

LEARNING GUIDE 1: UNIFYING THEMES IN THE STUDY OF LIFE

Subject Code: Biology 1: Fundamentals of Biology 1

Learning Guide Code: 1.0 (Unifying Themes in the Study of Life)

Lesson Code: 1.1 (Unifying Themes in the Study of Life)

Time Frame: 30 minutes



MATERIALS NEEDED

To complete this learning guide, you need the following:

1. Camera/Smartphone
2. Pen and paper
3. Biology: A global Approach by Campbell et al. (2015).
4. Laptop Computer/Internet-ready gadgets
5. Stable internet connection



TARGET

After completing this learning guide, you are expected to:

- Describe the scope and disciplines of Biology



HOOK

If your learning space is inside your room, leave it for a moment. Go out and take a 360-degree look at the living things that surround you. Look at the green grass, the blooming flowers, the towering trees, the flying birds, and many more. If your learning space gives you a chance to look at the greens without even going outside, then you're one lucky human! Take several seconds to a few minutes on observing living creatures and then take one picture that most interests you. We will go back to that in a while.

Now, **what question might you ask** after the short environmental scanning activity you did? Write it on the space below.

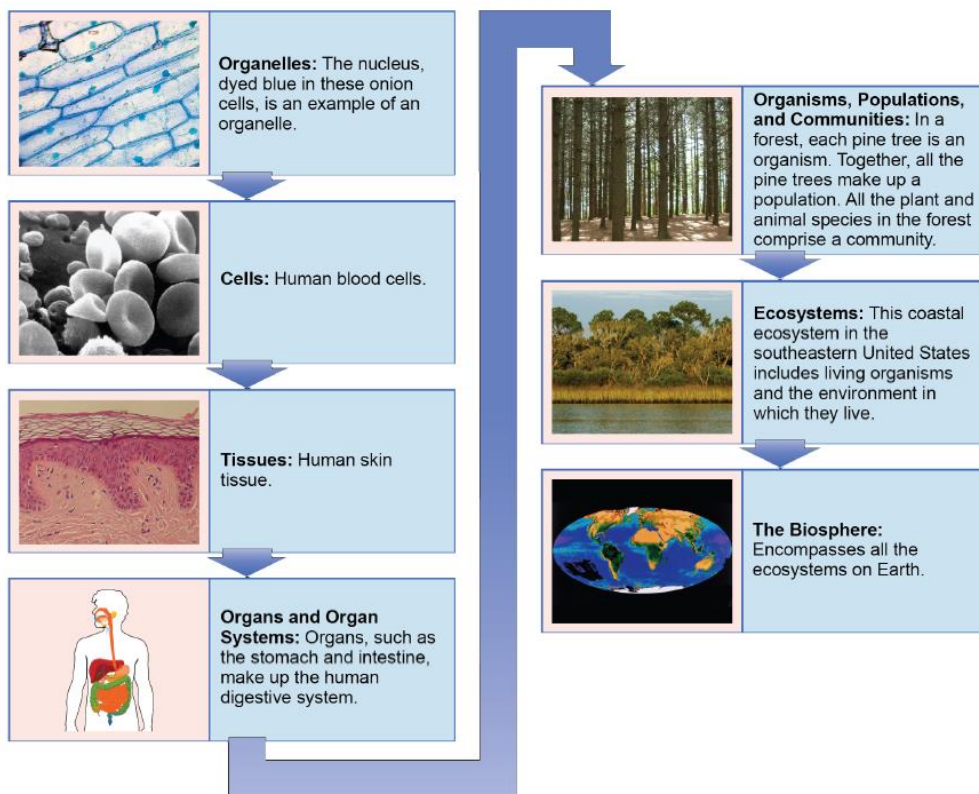


The question you just asked could have been asked once (or maybe more) by a biologist. Therefore, when you think of questions like that, you are becoming a biologist yourself! In this module, we will start exploring how the living world is wondrously varied by looking at the themes that unify them.



Biology as the study of life covers a very wide range of scope. Just imagine it concerns every single life form on Earth no matter how minuscule they are or how extremely extraordinary they may be. There has to be some sort of organization such that studying them might be an easier task. Biologists tried to identify five unifying themes or ways of thinking about life. These themes remain true today and will still be in the future. As we discuss them, try to reflect on how every living thing is connected to another and how unity exists amidst diversity.

