

Biology for the Logic Stage Sample Packet

The following sample packet includes the first two weeks of the *Biology for the Logic Stage* materials. You will see:

- ✓ The Teacher Guide (*beginning on pg. 3*)
- ✓ The Student Guide (*beginning on pg. 35*)

You can get more information and purchase this award-winning program here:

🔗 <https://elementalscience.com/collections/biology-for-the-logic-stage>

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Biology for the Logic Stage Teacher's Guide
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Biology for the Logic Stage *Introduction*

In *Success in Science: A Manual for Excellence in Science Education*, we state that the middle school student is “a bucket full of unorganized information that needs to be filed away and stored in a cabinet.”¹ The goals of science instruction at the logic level are to begin to train the students’ brains to think analytically about the facts of science, to familiarize the students with the basics of the scientific method through inquiry-based techniques, and to continue to feed the students with information about the world around them. *Biology for the Logic Stage* integrates the above goals using the Classic Method of middle school science instruction as suggested in our book. This method is loosely based on the ideas for classical science education that are laid out in *The Well-Trained Mind: A Guide to Classical Education at Home* by Jessie Wise and Susan Wise Bauer.

This guide includes the four basic components of middle school science instruction as explained in *Success in Science*.

1. **Hands-on Inquiry** – Middle school students need to see real-life science, to build their problem-solving skills, and to practice using the basics of the scientific method. This can be done through experiments or nature studies. In this guide, the weekly experiments fulfill this section of middle school science instruction.
2. **Information** – Middle school students need to continue to build their knowledge base, along with learning how to organize and store the information they are studying. The information component is an integral part of this process. In this guide, the reading assignments, vocabulary and sketches contain all of the necessary pieces of this aspect of middle school science instruction.
3. **Writing** – The purpose of the writing component is to teach students how to process and organize information. You want them to be able to read a passage, pull out the main ideas and communicate them to you in their own words. The assigned outlines or reports in this guide give you the tools you need to teach this basic component to the students.
4. **The Science Project** – Once a year, all middle school students should complete a science project. Their projects should work through the scientific method from start to finish on a basic level, meaning that their questions should be relatively easy to answer. The science fair project, scheduled as a part of unit five, fulfills the requirements of this component.

Biology for the Logic Stage also includes the two optional components of middle school science instruction, as explained in *Success in Science*.

1. **Around the Web** – Middle school students should gain some experience with researching on the Internet. So for this optional component, the students should, under your supervision, search the Internet for websites, YouTube videos, virtual tours and activities that relate to what they are studying. In this guide, the “Want More” lessons recommend specific sites and activities for you to use.
2. **Quizzes or Tests** – During the middle school years it is not absolutely necessary that you give quizzes or tests to the students. However, if you want to familiarize them with test-

¹Bradley R. Hudson and Paige Hudson, *Success in Science: A Manual for Excellence in Science Education* (Elemental Science, 2012), 52

taking skills, we suggest that you give quizzes or tests that will set the students up for success. With that in mind, we have included optional tests for you to use with each unit.

My goal in writing this curriculum is to provide you with the tools to explore the field of biology while teaching the basics of the scientific method at the middle school level. During these years, the students' will work on their observation skills, learn to think critically about the information they are studying, and practice working independently. *Biology for the Logic Stage* is intended to be used with fifth through seventh grade students.

This Guide in a Nutshell

This guide includes the weekly student assignment sheets, all the sketches pre-labeled for you, and discussion questions to help you guide the discussion time. This guide also contains information for each experiment, including the expected results and an explanation of those results. There is a list of additional activities that you can choose to assign for each week. Finally, this guide includes possible schedules for you to use as you guide the students through *Biology for the Logic Stage*.

Student Guide

The Student Guide, which is sold separately, is designed to encourage independence in the students as they complete *Biology for the Logic Stage*. The Student Guide contains all the student assignment sheets, pre-drawn sketches ready for labeling, experiment pages and blank report pages. The guide also includes blank date sheets as well as all the sheets they will need for the Science Fair Project. In short, the Student Guide contains all the pages the students will need; it is essential for successfully completing this program.

