure to also open all additional links:

http://library.thinkquest.org/08aug/00473/balancenature.html - Biodiversity Basics

Closely related to the concept of biodiversity is species richness or species diversity and species density.
A certain habitat's **species richness** refers to the number of *kinds* of species in the area. **Species density** refers to the number of species in the area.

Which habitat has greater biodiversity? The habitat with higher species richness, or the one with higher species density? Explain.

Now, focus on the biodiversity of the Philippines. Click on the link below to find out more:

http://www.eoearth.org/article/Biological_diversity_in_the_Philippines - Biological Diversity in the Philippines

Activity 3.3: I-R-F Chart

It's now time for you to complete the third column (**F** column) of the I-R-F sheet. Finalize your learning and ideas and prepare to submit this sheet. Again click on the link to open the chart. Then, click "Save" to keep a final copy of your chart.

I Initial	**R** Revised	**F** Final

End of Firm Up:
In this section, the discussion was all about biodiversity. This lesson will be able to integrate your knowledge about ecosystem and its interactions, and the need for biodiversity conservation.

DEEPEN :

How can there be harmony between living things and the environment? How does biodiversity conservation contribute to maintaining a balanced ecosystem? Your goal in this section is to take a critical look at some of the initiatives of the government to conserve biodiversity. You will also gain firsthand experience on assessing the impact of human activities on the biodiversity in the ecosystem.

Activity 4: Writing a reaction paper

Gather at least three articles that discuss human activities and situations that pose a threat to the biodiversity of the Philippines. The news articles may be from online newspapers or broadsheets.

Write a one-page reaction paper on the articles you have read. Submit the paper and attach the articles read.

Activity 5: Environmental Impact Assessment (EIA) and Critical Examination of existing laws on biodiversity conservation

Ecological Impact Assessment (EIA) refers to a wide range of predictive tasks within environmental planning. It focuses on the prediction and evaluation of the effects of human activities on the structure and functions of normal ecosystem components, including biodiversity.

Reading 7

Open the pdf file containing a sample EIA conducted on a landfill in Naga City by clicking this link: http://www.adb.org/Documents/Environment/PHI/43906/43906-01-phi-eia.pdf

Read thoroughly the *Description of the EIA Process* found on pages 2-4 of the file. ***What are the steps in conducting an EIA?*** (Refer to EIA Methodology.)

Now, do not be overwhelmed by the terms you may have encountered while reading. The methods for conducting EIA can be simply summarized in 5 phases:

Phases of Environmental Impact Assessment Lee and Añes (2008) *Lecture Notes in Environmental Science: The Economy of Nature and Ecology of Man*	
Phase 1: *Defining Study Goals*	What information is needed and how precise must it be • for minimizing potential environmental impact? • for concerned groups to know how they will be affected?
Phase 2: *Identifying Potential Impacts*	• What area will be affected? • What organisms or ecological functions will be affected? • What major ecological components (air, water, land, structures, and living organisms) will be affected? • What ecological interactions will be affected? • What are indirect effects that may be triggered at a future time or a different place?
Phase 3: *Describing Baseline Conditions and Predicting Significant Impacts*	Baseline Conditions: • What are the significant features of the ecosystem at present? • What is the condition of the physical resources at present? • What are the interactions occurring between ecological components at present? Prediction: • What will be the major effects of the proposed actions and undertaking, based on experiments, modelling, published case studies, scientific data, or established ecological principles, theories, and laws?

Phase 4: *Considering Alternatives to the Proposed Action*	• What are more environment-friendly alternatives? • What steps could be taken to mitigate or lessen adverse environmental effects of the proposed project?
Phase 5: *Communication of Findings and Recommendation*	• Communicate the findings of the proposed project.

Quickly go over the sample EIA again and look for the different phases described previously.