1. ORGANIZATION



All levels of life have systems of organized and related parts, take for example the levels of biological organization (see **FIGURE 1**). They can be studied from a global scale like that of the entire planet to a molecular scale like that of cells and molecules. Each level in the hierarchy has specific characteristics, and as one moves up the ladder of biological organization, there are arrangements and interactions of parts that result in novel properties. These properties are referred to as **emergent properties**, and they are not unique in biological systems.

FIGURE 1. The biological levels of organization of living things. Open Stax, Rice University (2020). Retrieved from: <https://openstax.org/details/books/biology-2e>. Textbook content produced by OpenStax is licensed under a Creative Commons Attribution 4.0 International License (CC BY 4.0).

organism can. If one looks at the reason for any biological event, it can be traced back to the workings of a living cell. There are two types of cell: prokaryotic and eukaryotic. Both of them has plasma membrane that is responsible for allowing materials to go in and out of the cells. Prokaryotic cells are smaller compared to eukaryotic cells. They also lack membrane-bound organelles and they are found among the members of the kingdom Bacteria and Archaea. In contrast, eukaryotic cells have membrane-bound organelles and are found among members of kingdom Protista, Fungi, Plantae, and Animalia.

When a scientist chooses to focus on the small parts that make up a system rather than the system itself, he/she is employing the **reductionist approach**. For example, developmental biologists study DNA and genes because they direct the development of an organism. They are employing the reductionist approach as along the process of understanding development (the whole), they are compelled to understand and delve into how the genetic material (part of the whole) works. Although this approach has been useful to scientists, some claim that they offer an incomplete view of life. To solve this dilemma, scientists encourage reductionism with **systems biology**. In this approach, the system (the whole) is analyzed and explored together with the parts that make up the system. Going back to the same

example given, upon understanding how the genetic material functions and interacts with other molecules that play roles in the development, developmental biologists try to relate these concepts with other observations so that the entire process of development is more clearly understood. In this way, systems biology offers a more holistic approach.

We also find a connection between structure and function at each level of the biological hierarchy. For example, the major branches of the respiratory system are lined with cilia. The beating of cilia helps in cleaning the respiratory system by moving mucus with trapped dust and other contaminants upward to the pharynx where it is usually swallowed. Analyzing a structure gives us an idea of how it functions. Similarly, knowing the function of something helps us visualize the structure that is responsible for that given function.

2. INFORMATION

The cell is the basic unit of life. Inside it, structures called **chromosomes** contain the genetic material, **deoxyribonucleic acid (DNA)**. Each chromosome has one long chain of DNA. Segments of DNA are called **genes** which are the units of inheritance. The DNA is composed of two strands. These strands run antiparallel to each other and are made up of nucleotide bases bonded together (see **FIGURE 2**). These nucleotides are Adenine (A), Guanine (G), Cytosine (C) and Thymine (T). Imagine them as the alphabet you know except that it has only four letters. Different arrangements of the letters will convey different meanings just like how rat is different from tar or art even when they are made from the same set of letters. The nucleotide bases which are part of your DNA works the same way. The differences in their arrangements within a given gene will result in the expression of different traits. During fertilization, 23 chromosomes are contributed by

each of the gametes of your parents. When the sperm and egg fuses, they form a zygote. That is YOU now. Inside you are 23 pairs of chromosomes that will dictate who you are and who you will become.

Many genes are involved in protein production. Proteins are macromolecules that play many roles in our bodies. Some function in building and repairing body tissues, allowing metabolic reactions to occur, and coordinating bodily functions to maintain homeostasis. Genes control protein production indirectly with the use of **RNA (ribonucleic acid)**, a molecule related to DNA. DNA has to be transcribed first to the intermediary form, RNA (mRNA) and the latter has to be translated into proteins. The entire process of creating proteins out of a template DNA is called **gene expression** (see **FIGURE 3**). In the process of translating mRNA into proteins, all life forms use the same genetic code. It is a set of combinations where each three nucleotides (known as codon) code for a single amino acid. One can derive many assumptions on the relatedness of two or more different species by examining and comparing nucleotide sequences between or among them.