Student Assignment Sheets

This Teacher Guide contains a copy of each of the student assignment sheets that are in the Student Guide. This way you can stay on top of what the students are studying. Each of the student assignment sheets contains the following:

✓ **Experiment**

Each week will revolve around a weekly topic that is to be studied. The students will be assigned an experiment that poses a question related to the topic. Each of these experiments will walk the students through the scientific method (see the Appendix pg. 246 for a brief explanation of the scientific method). In a nutshell, the scientific method trains the brain to examine and observe before making a statement of fact. It will teach the students to look at all the facts and results before drawing a conclusion. If this sounds intimidating, it's not. You are simply teaching the students to take the time to discover the answer to a given problem by using the knowledge they have and the things they observe during an experiment.

Each week, the student assignment sheet will contain a list of the materials needed and the instructions to complete the experiment. The Student Guide contains an experiment sheet for the students to fill out. Each experiment sheet contains an introduction, which is

followed by a list of materials, a hypothesis, a procedure, an observation and a conclusion section. The introduction will give the students specific background information for the experiment. In the hypothesis section, they will predict the answer to the question posed in the lab. In the materials listed section, the students will fill out what they will use to complete the experiment. In the procedure section, they will recount step-by-step what was done during their experiments, so that someone else could read their reports and replicate their experiments. In the observation section, the students will write down what they saw. Finally, in the conclusion section they will write whether or not their hypotheses were correct and share any additional information they have learned from the experiments. If the students' hypotheses were not correct, discuss why and have them include that on their experiment sheets.

Vocabulary and Memory Work

Throughout the year, the students will be assigned vocabulary for each week. They will need to write out the definitions for each word on the Unit Vocabulary Sheet found in the Student Guide on the week that they are assigned. You may want to have the students also make flash cards to help them work on memorizing the words. This year, the students will also memorize several lists of facts that correspond to each unit. There is a complete listing of the vocabulary words and memory work for each unit on the unit overview sheet in this guide, along with a glossary and a list of the memory work in the Student Guide.

Sketch

Each week the students will be assigned a sketch to complete and label. The Student Guide contains an unlabeled sketch for them to use. They will color the sketch, label it and give it a title according to the directions on the Student Assignment Sheet. The information they need will be in their reading, but the sketch is not always identical to the pictures found in the encyclopedia. As a result, these sketch assignments should make the student think. This guide contains a completed sketch for you to use when checking their work.

Writing Assignments

Each week the students will be assigned pages to read from one of the spine texts, either in *The Usborne Science Encyclopedia* or in *The Kingfisher Science Encyclopedia*. Have them read the assigned pages and discuss what they have read with you. After you have finished reading and discussing the information, you have three options for the students' written assignments:

Option 1: Have the students write an outline from the spine text

A typical fifth grader completing this program should be expected to write a two to three level outline for the pages assigned for the week. This outline should include the main point from each paragraph on the page as well as several supporting and sub-supporting points;

Option 2: Have the students write a narrative summary from the spine text

A typical fifth grader completing this program should be expected to write a three to six paragraph summary (or about a page) about what they have read in the spine text;

Option 3: Have the students write both an outline and a written report

First, have the students read the assigned pages in the spine text. Then, have them write a two to three level outline for the assigned pages. Next, have the students do

some additional research reading on the topic from one or more of the suggested reference books listed below. Each topic will have pages assigned from these reference books for their research. The following encyclopedias are scheduled to be used as reference books:

- 📖 *The Usborne Science Encyclopedia, 2015 Edition (USE)* – This resource is good for most fifth and sixth graders. It is also the spine text for Units 1 and 2 of this study.
- 📖 *The Kingfisher Science Encyclopedia, 2017 Edition (KSE)* – This resource is a slightly more advanced reference work than *The Usborne Science Encyclopedia*. It is also the spine text for unit 6 of this study.
- 📖 *DK Encyclopedia of Nature, 2007 Edition (DKEN)* – This resource is good for most fifth through seventh graders. It is on the same level as *The Kingfisher Science Encyclopedia*, but it can be difficult to find as it goes in and out of print.
- 📖 *Usborne Illustrated Dictionary of Science, 2012 Edition (UIDS)* – This resource is approaching the high school level.
- 📖 *DK Eyewitness Book: Human Body, 2014 Edition (DK HB)* – This resource is only for the human body study and is also approaching the high school level.