Reading 8

Click on the link below to look at another sample EIA.
http://pdf.usaid.gov/pdf_docs/PNADG551.pdf
You may go over the whole text but you are only required to read thoroughly and understand the **non-technical summary** found on **pp. 11-19.**

Exercise 1.

Fill out the table below with actual information found in the EIA you have just read (http://pdf.usaid.gov/pdf_docs/PNADG551.pdf).

Title:	
Phase 1: *Defining Study Goals*	
Phase 2: *Identifying Potential Impacts*	
Phase 3: *Describing Baseline Conditions and Predicting Significant Impacts*	
Phase 4: *Considering Alternatives to the Proposed Action*	

Phase 5: *Communication of Findings and Recommendation*	

Reading 9

Among the important considerations in developing an EIA are the currently existing environmental laws. Click on the links below and go over the full text (PDF Version) of the following republic acts concerning biodiversity conservation in the Philippines:

http://www.psdn.org.ph/chmbio/pd1586.html - Presidential Decree no. 1586 or the Philippine Environmental Impact Statement System (PEISS)

http://www.iapad.org/publications/legislation/phl_ra_7586_nipas.pdf - NIPAS Act

http://pdf.usaid.gov/pdf_docs/PNADL681.pdf - Philippine Forest and Wildlife Law Enforcement

http://www.searca.org/bic/info_kits/policies/eo247.html - Bioprospecting Act

Exercise 2.

Use the following graphic organizer for evaluating the different laws. You may do further research to help you accomplish the 3rd and 4th columns.

LAWS	**Basic Provisions**	**Implementation**	
		At present	How it can be improved in the future

Activity 6: Ecological Impact Assessment

It's now time for you to conduct your own Ecological Impact Assessment for any **one** of the following human activities:

- Reclaimed coastal land
- Conversion of natural areas into residential or industrial lots
- Construction of high-rise buildings

Specifically, you will assess the impact of these activities on the **biodiversity in your locality.**

You will submit a written report of your EIA. The report should contain the following: (*You are only required to do Phases 1, 3, and, 4.)*

1. Description of baseline conditions
2. Discussion of potential impacts (through case studies, modelling, and theoretical considerations)
3. Suggested management and controlling strategies

Reminders:

- This activity will serve as your preparation for the major transfer (performance) task.
- Any questions or inquiries that you have should be addressed to the teacher.
- As you complete your EIA, always ask for feedback from the checker.
- Do self-evaluation before submitting your final EIA.

End of DEEPEN:

In this section, the discussion was about the different biodiversity conservation laws. The activity allowed you to reflect on current practices about biodiversity conservation and suggest ways to improve them.

What new realizations do you have about the topic? What new *connections have you made for yourself? What questions do you still have? Fill-up the Learned, Affirmed, and Challenged cards given below:*

Learned	***Affirmed***	***Challenged***
What new realizations and learning do you have about the topic?	*What new connections have you made? Which of your old ideas have been confirmed / affirmed?*	*What questions do you still have? Which areas seem difficult for you? Which do you want to explore*

Now that you have a deeper understanding of the topic and the relevant issues associated with biodiversity conservation, you are ready to do the task in the next section.

TRANSFER:

Your goal in this section is to apply your learning in real life situations. You will be given a practical task which will demonstrate your understanding.

TASK

The **Environmental Impact Statement (EIS)** System refers to the comprehensive process of assessing the significance of the effects of a project or undertaking on the quality of the physical, biological, and socio-economic environment. It also entails designing appropriate measures as well as environmental quality-enhancing alternatives.

A certain business corporation is located near an identified protected area in your locality. Pursuant to the EIS System, the said corporation is currently applying for an *Environmental Compliance Certificate (ECC)* so that they can continue with their projects and undertaking. Your team of environmental assessors is tasked to help the company achieve an ECC. The executives are interested to know the potential impacts of their business and projects on the nearby protected area; and more importantly, they want to hear *possible* ways and measures by which they can minimize, if not totally eliminate, such negative impacts.

