Tree of Life School

"Wisdom is a tree of life to those to those who embrace her."
Proverbs 3:18

Biology
Course Outline

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Course Outline
Introduction

This course is a general introduction to biology, the scientific study of living things created by God. The diversity of life on earth is simply amazing, and this course will consider both the general features that all organisms share as well as the differences present in various groups. Biology is a descriptive science so the student will learn many new words and definitions through the course. However, the general concepts of how life works will repeatedly come up. The variety of assignments and tests will focus on memory of factual information as well as understanding of concepts, practical experiments, research, and writing. The goal of this course is to introduce the student to the language and systematic study of living things as well as to instill an appreciation and wonder of God's living creation.

How to Work Through The Course

This course has been divided into a **140 day schedule**. This will allow the student to follow a **four-day school week** and still complete the course in a normal academic year. The **fifth day** of each week can used to **catch up on assignments**, do **extra reading**, or simply **take the day off** from the course. If, however, a five-day school week is more desirable, the student is encouraged to pursue this course and will be rewarded by early completion of the material. Care has been taken to provide specific instructions for each day's work. Therefore, **all work is to be completed in the order presented in the daily schedule**.

The guide provides a suggested day-by-day sequence of lessons that will pace you through the reading material, experiments, assignments, and tests. This course uses the textbook *Exploring Creation with Biology, 2nd edition* by Jay Wile, but the textbook is not itself the course, but only the main reading source you will use as you study the science. This course guide offers important suggestions over the next few pages on **how to study this course** as well as comments and tips throughout the 140 day plan. The beginning of the textbook also describes how the textbook should be used during study.

For general instructions on how to access course materials, prepare and send in assignments, and expectations, see **The Tree of Life Student Handbook**.

Calculating Your Final Grade

Every module (chapter) of the course has either an assignment or a test to send for marking. **Please note that Tree of Life doesn't use the test package that comes with your textbook.** Your final mark in the course will be based on the following percentages:

7 Assignments	**50%**
8 Tests	**50%**

Lab Reports

Submitted lab reports demonstrate the stages of thinking about a particular scientific idea (asking a question, giving a possible solution, devising an experiment, making observations/measurements, providing a conclusion/answer to the question). Most lab reports contain this format. A sample lab report is found in the appendix to this guide.

1. Title of Lab/course/name/date

   The title of the lab should describe the experiment. Instead of "*Atmospheric Pressure,*" use "*The Effect of Atmospheric Pressure on Cans*".

2. Problem 1-2 sentences

   State the scientific question in the form of a question (ending in "?"). For example: "*What happens to the freezing point of water when salt is dissolved in the water?"* Depending on the experiment, you may also need to explain what the question means in connection with the experiment if it is not obvious.

3. Hypothesis 1-3 sentences

   The hypothesis is an educated guess or possible answer to the problem, and is written before doing the experiment. The hypothesis should imply or state a prediction for what *should* happen during the experiment (not what *did* happen already). Also, the hypothesis may state a theory or reason for the prediction. For example: *The freezing point of water will decrease after dissolving the salt. Therefore, the pure water will freeze before the salt water. This is because the salt interferes with the formation of a solid crystal structure*." Note the *"will"* prediction in my example. Do not use "I believe" or "We think" at the beginning. Do not use past tense either as that would imply you already did the experiment.

4. Summary of Procedure max. 5 sentences

   You do not need to give every detailed step of the experiment, nor every item you used. You should <u>not</u> copy the procedure from the textbook. This section should be at most 5 sentences. See sample lab report for example.

5. Observations and Results 1-2 paragraphs

   The results section is an important part of the lab report because it describes what you discovered by doing the experiment. There are different kinds of results:

   1. Sense observations (what you saw happening, smell, touch, sound, taste)
   2. Measurements (numbers from measuring instruments)

Generally, you should always include some kind of sense observations in written form for every lab. Try to be as detailed as possible with your observations. Instead of saying "*The tablet reacted with the water",* you could say:

"*When the tablet was added to the glass of water, it began to bubble vigourously with a fizzing sound. Small bubbles came from the surface of the tablet. The tablet bounced around on the bottom of the glass. There was no smell from the reaction. The reaction lasted 22 seconds. After the reaction was done, the tablet was gone."*

Note that this example also has a measurement (22 seconds). Some experiments won't require any measurements, however. If the experiment involves many measurements, you should present these in a table. Note that the results section should **not** explain or interpret the results of the experiment (say what it means or why it happened). Save this for the conclusion. Just describe objectively what has occurred during the experiment.