Once the students complete the additional research reading, have them write a report of three to four paragraphs in length, detailing what they have learned from their research reading. Your writing goal for middle school students is to have them write something (narrative summary, outline, or list of facts) every day you teach school, either in science or in another subject. The writing option you choose for this curriculum will depend on the writing the students are already doing in their other subjects.

When evaluating the students' reports, make sure that the information they have shared is accurate and that it has been presented in a grammatically correct form (i.e. look for spelling mistakes, run-on sentences, and paragraph structure). In the Student Guide, there are two blank lined sheets for the students to use when writing their outlines and/or summaries. If you are having the students type their reports, have them glue a copy into their Student Guide.

🕒 **Dates**

Each week the dates of important discoveries within the topic and the dates from the readings are given on the student assignment sheet. The students will enter these dates onto one of their date sheets. The date sheets are divided into the four time periods as laid out in *The Well-Trained Mind* by Susan Wise Bauer and Jessie Wise (Ancients, Medieval-Early Renaissance, Late Renaissance-Early Modern, and Modern). Completed date sheets are available for you to use in the Appendix of this guide, on pp. 243-245.

Schedules

Biology for the Logic Stage is designed to take up to three hours per week. You and the students can choose whether to complete the work over five days or over two days. Each week I have included two scheduling options for you to use as you lead them through this program. They are meant to be guides, so feel free to change the order to better fit the needs of the students. I also

recommend that you begin to let them be in charge of choosing how many days they would like to do science, as this will help to begin to foster independence in their school work. I have included two blank scheduling templates for you to use in the Appendix of this guide on pp. 255-256.

Additional Information Section

The Additional Information Section includes tools that you will find helpful as you guide the students through this study. It is only found in the Teacher Guide, and it contains the following:

Experiment Information

Each week, the Additional Information Section includes the expected experiment results and an explanation of those results for you to use with the students. When possible, you will also find suggestions on how to expand the experiment in the “Take it Further” section.

Discussion Questions

Each week the Additional Information Section includes possible discussion questions from the main reading assignment, along with the answers. These are designed to aid you in leading the discussion time with the students. I recommend that you encourage them to answer in complete sentences, as this will help them organize their thoughts for writing their outlines or reports. I have also included a list of the discussion questions without the answers at the end of each unit’s material in this guide. This is so you can give them to the students ahead of time, if you desire, or you can use them to review for the unit test. If they are already writing outlines or lists of facts, you do not need to have them write out the answers to the discussion questions beforehand, as there is plenty of writing required in this program already.

Want More

Each week, the Additional Information Section includes a list of activities under the “Want More” section. *These activities are totally optional.* The “Want More” activities are designed to explore the science on a deeper level by researching specific topics or through additional projects to do. The students do not have this information in their guides, so it is up to you whether or not to assign these.

Several of the “Want More” activities require materials that would need to be purchased from a lab science supply company. The following companies are good places to look for these materials:

1. **Home Science Tools** (<http://www.hometrainingtools.com>)
2. **Nasco Science Supplies** (<http://www.enasco.com/science>)
3. **Carolina Biological Supply Company** (<http://www.carolina.com>)

Since you will need to purchase a frog dissection kit for Week 19 from one of these companies, I have also included a list of the optional dissections that you can get from a lab supply company for the optional “Want More” activities for your reference:

- ✦ **Week 12:** Earthworm dissection kit
- ✦ **Week 13:** Starfish dissection kit
- ✦ **Week 20:** Owl pellet dissection kit
- ✦ **Week 29:** Sheep’s brain dissection kit
- ✦ **Week 31:** Sheep’s heart dissection kit
- ✦ **Week 34:** Sheep’s kidney dissection kit

☑ Sketch

Each week, the Additional Information Section includes copies of the sketches that have been labeled. These are included in this guide for you to use as you correct the students' work.