You will prepare a report of your **assessment and proposal,** and present it to the business executives. The report is expected to be comprehensive, based on accurate scientific data, and proposes environmental-friendly measures that are practical and realistic.

RUBRIC: EIS Report

STANDARDS → / SCALE ↓	Content (Background Information)	Organization	Use of Scientific Data to Justify Proposals and Decisions	Conservation and Management Plans
Exemplary 4	Provides exhaustive and reliable background information about the area; Information provided is clearly relevant to the objective of the study	Logical and interesting sequencing of ideas through well-developed and engaging paragraphs	Convincingly discusses, based on rich and elaborate scientific data, the potential environmental impact of the corporation's activities and undertakings; Expresses information clearly and concisely making the proposal reasonable and highly convincing	Proposed management and conservation plans reflect in-depth understanding of the relationships and processes happening within the chosen ecosystem. Management plans promote original, practical, and innovative techniques
Accomplished 3	Provides comprehensive and accurate background information about the area; Information provided is relevant to the objective of the study	Logical sequencing of ideas through well-developed paragraphs	Adequately discusses, based on accurate scientific data, the potential environmental impact of the corporation's activities and undertakings; Expresses information	Proposed management and conservation plans reflect clear understanding of the relationships and processes happening within the

			clearly and concisely making the proposal reasonable and convincing	chosen ecosystem. Management plans promote realistic, practical, and innovative techniques
Developing 2	Provides background information about the area; Some information are not relevant to the objective of the study	Some ideas are not logically sequenced, making them appear "hanging" and irrelevant	Discusses the potential environmental impact of the corporation's activities and undertakings but with minimal use and reference to scientific data; Some important information not expressed clearly making the proposal unconvincing in certain parts	Proposed management and conservation plans reflect some flawed and incomplete understanding of the relationships and processes happening within the chosen ecosystem. Management plans are innovative but not very realistic and practical
Beginning 1	Provides incomplete background information about the area; Many of the information are not relevant to the objective of the study	Lack of logical organization; Statements and paragraphs lack coherence	Superficial discussion of the potential environmental impact of the corporation's activities and undertakings, and with very few or almost no reference to	Proposed management and conservation plans reflect lack of understanding of the relationships and processes happening

			scientific data; Many important information not expressed clearly making the proposal unconvincing	within the chosen ecosystem; Management plans are unrealistic and impractical

End of TRANSFER:

Your task was to apply concepts learned about Biodiversity Conservation Initiatives in a practical situation. How did you find the performance task? How did the task help you see the impact of human activities to the ecosystem?

Having gone through the whole module, what are now your thoughts regarding these questions: ***How do living things affect the environment? Do living things help or harm the environment? How can there be harmony between living things and the environment?***

Write a **reflective journal** relating your experiences in completing the transfer task.

You have completed this module. Before you go to the next module, you have to answer the following post-assessment.

POST-ASSESSMENT:

It's now time to evaluate your learning. Click on the letter of the answer that you think best answers the question. Your score will only appear after you answer all items. If you do well, you may move on to the next module. If your score is not at the expected level, you have to go back and take the module again.

1. Which of the following problems is investigated in ecology?
   A. Air Pollution and Global Warming
   B. Earthquakes and volcanic eruptions
   C. Frequent occurrence of road accidents
   D. Rising incident of genetic diseases

2. This refers to a group of different species interacting with one another and with their non-living environment.
   A. Biosphere
   B. Community
   C. Ecosystem
   D. Population

3. Which group represents a population?
   A. Corals of the *Puerto Galera* marine reserve
   B. Benguet pines from the Mt. Pulag National Park
   C. Dipterocarp trees of Mt. Makiling forest reserve
   D. Mammals found in the Mt. Apo Natural Park