6. Discussion and Conclusion 1-2 paragraphs

The conclusion paragraph of the lab report is not quite the same thing as an essay conclusion. The science conclusion should include the following things:

- Restate the problem and your hypothesis
- Summarize the results (what happened)…yes, write it again
- Answer the question (problem) you wrote at the beginning of the lab
- Say if the hypothesis was supported or rejected (not correct/incorrect)
- Explain the results as best you can (*why* did it happen?)
- You may need to mention some background theory that helps explain the results.

If you write at least 1 sentence per item above, you will have at least one good conclusion paragraph.

Additional Instructions for Dissections, Microscope Lab, and non-experimental Labs

Biological dissections and microscope labs are not experiments as such, and so you don't write the lab report in the same way. However, they are still scientific activities done for the purpose of learning about the organism. Generally, lab reports for dissections should show what you have learned about the parts of the organism (anatomy) and how those parts help the organism live and function (physiology).

Lab Reports for Dissections and microscope labs should include the following parts:

1. Title of Lab/course/name/date

2. Purpose 1-2 sentences

The purpose should state what you are trying to learn about the organism or structure.

Perhaps you want to examine the internal organs. Maybe you want to look at the parts that help the organism move. Remember to think about what you personally want to learn.

3. Background 1-4 sentences

This section gives background information about the organism or structure you are dealing with. For example:

i. What groups of organisms does it belong to? Arthropod? Amphibian?
ii. Where does it live (habitat)?
iii. What does it do (it's niche)? What does it eat?
iv. Any other important facts…

4. Procedure max. 5 sentences

Give a summary of the procedure from the textbook. Do not copy down everything. For example: "*First, the external features of the frog are examined. Then the abdominal cavity is opened and the digestive organs are examined. The stomach is opened…" etc.* This can be given in point form in a list.

5. Observations 1-2 paragraphs plus drawings

This section gives the meat of what you learned from the procedure. Start with a written description of your examination of the organism. You could list the parts/organs you found. You should describe the appearance of the more important parts/organs. Obviously it will be helpful to make notes during the lab. You should also answer any questions given in the dissection procedure.

Depending on what organism you are dissecting, you should include several drawings. The first is a general external sketch (before any cuts). The next is usually a large sketch of the internal organs. You might make detailed drawings for other parts of the organism (head, heart/lungs, reproductive organs, etc.).

Remember that you don't need to be an artist to make good biological drawings. You do need to look closely and carefully, and copy the details you see. Be patient. Do the drawings while you are dissecting, not later from memory. Below are a few more guidelines:

a. half or full blank pages
b. complete title goes below the drawing
c. pencil only
d. nothing coloured
e. labeled parts
f. label lines drawn using a ruler, no arrow heads
g. details in texture and shape

6. Conclusion 1 paragraph

When writing the conclusion, think back to the purpose of the lab. What have you learned about this organism? Think about how God has designed this organism for a specific habitat and niche (way of living). How do the parts match how the organism lives? You may also mention any parts that you found interesting or surprising.

How To Study Biology

Reading and Note-Taking

The backbone of the course is the textbook, which poses questions and provides scientific information and discussion in a very understandable and conversational tone. However, simply reading the textbook will yield little learning if there is no critical interaction with the material. One does not read science as one read novels of fiction, for example. Some people can read novels very quickly. But for science, you must slow down and sometimes read every word in the sentence to understand the concept. You might need to look back and forth five times between a diagram and a paragraph you are reading in order to "connect the dots". This type of careful reading is necessary for learning science.

One very important learning method you should employ for this and following science courses is **note-taking** or **reading notes**. When reading a section of the textbook, you should always have at your side a notebook used for recording important terminology, definitions, explanations, facts, diagrams, and illustrations. The best time to write down notes is the moment your mind is on them. The purpose of reading notes is threefold. First, the act of note-taking forces you to think about what are the most important things in what is being said – that's what to write down. Second, good notes give you a quick reference to the most important information from the textbook. You can find the main points more easily when studying for the test. Thirdly, as in the case of copying diagrams, note-taking causes you to look carefully and think harder about what you are looking at. If you take good notes while reading, you might accumulate 2-3 pages per module (not including practise questions).

How to use this Study Guide

This study guide is intended to provide a sequence of learning steps to pace you through the course. Each day gives a suggested number of pages for reading, practise questions, experiments, and tips. Some days will require more time and work; in this case, take an extra day if you need. If you are able to move faster, that's fine too. However, good study habits are still important to develop, so following every lesson step is recommended. A good memory for terminology and concepts in science only goes so far, and a failure to develop study methods will eventually make learning harder or less enjoyable.