Tests

The students will be completing a lot of work each week that will help you to assess what they are learning, so testing is not absolutely necessary. However, I have included end-of-unit tests that you can use with the students if you feel the need to do so. The tests and the answers to them are included after the material for each unit in this guide, with the exception of Unit 6. Unit 6 has two tests, one mid-unit test that covers the first five weeks and one end-of-unit test that covers the last five weeks. You can choose to give the tests orally or copy them for the students to fill out.

What a typical two-days-a-week schedule looks like

A typical two-day schedule will take one to one-and-a-half hours per day. Here is a breakdown of how a normal two-days-a-week schedule would work using week one as an example:

✦ Day 1: *Define the vocabulary, do the experiment, complete the experiment sheet, and record the dates*

Begin day 1 by having the students do the “What do plant cells look like?” experiment. Have them read the introduction and then perform the experiment using the directions provided. Next, have them draw what they see, discuss their results with you and then write a conclusion for their experiment. Finish the day by having them look up and define “cell” and “mitosis” using the glossary in the Student Guide and add the dates to their date sheets.

✦ Day 2: *Read the assigned pages and discuss together, prepare an outline or narrative summary and complete the sketch*

Begin by having the students read pp. 250-251 and 298-299 of the *Usborne Science Encyclopedia*. Then, using the questions provided, discuss what they have read. Have them complete the sketch using the directions on the Student Assignment Sheet. Finally, have them write an outline or narrative summary. Here is what that could look like:

Sample one-level outline of the spine text for Week 1

- I. *Cells are the basic building blocks of life.*
- II. *Animal cells have a thin outer membrane and have specialized structures inside called organelles.*
- III. *Plant cells differ from animal cells because they have a tough outer membrane and contain chloroplasts.*
- IV. *Cells can work together.*
- V. *Cells reproduce through a process called mitosis.*

Sample Narrative Summary from the spine text only for Week 1

Cells are the basic building blocks of all living things. They are controlled by genes called DNA. Cells can work together in a multi-cellular organism. They reproduce through a process called mitosis.

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Animal cells are usually soft and flexible. They have a thin outer membrane and are filled with a jelly-like substance called cytoplasm. The cytoplasm contains small structures called organelles. The organelles carry out many functions in the cell, such as making proteins.

Plant cells differ from animal cells in several ways. They have an additional outer membrane, which is tough. A plant cell is rigid due to pressure from the inside. Also, plant cells contain chloroplasts, which are necessary for photosynthesis.

What a typical five-days-a-week schedule looks like

A typical five-day schedule will take thirty to forty-five minutes per day. Here is a breakdown of how a normal five-days-a-week schedule would work using week one as an example:

✦ Day 1: Do the experiment and complete the experiment sheet

Begin day 1 by having the students do the “What do plant cells look like?” experiment. Have them read the introduction and then perform the experiment using the directions provided. Next, have them draw what they see, discuss their results with you, and then write a conclusion for their experiment.

✦ Day 2: Read the assigned pages, discuss together and write an outline or list of facts

Begin by having the students read pp. 250-251 and 298-299 of the *Usborne Science Encyclopedia*. Discuss what they have read using the provided questions. Then, have the students write a two to three level outline, and complete the sketch using the directions on the Student Assignment Sheet. Here’s a sample list of facts:

Sample list of facts from the spine text for Week 1

1. Cells are the basic building blocks of life.
2. Animal cells have a thin outer membrane and have specialized structures inside called organelles.
3. Plant cells differ from animal cells because they have a tough outer membrane and contain chloroplasts.
4. Cells can work together.
5. Cells reproduce through a process called mitosis.

✦ Day 3: Record the dates, define the vocabulary and complete the sketch

Begin by having the students look up and define “cell” and “mitosis” using the glossary in their guide. Have them add the dates to their date sheets. Then, have them complete the sketch using the directions on the Student Assignment Sheet.

✦ Day 4: Read from the additional reading assignments and prepare a written report

Begin by having the students read pp. 238-240 about the parts of the cell in the *The Usborne Illustrated Dictionary of Science*. Then, have them use their outline or list of facts along with what they have just read, to write a two to four paragraph summary of what they have learned. Here’s a sample of what that summary could look like:

Sample Written Report for Week 1

Cells are the basic building blocks of life from which every living thing is made. There are many different types of cells that

work together to keep an individual alive. Cells perform all the processes necessary for life, such as absorbing food and minerals, removing waste and producing energy. They are constantly making copies of themselves, through mitosis, so that the new cells can replace ones that die.