The complete set of genes in an organism is called the **genome**, and the study of it is referred to as **genomics**. On the other hand, the complete set of proteins expressed by a cell or group of cells is called **proteome**, and the study of it is called

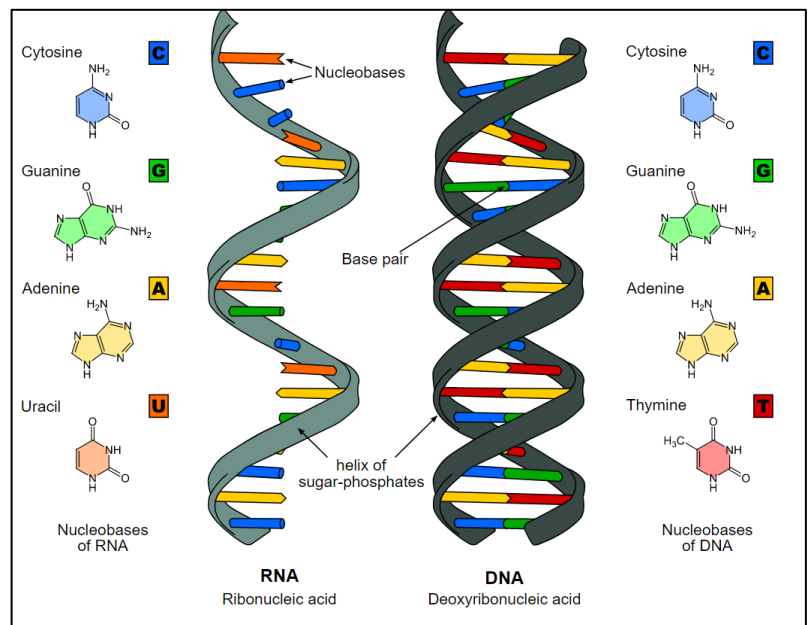


FIGURE 2. Differences between DNA and RNA. File:Difference DNA-RNA-DE.svg;Sponk/*translation:Sponk Retrieved from: https://upload.wikimedia.org/wikipedia/commons/3/37/Difference_DNA_RNA-EN.svg. This file is licensed under the Creative Commons Attribution-Share Alike 3.0 Unported license.

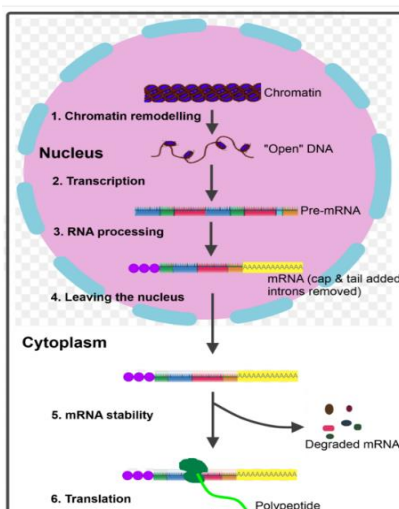


FIGURE 3. Gene expression Eukaryote. CKRobinson (2015, December 4). Retrieved from: https://es.m.wikipedia.org/wiki/Archivo:Gene_expression_eukaryote.png. This file is available under the Creative Commons Attribution-ShareAlike 4.0

proteomics. The developments in these fields were achieved because of the use of cutting-edge technologies, bioinformatics, and collaboration among interdisciplinary research teams.

3. ENERGY AND MATTER

Organisms require energy to perform work. For example, plants heavily rely on energy from the sun to fuel their sugar production. In the process of producing sugar, the light energy from the sun has to undergo a series of transformations for it to be converted into chemical energy in the form of food. Consumers may consume the producers or other consumers so that the chemical energy in food is now transferred to them. When they perform work, some of the energy is lost to the environment in the form of heat. Here we see the one-way flow of energy through an ecosystem, initially coming in as light and coming out as heat.

4. INTERACTIONS

In all levels of the biological hierarchy, interaction is important. In ecosystems, organisms must interact with both biotic and abiotic factors. Interactions between biotic factors establish symbiotic relationships among the organisms involved. These relationships may cause benefit to one party only (parasitism), on both parties (mutualism), or it can neither detrimentally affect both parties (commensalism). Interactions can also be observed on molecular levels such as when positive or negative feedback loops operate. If the result of a reaction is amplified, positive feedback is operating. If, on the other hand, the result is reduced or changed, it is negative feedback.

5. EVOLUTION

According to Theodosius Dobzhansky, "Nothing in biology makes sense except in the light of evolution". Evolution is defined as the change in living organisms over time. According to this concept, all life forms arose from a single common ancestor which through time has developed adaptations through natural selection. This explains why we can still find unity amidst diversity.

Refer to our main reference (Campbell et al., 2015) for more detailed explanations and illustrative examples (pp.49-57).

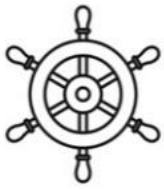
All these themes and the properties and processes of life embedded within these themes work to maintain homeostasis within a body of a living organism. Homeostasis is the state of steady internal state despite the changes outside the organism.