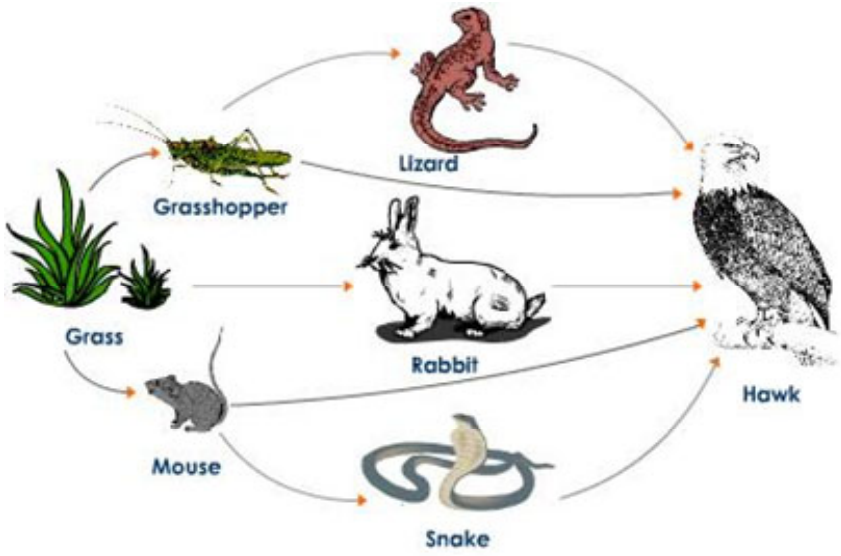
4. A student measured some **abiotic** factors present in an aquarium in the science laboratory. Which data did the student most likely record?
   A. the number of each type of green plant and each type of snail
   B. the size and number of each species of fish
   C. the temperature and oxygen content of the water
   D. the weight and color of each type of scavenger

5. Which of the following is an example of **ecological niche**?
   A. Decomposer
   B. Food chain
   C. Forest
   D. Parasitism

6. What are organisms that feed on dead organisms called?
   A. Carnivores
   B. Detritivores
   C. Herbivores
   D. Omnivores

7. Which of the following describes the relationship between grasses and other vegetable plants in the garden?
   A. Commensalism
   B. Competition
   C. Mutualism
   D. Parasitism

For numbers 8-9, refer to the given food web in a grassland ecosystem:

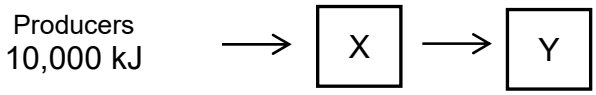


8. Which of the organisms is a primary consumer?
   A. Hawk
   B. Grasshopper
   C. Lizard
   D. Snake

9. A significant decrease in the snake population occurs. After a certain period of time, which of the following will most likely be observed in the grassland?
   A. Decrease in the mouse population
   B. Decrease in the rabbit population
   C. Increase in the grass population
   D. Increase in the hawk population

10. Hawks and owls living in the same area compete for the same type of mouse for food. Which situation would lead to the greatest problem in the food supply?
   A. an increase in the owl population
   B. an increase in the mouse population
   C. a decrease in the hawk population
   D. a decrease in the owl population

11. The figure shows the energy flow in a food chain.



   If 80% of the energy is lost from one trophic level to the next, how much energy is received by organisms in Y?
   A. 400 kJ
   B. 1,600 kJ
   C. 2,000 kJ
   D. 8,000 kJ

12. Nitrates and phosphates from inorganic fertilizers used in agriculture may run-off to nearby bodies of water. An increase in nitrate and phosphate triggers excessive growth of algae in marine environments. What is its effect on fishes and other marine animals?
   A. Bad, because the algae pollutes the water and makes it turbid
   B. Bad, because the algae decreases oxygen available for the fish
   C. Good, because the algae will absorb excess CO_2 when they photosynthesize
   D. Good, because more algae means more food for the fishes

13. Which human activity would most likely result in the addition of an organism to the endangered species list?
   A. Cover cropping
   B. Habitat destruction
   C. Use of erosion controls
   D. Use of pollution controls