A few other tips and notes…

- You should always check the **answers to the Practise Questions** ("On Your Own" questions); the answers are at the end of the module. Don't "peek" if you aren't sure of an answer; give your honest effort first, then check afterward.

- Keep up to date with the **Study Guide questions at the end of each module**. If you wait until the day before the test, they will be of little value in preparation. Perhaps doing about 3 study guide questions per day will help keep the material fresh in your mind.

- It is a good idea to **review the lab supplies required for different experiments** *before* the day of the lab. That way, you can be prepared. It is very important to pre-read the entire procedure for the experiment before you start.

Why should we do the experiments?

The experiments in this course are very important to do for several reasons. First, many experiments can help turn abstract scientific concepts into observable events and memorable pictures in your mind that help develop understanding. Another reason for the experiments is that they are fun and sometimes entertaining! They give variety to the course. Thirdly, experiments are an important activity of working scientists who make hypotheses about their observations in nature, and then set out to test their predictions within controlled conditions. Although you must learn the foundations of science before practicing like real scientists, the kind of experiments in this course emulate the same thinking processes in natural science. **You should do as many of the experiments in this course as possible, regardless of whether it needs to be evaluated.**

What if I don't have a microscope, the slide sets, or the dissection kit?

A number of experiments in this biology course use either the microscope and slide sets, or a dissection kit. While the best learning experience will include all of these materials, **they are not required to learn biology or to complete the course**. If you don't have these materials for certain days in the 140-day schedule, here are some suggestions of alternatives:

- catch up on textbook reading, or review material already learned;
- spend the time working on the assignment for the module;
- answer "On Your Own" questions;
- complete Study Guide questions at the end of each module;
- use book/library/Internet sources to learn about the organisms in the experiments you are unable to complete (this may include looking for microscope pictures, dissections, etc.);
- refer to the student notes section of the Apologia website for extra pictures on experiments;
- spend time conducting a field study of organisms near your home; this may include collecting, studying, drawing, and identifying organisms with a field guide;

Module 1: The Study of Life

In this introductory module, you will learn about the characteristics of life and how living things are described and classified (put into groups). All of the chapters including this one will include important new words that make up a language of science; be sure to record these new words in your notebook as you study.

DAY 1 - Start by reading pages 1-6 in your textbook. Because there are many new words in this section, you should record these in a vocabulary section of your notebook. **Answer On Your Own questions 1.1 and 1.2** in your notebook.

DAY 2 - Read pages 6-11. Answer questions 1.3, 1.4 and 1.5 in your notebook.

DAY 3 - Read pages 12-16. Also make sure you have read the introductory material at the beginning of this course guide including the many useful suggestions in "How To Study This Course" on pages 11-12.

DAY 4 - Read pages 16-21. **Answer questions 1.6 and 1.7.** (Note: you should always complete the "On Your Own" questions from the textbook whenever you come across them during reading. They will no longer mentioned in this study guide but it is implied that you complete them as part of your study.)

DAY 5 -Read pages 21-24. **Complete Experiment 1.1** on Biological Keys. This activity is one of the options for Assignment #1 to send for evaluation. However, you should complete it regardless of which option you choose to send.

DAY 6 - Read pages 27-30. Also read through the instructions for Experiment 1.2. If you have a microscope, you will do this experiment tomorrow. Make sure you have all the necessary materials at hand. Even if you don't have a microscope to use for this experiment, this will be profitable to read because the microscope is an important scientific instrument for making discoveries in biology.

DAY 7 - **Work on Assignment #1.** See the assignment section of this guide for details.

DAY 8 - **Finish working on Assignment 1** and submit by email for evaluation. See the **Tree of Life Student Handbook** for general instructions on how to prepare and send assignments for evaluation. Optionally, you may also check any "On Your Own" answers at the end of the module, and review the study guide questions.

Module #2 - Kingdom Monera

This module will introduce the simplest group of living things - Monera. Bacteria are

Tree of Life School Biology				
Assignment		Test	Description	Mark
1			Microscope Lab or Classification Assignment	
		1	**Test covers Modules 1-2**	
2			Microscope Lab or Research Assignment	
		2	**Test covers Modules 3-4**	
3			Experiment	
		3	**Test covers Modules 5-6**	
4			Microscope Lab or Experiment	
		4	**Test covers Modules 7-8**	
5			Biologist Research	
		5	**Test covers Modules 9-10**	
6			Dissection or Microscope Lab or Experiment	
		6	**Test covers Modules 11-12**	
7			Plant Study	
		7	**Test covers Modules 14-15**	
		8	**Test covers Modules 13 and 16**	
			7 Assignments (50%)	
			8 Tests (50%)	
			Final Mark	