Animal cells have a nucleus and cell membrane. Inside they are filled with a substance called cytoplasm, which contains a number of organelles. Organelles each have different functions, such as the mitochondria that convert simple substances into energy that can be used by the cell. Animal cells work together to form tissues, tissues work together to form organs, organs work together to form systems and systems work together to form an individual.

Plant cells are a little larger than animal cells, but they also contain several unique structures. The first is the cell wall, which is a rigid outer layer made of cellulose. The second are chloroplasts, which contain chlorophyll, a chemical that helps to produce food for a plant. Plant cells also have a sap-filled vacuole, chromoplasts, a cell membrane and a nucleus. Plant cells work together to form three main plant tissues.

✦ **Day 5: Complete one of the “Want More” activities**

Have the students look at some pre-prepared slides that came with your microscope or make a replica of a cell with Jell-O. You could also have them read about a scientist from the field of biology.

The Science Fair Project

I have scheduled time for the students to complete a science fair project during Unit 5. *Janice VanCleave’s A+ Science Fair Projects* and *Janice VanCleave’s A+ Projects in Biology: Winning Experiments for Science Fairs and Extra Credit* are excellent resources for choosing project topics within the field of biology. You can call your local school system to see if it allows homeschooled students to participate in the local school science fair, or you can get information on national science fairs from them. Another option would be to have the students present their projects in front of a group of friends and family.

How to Include Younger Students

I recognize that many homeschool families have a range of different student ages. If you wish to have all the students studying the topic of biology, you have two options for the elementary students when using this program with the middle school students:

✦ **Option 1: Have the younger students use *Biology for the Grammar Stage***

I recommend this option if the younger students are in K through second grade and/or the older student is ready for some independence. You will need to rearrange the units in *Biology for the Logic Stage* so that all the students will remain on similar topics. The older students will do Unit 1, Units 3 through 5, then Unit 6, and finish with Unit 2.

✦ **Option 2: Have the younger students use *Biology for the Logic Stage* along with the older students**


I recommend this option if the younger students are in second through fourth grade and/or

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the older students are not ready to work independently. You will need to adjust the workload for the younger student. Here are some suggestions on how to do that:

- ✓ Have them watch and observe the experiments, but do not require the younger students to predict the outcome of the experiment (hypothesis);
- ✓ Add in some picture books from the library for each of the topics;
- ✓ Read the reading assignments to them and have them narrate them back to you;
- ✓ Let the younger students color the sketches and then tell them how to label them.

As for the reading assignments, you may find that the spines scheduled are too much for the younger students. If so, you can use the following books instead:

 *DK Encyclopedia of Animals, 2006 Edition*


 *DK First Human Body Encyclopedia, 2005 Edition*

I have included a chart coordinating these resources in the Appendix of this guide, on pp. 248-250.


Helpful Articles

Our goal is to provide you with the information you need to be successful in your quest to educate your students in the sciences at home. This is the main reason we share tips and tools for homeschool science education at our blogs. As you prepare to guide your students through this program, you may find the following articles from there helpful:


- 📖 *Classical Science Curriculum for the Logic Stage Student* – This article explains the goals of logic stage science and demonstrates how the classical educator can utilize the tools they have at their disposal to reach these goals.

 <http://elementalblogging.com/classical-science-curriculum-logic/>

- 📖 *Scientific Demonstrations vs. Experiments* – This article shares information about these two types of scientific tests and points out how to employ scientific demonstrations or experiments in your homeschool.


 <https://elementalscience.com/blogs/news/89905795-scientific-demonstrations-or-experiments>

- 📖 *A Simple Explanation of the Scientific Method* – This article details the steps of the scientific method, along with why it is so important to teach.

 <https://elementalscience.com/blogs/news/simple-explanation-of-the-scientific-method/>

Additional Resources

The following page contains quick links to the activities suggested in this guide along with several helpful downloads:

 <https://elementalscience.com/blogs/resources/bls>

Final Thoughts


If you find that this program contains too much work, please tailor it to the needs of your students. As the author and publisher of this curriculum I encourage you to contact me with any questions or problems that you might have concerning *Biology for the Logic Stage* at support@elementalscience.com. I will be more than happy to answer them as soon as I am able. I hope that you and your students enjoy *Biology for the Logic Stage*!