14. Refer to the following data gathered in a 50 m x 50 m quadrat sampling of forest / agricultural lands:

Quadrat 1		**Quadrat 2**	
Plant species	Frequency	Plant Species	Frequency
Musa sapientum (banana)	2	*Musa sapientum* (banana)	4
Mangifera indica (mango)	6	*Mangifera indica* (mango)	8
Moringa oleifera (malunggay)	1	*Moringa oleifera* (malunggay)	0
Psidium guajava (guava)	2	*Psidium guajava* (guava)	0
Leucaena glauca (ipil-ipil)	1	*Leucaena glauca* (ipil-ipil)	0
Anacardium occidentale (cashew)	1	*Anacardium occidentale* (cashew)	1

Which of the following statements is **true** about the two habitats?

A. Quadrat 1 has greater biodiversity than Quadrat 2.
B. Quadrat 2 has higher species richness than Quadrat 1.
C. Quadrat 1 has higher species density than Quadrat 2.
D. Quadrats 1 and 2 have equal biodiversity indices.

15. A new species of plant will be introduced to a plantation. Before planting, which of the following will an ecologist be most interested in knowing?

A. If the plant can easily grow on the native soil of the plantation
B. If the plant has any special growth requirements
C. If the plant is edible, or has any special or unique uses
D. If the plant may compete with other plants for resources

16. You and your friend heard from the news that a certain river very far from your locality is contaminated with *polychlorinated biphenyls* (PCBs), a class of compounds known for their persistence and toxicity to organisms. Your friend did not pay attention and thinks that this is not going to pose a threat to your area. You disagreed, and gave a simple explanation as to how this situation can be threatening. Which of the following is the most probable explanation?

A. PCBs may be taken in by primary consumers then passed to different organisms through the food chain.
B. PCBs may enter the water cycle, mix with evaporated water, and fall on land as acid rain.
C. PCBs may lower the quality of water for human consumption, thereby causing water-borne diseases.
D. PCBs may pollute the air which all of us are inhaling, potentially causing respiratory problems.

17. You heard a certain campaign with the slogan, *"Eat lower on the food chain – it is good for the planet."* How will you best interpret this in a way that will be understood by grade school pupils?
    A. "It is healthier for both our body and our environment if we eat less meat and more vegetables and fruits."
    B. "It is less environmentally-damaging if we take in foods that are found at the bottom of the food chain."
    C. "Let us help solve the environmental problems by eating less frequently in fastfood chains."
    D. "Our choice of what to eat and drink affects the natural processes happening in our environment."

18. A non-government organization advocates protection of endemic/endangered species. Your research team is tasked to assess the biodiversity of your locality citing its various endemic/endangered species in relation to the ecosystem of the place. How will you present your biodiversity assessment to the officials from the Department of Environment and Natural Resources?
    A. Audio-visual presentation
    B. Brochure
    C. Case study
    D. Poster

19. R.A. 7586, otherwise known as the National Integrated Protected Areas System Act, provides for the establishment and management of "protected areas" in the Philippines. You are a member of the *Community Environment and Natural Resources Office* (CENRO) of your locality. You're doing a study of a certain area in your locality that you think should be established as a protected area. Which of the following is the **foremost** reason for believing so?
    A. Because the area is a tourist spot, it brings income and creates opportunities for employment.
    B. People from your community depend on the resources of the area for food and livelihood.
    C. The area is habitat to many rare, endemic, and endangered species of plants and animals.
    D. There is a large population of indigenous people living together peacefully in the area.

20. In one of your class trips to a forest, you saw a rare plant that seemed to be growing only in that particular locality. For your investigatory research, you decided to investigate the biological and ecological characteristics of the said plant. However, that requires you to get many samples of the plant. Based on the laws of bioprospecting, do you think you should pursue your research?