As mentioned earlier, Biology as the study of life is very broad. Originally, it had three main branches: Botany, Zoology, and Microbiology. Botany deals with the study of the different aspects of plants. Zoology deals with the study of the different aspects of animals. And Microbiology deals with the study of the different aspects of microorganisms. Today, a long list of many disciplines fall under the scope of Biology.

Check out this site for the complete list of the branches of Biology.



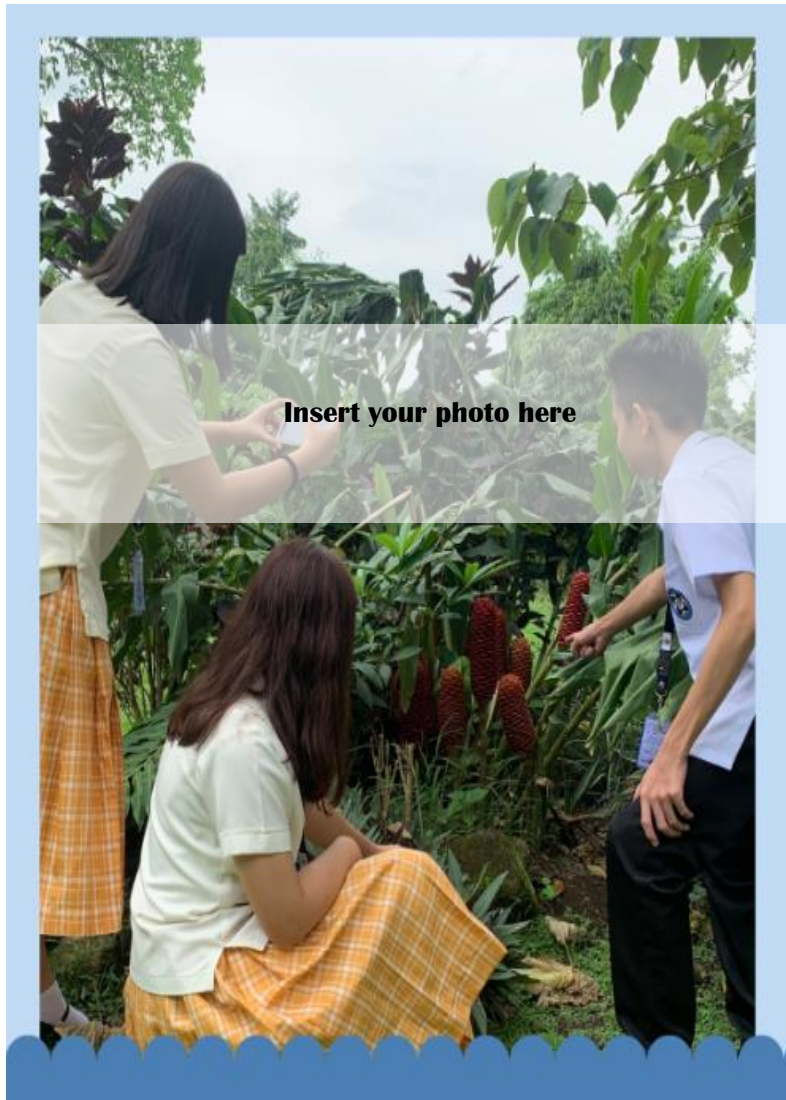
Complete List of All Branches of Biology for SSC and Banking Exams-GK Notes in PDF!
<https://testbook.com/blog/branches-of-biology-gk-notes-pdf/>



NAVIGATE

*Note: This is a **GRADED** assessment.*

We now go back to the picture you took at the start of this module. Print and paste it on the space below, and describe how the unifying themes of Biology just discussed were apparent.



ORGANIZATION

INFORMATION

ENERGY AND MATTER

INTERACTIONS

EVOLUTION

Alternative Assessment:

Choose one from the identified tasks that you think you will be able to do best. Once finished, submit your output via Moodle.

TASKS:

A. Online Interview

Conduct an online interview with a professional whose line of work is related to the disciplines under Biology. Record your interview and write a report about it. Pattern your interview report on the samples found in this site: <https://asc.yale.edu/samlereports>. You may also add more interview points to what is provided.