Book List

The following books were used when planning this study:

Encyclopedias for Reading Assignments


The following books are the main spines of this program. You will need to purchase both of these to complete the reading assignments scheduled in this program. (**Note**—*The editions noted here are the most current editions. However, the past two editions of each of these spines will also work.*)


 *The Usborne Science Encyclopedia, 2015 Edition (USE)*


 *The Kingfisher Science Encyclopedia, 2017 Edition (KSE)*

References for Reports

The following encyclopedias are scheduled for additional reference reading. They are optional, but I suggest that you purchase one or two to use throughout the year. With the exception of the *Human Body* book, these encyclopedias will be scheduled in subsequent logic stage programs.

 *Usborne Illustrated Dictionary of Science, 2012 Edition (UIDS)* – This resource is approaching the high school level.

 *DK Encyclopedia of Nature, 2007 Edition (DKEN)* – This resource is good for most fifth through seventh graders. It is on the same level as *The Kingfisher Science Encyclopedia*, but it can be difficult to find as it goes in and out of print.

 *DK Eyewitness Book: Human Body, 2014 Edition (DK HB)* – This resource is only for the human body study and is also approaching the high school level. (**Caution** – *This book is very graphic and is not for sensitive children.*)

Experiment Equipment

If you would like to create a more lab-like experience for the students this year, I suggest using equipment that is more commonly found in the laboratory setting. Here's a list of material that you can substitute:

- ✓ **Jar** – Use a beaker or Erlenmeyer flask that is at between 750 and 1000 mL;
- ✓ **Cup** – Use a beaker or Erlenmeyer flask that is at between 200 and 500 mL;
- ✓ **Bottle** – Use an Erlenmeyer flask that is between 250 and 1000 mL;
- ✓ **Small cup** – Use a small beaker (50 mL) or test tube;
- ✓ **Eye dropper** – Use a pipette.

You can use the glass or plastic version of each of the above.

Safety Advisory

Some of the experiments in this book use boiling water or open flames. We recommend that the students use safety glasses and protective gear with each experiment to prevent accidents. Do not allow the students to perform any of the experiments marked “☠ CAUTION” on their own.


Microscope Information

What to look for when buying a microscope

When purchasing a microscope for homeschool use, look for the following specs:


- ✦ A compound monocular microscope;
- ✦ A microscope with 4x, 10x, and 40x objective lenses at a minimum (**Note**—*The eyepiece should also give 10x magnification, which then will allow you to look at an object at 40x, 100x, and 400x magnification.*);
- ✦ A microscope with separate coarse and fine adjustment knobs;
- ✦ A good light source. (**Note**—*The best light sources are an LED or cool fluorescent bulb. Do not get one with mirror illumination, as they are very difficult to adjust.*)


You can purchase a good quality microscope at *Lab Essentials, Inc.* (www.labessentials.com), *Children's Microscopes* (www.childrensmicroscopes.com) or *Home School Science Tools* (www.hometrainingtools.com). Be sure to also purchase some blank slides so that you can make your own slides. For more information on purchasing a microscope, listen to the following podcast:

 <https://elementalscience.com/blogs/podcast/27>

How to use a microscope

To learn how to use a microscope before you have to teach it, see these articles:

 <http://www.microscope-microscope.org/basic/how-to-use-a-microscope.htm>

 <https://elementalscience.com/blogs/science-activities/how-to-make-a-microscope-slide>

Experiments that use a microscope

The following weeks will require the use of a microscope to complete the experiment:

- ✦ **Week 1:** What do plant cells look like?
- ✦ **Week 7:** Can I grow algae?
- ✦ **Week 8:** Observation of a fern
- ✦ **Week 9:** Dissection of a flower

What if I can't afford to purchase a microscope?

If you cannot afford to purchase a microscope or are unable to borrow a microscope, don't worry: the students can still complete the experiments scheduled in this program. I have included links to websites where you can view the assigned slides in the "Additional Information" section in this guide. You can also Google the sample name along with "microscope" to find additional pictures.