A. No, because the plant may already be listed as endangered species
B. No, because taking plant samples is prohibited by the Philippine laws
C. Yes, because there are important benefits to be derived from the research
D. Yes, because everyone has the right to obtain resources from nature

GLOSSARY OF TERMS USED IN THIS MODULE:

abiotic – non-living; referring to physical and chemical properties of an environment
alleopathy – involves the production and release of chemical substances by one species that inhibit the growth of another
amensalism – a relationship in which a product of one organism has a negative effect on another organism
bioaccumulation – accumulation of substances, such as pesticides, or other organic chemicals in an organism
biodiversity – variation among organisms found in the ecosystem
biome – any of the world's major ecosystems, often classified according to the predominant vegetation and characterized by adaptations of organisms to that particular environment
biosphere – the entire portion of the Earth inhabited by life; the sum of all the planet's ecosystems
biotic – pertaining to the living organisms in the environment
captive breeding – process of breeding animals in human-controlled environments
carnivore – an animal that mainly eats other animals
commensalism – a symbiotic relationship in which one organism benefits but the other is neither helped nor harmed
community – an assemblage of populations of different species living together in an area
competition – a type of interaction between organisms living in the same habitat and competing for limited resources
control variable – any factor that remains unchanged in an experiment
decomposer – any organism that absorbs nutrients from non-living organic material and wastes of living organisms and converts them to inorganic forms; a detritivore
dependent variable – the factor that is measured in the experiment; what is affected during the experiment
detritivore – a consumer that derives its energy and nutrients from non-living organic material and wastes of living organisms; a decomposer
ecological niche – the sum of a species' use of the biotic and abiotic resources in its environment
ecology – the study of how organisms interact with each other and their environment
ecosystem – all the organisms in a given area as well as the abiotic factors with which they interact
environment – circumstances and conditions that surround an organism or group of organisms; includes all other forms of life on Earth and its nonliving environment
Environmental Impact Assessment – wide range of predictive tasks within environmental planning; focuses on the prediction and evaluation of the

effects of human activities on the structure and functions of normal ecosystem components

Environmental Impact Statement System – comprehensive process of assessing the significance of the effects of a project or undertaking on the quality of the physical, biological, and socio-economic environment, and designing appropriate measures as well as environmental quality-enhancing alternatives

food chain – the pathway along which food energy is transferred from one organism to another, beginning with producers

food web – interconnected feeding relationships in an ecosystem; interlinked food chains

forest denudation – the stripping of a forest by depriving it of something it needs in order to exist

habitat – ecological or environmental area that is inhabited by a particular species of animal, plant or other type of organism

herbivore – an animal that mainly eats plants or algae

independent variable – a variable that is manipulated to determine the value of dependent variables

mutualism – a symbiotic relationship in which both participants benefit

omnivore – an animal that regularly eats animals as well as plants or algae

organism – any form of life

parasitism – a symbiotic relationship in which one organism, the parasite, benefits at the expense of another, the host, by living either within or on the host

population – group of individuals of the same species that can interbreed and produce fertile offspring

predation – an interaction in which one species, the predator, eats the other, the prey

producer – an organism that produces organic compounds through photosynthesis or other chemosynthetic reactions

reclamation – process of creating new land from sea or riverbeds

species – group of organisms that resemble one another in appearance, behavior, chemistry, and genetic make-up; can produce offspring of their own kind

species density – number of species in a given area

species richness – number of kinds of species in a given area

symbiosis – an ecological relationship between organisms of two different species that live together in direct and intimate contact

trophic level – each feeding level in a food chain

WEBSITE RESOURCES AND LINKS IN THIS MODULE:

http://www.worldscibooks.com/etextbook/6137/6137_chap01.pdf - Basic Ecological Principles

http://www.elmhurst.edu/~chm/vchembook/184ph.html - pH

http://www.eoearth.org/article/Temperature - temperature

http://www.cropsreview.com/light-intensity.html - light intensity

http://science.howstuffworks.com/dictionary/meteorologicalterms/question651.htm - humidity

http://www.ehow.com/facts_5399701_definition-topography.html - topography

http://www.wisegeek.com/what-is-a-microclimate.htm - microclimate

www.philippineeagle.org – about the Philippine eagle

http://water.epa.gov/type/watersheds/whatis.cfm - What is a watershed?