Suggested discussion points:

1. Relevant skills they must have or trainings they have undergone before they got their job
2. Opportunities they enjoy in their career
3. Daily routine in their workplace

For submission:

1. Audio recording
2. Interview report

B. Infographic Making

Suppose you were chosen by Schraer and Stotze, the authors of *Biology: The Study of Life*, to promote a specific career in Biology. Your work will be posted in the book's section titled, *Careers in Action*. Create an infographic about why your chosen career is important and how it will be of significant use to your local community.

For submission:

1. Infographic

C. Essay Writing

This site: <https://www.prospects.ac.uk/careers-advice/what-can-i-do-with-my-degree/biology> lists several career options in the field of Biology. If you were to become a biologist, what career will you choose from the list and why? Write a one-page essay about it following the format below:

- Size of paper: A-4
- Three (3) to five (5) paragraphs
- Single spaced
- Uniform 1" margin
- Saved in pdf file



For submission:

1. Essay

D. Graphic Organizer

Choose a notable Filipino scientist in the field of Biology (and all its other sub-disciplines) and complete the graphic organizer below.

Name :		Grade :	<div>INSERT PICTURE OF YOUR IDOL HERE</div>
• NAME	• FIELD	• YEARS ACTIVE	
• BACKGROUND	• ACHIEVEMENTS	• WHAT THEY TAUGHT ME	

For submission:

1. Graphic organizer image (JPEG or PNG)

RUBRICS**A. Rubric on Rating Interview Report**

Criteria	Exceptional 4 pts	Acceptable 3 pts	Marginal 2 pts	Unacceptable 1 or 0 pt
Introduction	Interview events were discussed in detail and has skillfully introduced the person interviewed.	Interview events were described and has introduced the person interviewed.	Interview events were described but introduction to the person interviewed has lacking details.	Interview events and introduction were lacking details.
Questions	The interviewer has prepared and asked relevant questions with mastery of the main points of the subject's initial query.	The interviewer has prepared and asked relevant questions with understanding, if not mastery, of the main points of the subject's initial query.	The interviewer has prepared and asked relevant questions with minimal understanding, if not mastery, of the main points of the subject's initial query.	The interviewer exhibits little preparation and attention through the type of questions asked.
Listening Skills / Follow-up Questions	The interviewer has demonstrated careful listening by asking critically constructed questions as follow up to significant responses of the person interviewed. The interviewer also elicits elaboration of answers.	The interviewer has demonstrated careful listening by sometimes asking critically constructed questions as follow up to significant responses of the person interviewed. The interviewer also elicits elaboration of answers but does not grab that opportunity whenever it presents.	The interviewer gives little evidence of careful listening by largely ignoring potentially relevant responses and moving on to the next prepared question. The interviewer also elicits little elaboration.	The interviewer gives no evidence of listening; proceeds directly to prepared questions without regard to responses. The interviewer also does not elicit elaborated responses.
Summary	The interviewer has provided a detailed summary of the interview. All questions and responses were recorded	The interviewer has provided a detailed summary of the interview, but not all questions and responses were recorded.	The interviewer has not provided a detailed summary and some important questions and responses were omitted.	The interviewer has only provided an incomplete summary without all the questions and responses.
Conclusion	The interviewer has identified at least three points he/she has learned from the interview and conveyed how they will be helpful applications in the future.	The interviewer has identified at least two points he/she has learned from the interview and conveyed how they will be helpful applications in the future.	The interviewer has identified a single point he/she has learned from the interview and conveyed how they will be helpful applications in the future.	The interviewer has not any point he/she has learned from the interview and conveyed how they will be helpful applications in the future.
Writing mechanics and organization	The interviewer's writing demonstrates a sophisticated clarity, conciseness, and correctness; The report	The interviewer's writing is accomplished in terms of clarity and conciseness and contains only a few	The interviewer's writing lacks clarity or conciseness and contains numerous	The interviewer's writing is unfocused, rambling, or contains serious errors; The

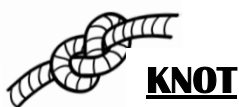
	is extremely well-organized.	errors; The report is well-organized.	errors; The report lacks organization.	report is poorly organized.
--	------------------------------	---------------------------------------	--	-----------------------------