Additional activities that will use a microscope

The following weeks have optional Want More activities that will require the use of a microscope:

- ✦ **Week 1** (Any type of cells; plant cells)
- ✦ **Week 13** (Water hydra)
- ✦ **Week 27** (Hair and skin)
- ✦ **Week 28** (Bone cells)
- ✦ **Week 29** (Muscle cells)
- ✦ **Week 32** (Red blood cells)

Biology for the Logic Stage ~ Microscope Information

Sequence of Study

Introductory & Plant Units (11 weeks)

Unit 1: Biological Building Blocks (5 Weeks)

- ✓ Cells
- ✓ DNA and Genetics
- ✓ Classification
- ✓ Nutrient Cycles
- ✓ Ecology

Unit 2: Plants (6 Weeks)

- ✓ Fungi
- ✓ Simple Plants
- ✓ Flowerless Plants
- ✓ Flowering Plants
- ✓ Seeds and Fruit
- ✓ Trees

Animal Units (14 weeks)

Unit 3: Invertebrates (5 Weeks)

- ✓ Annelids/Platyhelminthes/Nematodes
- ✓ Cnidarians/Echinoderms
- ✓ Mollusks
- ✓ Arthropods
- ✓ Insects

Unit 4: Vertebrates (5 Weeks)

- ✓ Fish
- ✓ Amphibians
- ✓ Reptiles
- ✓ Birds
- ✓ Mammals

Unit 5: Animal Overview (4 weeks)

- ✓ Science Fair Project
- ✓ Migration
- ✓ Animal Behavior
- ✓ Animal Partnerships
- ✓ Adaptations and Defenses

Human Body Unit (10 weeks)

Unit 6: Human Body (10 Weeks)

- ✓ Integumentary System
- ✓ Skeletal System
- ✓ Muscular System
- ✓ Nervous System
- ✓ Endocrine System (optional Reproductive System)
- ✓ Circulatory System
- ✓ Respiratory System
- ✓ Digestive System
- ✓ Urinary System
- ✓ Immune System

Review (1 week)

Materials Listed by Week

Introductory & Plant Units

Unit 1: Biological Building Blocks

Week	Materials
1	Microscope, Slides, Cover slips, Onion skin, Celery stalk
2	Banana Slices, Dish soap, Salt, Ice-cold isopropyl alcohol (70% or higher), Zipper-style plastic bag, Coffee filter, Funnel, Wooden coffee stirrer, Test tube (or clear glass jar)
3	Leaf for identification
4	<i>There are no materials needed for this week.</i>
5	Air dry clay, Shoebox, Paint, Construction paper

Unit 2: Plants

Week	Materials
6	Bread, Plastic bag, Water
7	Pond or aquarium water, Small glass jar, Light source, 2 Slides and cover slips
8	Fern (with spores if possible), Magnifying glass, Microscope, Slide and cover slip
9	Flower (either lily, poppy or tulip), Razor blade, Magnifying glass, Microscope, Slide and cover slip
10	2 Cups, Soil, Bean seed, Corn seed, Marker
11	Ruler, String, Measuring tape, Partner, Broadleaf tree

Animal Units

Unit 3: Invertebrates

Week	Materials
12	Small plastic soda bottle, Sand, Loam, Crushed leaves, Worms, Water, Paper towel, Rubber band
13	Plastic bowl, Porous material (such as a sponge, brick or charcoal), Liquid bluing, Water, Salt, Measuring spoon
14	Snail, 2 Lettuce leaves, Paper towel, Caffeinated drink (preferably black coffee), Empty milk jug, Rubber band
15	3 Cups, 3 Uncooked shrimp shells, Bleach, Vinegar, Salt, Water, Gloves
16	1 Apple, 2 Glass jars

Unit 4: Vertebrates

<i>Week</i>	<i>Materials</i>
17	1 Large clear glass jar or bowl, 3 Small balloons, 3 Small marbles, Ruler, Water
18	1 Frog dissection kit, 1 Preserved frog
19	Clothespin, Blindfold, 5 Pieces of bread with different edible spreads on them (such as garlic, cinnamon/ sugar, butter, peanut butter, and plain), 5 Plates
20	Chopsticks, Tweezers, Pliers, Eye dropper, Sugar, Water, Gummy worms, Peanuts, Seeds, Raisins, Plates
21	Felt, Cotton balls, Water, 1 Large cup, 4 Small cups, Instant thermometer, Foil

Unit 5: Animal Overview

<i>Week</i>	<i>Materials</i>
22-25	Science Fair Project supplies will vary depending on the project the students choose to do.