http://www.gk1world.com/NewOurVision - Gawad Kalinga website

https://dnet01.ode.state.oh.us – exercises on biotic relationships

http://www.vtaide.com/png/foodchains.htm - information and activities about food chain and food web

http://www.ecokids.ca/pub/eco_info/topics/frogs/chain_reaction/play_chainreaction.cfm - interactive site about food chain; also provides information about bioaccumulation

http://www.youtube.com/watch?v=o_RBHfjZsUQ – video titled Energy Flow and Nutrient Cycles in the Ecosystem

http://www.youtube.com/watch?v=kqUFvd0J1ds&feature=related – video titled Energy Flow

http://www.youtube.com/watch?NR=1&feature=endscreen&v=Bh1nUCD7aaE – video on Nutrient Cycles

http://www.classzone.com/books/ml_science_share/vis_sim/em05_pg20_nitrogen/em05_pg20_nitrogen.swf - Nitrogen cycle

http://earthguide.ucsd.edu/earthguide/diagrams/watercycle/ - Water cycle

http://www.epa.gov/ogwdw/kids/flash/flash_watercycle.html - Water cycle interactive

http://www.sumanasinc.com/webcontent/animations/content/phosphorouscycle.swf - Phosphorus cycle

http://www.gmanetwork.com/news/story/242069/news/regions/illegal-logging-blamed-for-cagayan-de-oro-flash-floods - news clip on illegal logging and flash floods

http://www.abs-cbnnews.com/nation/regions/12/02/11/starfish-outbreak-threatens-corals-negros - news clip about starfish outbreak

http://lyrfutures08.wordpress.com/category/effects/ - personal blog about the effects of deforestation

http://www.youtube.com/watch?v=FTJYMMhXHxs – Haribon's TVC about Biodiversity Conservation

http://library.thinkquest.org/08aug/00473/balancenature.html - Biodiversity Basics

http://www.eoearth.org/article/Biological_diversity_in_the_Philippines - Biological Diversity in the Philippines

http://www.adb.org/Documents/Environment/PHI/43906/43906-01-phi-eia.pdf - sample Environmental Impact Assessment Report – *Secured Landfill Project* of the Cebu Provincial Government

http://pdf.usaid.gov/pdf_docs/PNADG551.pdf - sample Environmental Impact Assessment Report – Solid Waste Management in Lebanon

http://www.psdn.org.ph/chmbio/pd1586.html - Presidential Decree no. 1586 or the Philippine Environmental Impact Statement System (PEISS)

http://www.iapad.org/publications/legislation/phl_ra_7586_nipas.pdf - NIPAS Act full text

http://pdf.usaid.gov/pdf_docs/PNADL681.pdf - Philippine Forest and Wildlife Law Enforcement

http://www.searca.org/bic/info_kits/policies/eo247.html - Bioprospecting Act

Image Credits:

http://chitoirigo.multiply.com/photos/album/128 - map of Calamian group of islands

http://www.shutterstock.com/pic-11597569/stock-photo-dragon-boat-racing.html - dragon boat racing

http://www.dfa.gov.ph/main/index.php/news-from-rp-embassies/3577-philippine-philharmonic-orchestra-completes-goodwill-concert-in-beijing - Philippine Philharmonic orchestra

http://www.hikekorea.net/?p=342 – lush forest

http://www.mnh.si.edu/exhibits/ocean_hall/marine_debris.html - trash-filled albatross nesting area

http://lyrfutures08.wordpress.com/category/effects/ - denuded forest

http://www.tutorvista.com/content/biology/biology-iv/ecosystem/food-web.php - grassland ecosystem food web