B. Rubric on Rating Infographic

Criterion	Weight	Exceptional 4 pts	Acceptable 3 pts	Marginal 2 pts	Unacceptable 1 or 0 pt
Content	50%	Appropriate details support main idea, Accurate and detailed information; and Information adequately supports purpose of visual	Most details support main idea, Accurate information for almost all subject matter; and Information is mostly adequate and supportive of visual's purpose	Few details support main idea, Lacking accurate information; and Inadequate information is not clearly supportive of visual's purpose	No details to support main idea, Information is not accurate; and Information does not support the visual's purpose
Focus	20%	Topic and title clear and easily identified, Main idea is clearly appropriate to topic; and All illustrations complement purpose of visual	Topic and title are mostly clear and easily identified, Main idea is appropriate to topic; and Most illustrations complement purpose of visual	Topic and title are difficult to identify, Main idea is not clearly stated; and Few illustrations complement purpose of visual	Topic and title are not clearly identified, Mo main idea; and Illustrations do not complement purpose of visual
Visual Appeal	20%	Outstanding use of color, design, and space, Original and creative design; and Overall design is pleasing and harmonious	Adequate use of color, design, and space, Design is adequate; and Overall design is mostly pleasing and harmonious	Inappropriate use of color, design, and space, Design lacks creativity; and Lack of harmonious design in presentation	Little attempt to use of color, design, and space appropriately, Design is dull; and Project has sloppy appearance
Mechanics	10%	Free of grammatical errors. Words are legible and pertinent to topic.	Mostly free of grammatical errors. Most words are legible and pertinent to topic.	Frequent grammatical errors. Presentation is illegible and confusing.	Too frequent grammatical errors. Distractive elements make illustration ineffective.

C. Rubric on Rating Essay

Submission/ Compliance	1	0.5	0
	The student submitted the output on or before the deadline.	The student submitted the output beyond the given deadline.	The student did not submit any output.
	3	2	1
	All of the explanations are accurately anchored to the concepts presented in the lesson. The students demonstrate accurate and complete understanding of the lesson which was applied in his/her explanation.	Most of the explanations are accurately anchored to the concepts presented in the lesson. There is at most one part of the explanation which is inaccurate and not founded on the scientific principles learned.	Some of the explanations are accurately anchored to the concepts presented in the lesson. There are more than one part of the explanations which are inaccurate and not founded on the scientific principles learned.
	1	0.5	0.25
	There are at most three grammatical errors in the output.	There are four to six grammatical errors in the output.	There are at least seven grammatical errors in the output.



Biology is the study of all living things. These living things vary so much with one another so Biology has many sub-disciplines that work together to study them. Among these sub-disciplines are Botany, Zoology, and Microbiology. Furthermore, there are major unifying themes in Biology. They are categorized as Organization, Information, Energy and Matter, Interactions, and Evolution. These themes as well link Biology to other sciences.

REFERENCES:

Book

Campbell, N., Reece, J., Urry, Lisa., Cain, M., Wasserman, S., Minorsky, P., Jackson, R. (2015). Biology A Global Approach. Tenth Edition. Pearson Education South Asia PTE.LTD

Online Resources

Testbook. (2020, July 8). Complete list of all branches of biology for SSC - Notes in PDF! Testbook Blog. <https://testbook.com/blog/branches-of-biology-gk-notes-pdf/>

Rubric for Interview Report. (2013). <https://lib800.files.wordpress.com/2013/08/lib-800-interview-grading-rubric.pdf>

Texas Education Agency. (2015). Rubric for Infographic or Poster. <http://cte.sfasu.edu/wp-content/uploads/2015/04/Rubric-for-Infographic-or-Poster.pdf>

Read.Write.Think. (2013). Essay Rubric. <http://www.readwritethink.org/files/resources/printouts/Essay%20Rubric.pdf>

Images

Amazingly simple graphic design software – Canva. (n.d.).
Canva. https://www.canva.com/design/DAEBo6n_hwM/7ms2ByYtg5g58rc48giJUA/e

CKRobinson / CC BY-SA (<https://creativecommons.org/licenses/by-sa/4.0>)

File:Difference DNA RNA-DE.svg: Sponk / *translation: Sponk / CC BY-SA (<https://creativecommons.org/licenses/by-sa/3.0>)

Student Clipart Student Thinking. <https://webstockreview.net/explore/student-clipart-student-thinking/>

The Biological Levels of Organization of Living Things. <https://openstax.org/details/books/biology-2e>.

Prepared by:

HANNAH FE A. EMILA
Special Science Teacher II
PSHS-BICOL REGION CAMPUS

Reviewed by:

ELEAZAR B. GUIA
Special Science Teacher V
PSHS-CENTRAL VISAYAS CAMPUS

MICHELLE B. DUCUSIN
Special Science Teacher V/Team Lead (Biology)
PSHS-ILOCOS REGION CAMPUS