*Human Body Unit**Unit 6: Human Body*

<i>Week</i>	<i>Materials</i>
26	Pennies (10-30), 2 Pieces of hair (at least 5 inches long), Several heavy books, Pencil, Tape, Glass, Bleach, Glove, Water
27	3 Bones, Vinegar, Glass, 3 Plastic bags, Hammer
28	Yoursself, Door frame
29	Yardstick, Partner
30	Watch with a second hand, Partner
31	Water, Cornstarch, Flour, Sugar, Red food coloring, Glass
32	Watch with a second hand
33	3 Cups oatmeal (cooked according to package directions and cooled), Water, Bowl, Pantyhose
34	2 Glasses, Coffee filter, Food coloring, Flour or sand, Water, Rubber band
35	Several friends, Several different colors of glitter

Biology: Unit 1

Biological Building
Blocks

Unit 1: Biological Building Blocks Overview of Study

Sequence of Study

Week 1: Cells

Week 2: DNA and Genetics

Week 3: Classification

Week 4: Nutrient Cycles

Week 5: Ecology

Materials by Week

Week	Materials
1	Microscope, Slides, Cover slips, Onion skin, Celery stalk
2	Banana Slices, Dish soap, Salt, Ice-cold isopropyl alcohol (70% or higher), Zipper-style plastic bag, Coffee filter, Funnel, Wooden coffee stirrer, Test tube (or clear glass jar)
3	Leaf for identification
4	<i>There are no materials needed for this week.</i>
5	Air dry clay, Shoebox, Paint, Construction paper

Vocabulary for the Unit

1. **Cell** – A tiny unit of living matter, the basic building block of all life.
2. **Mitosis** – The division of a cell nucleus to produce two identical cells.
3. **DNA** – The material that forms the genes and chromosomes of all living things, short for deoxyribonucleic acid.
4. **Genes** – A set of instructions that tell your body how to develop; found on the chromosomes.
5. **Chromosomes** – Bundles of DNA that can be found in the cell's nucleus; they work together to tell an organism how to develop.
6. **Classification** – A way of identifying or grouping living things.
7. **Kingdom** – The highest category into which living things are classified.
8. **Species** – A group of living things that can breed together in the wild.
9. **Nutrient** – Any material that is taken in by a living thing to sustain life.
10. **Food chain** – A process whereby energy passes along a chain of living things.
11. **Food web** – A collection of interconnected food chains.
12. **Ecosystem** – A collection of living things and their environment.
13. **Ecology** – The study of relationships between living things and their environment.
14. **Habitat** – The natural home of a species.

Memory Work for the Unit

Divisions of Life

1. Kingdom
2. Phylum
3. Class
4. Order
5. Family
6. Genus
7. Species

(The following mnemonic can help you as you work on memorizing these:

King Phillip Can Only Find his Green Shoes)

Five Kingdoms and their Basic Characteristics

1. **Monerans** – Microscopic organisms that have a simple, single cell. *(Example: Bacteria)*
2. **Protists** – A variety of complex, but mainly single-celled organisms. *(Example: Algae)*
3. **Fungi** – Organisms that absorb food and reproduce by making spores. *(Example: Molds)*
4. **Plants** – Living things that have many cells and most carry out photosynthesis.
(Example: Trees)
5. **Animals** – Organisms made up of many cells and live by eating food. *(Example: Humans)*

Notes

Student Assignment Sheet Week 1 Cells

Experiment: What do plant cells look like?

Materials

- ✓ Microscope
- ✓ Slide
- ✓ Onion skin
- ✓ Celery stalk

Procedure

Note—If you have never used a microscope before, please ask the teacher to demonstrate how to use a microscope before beginning this experiment.

1. Read the introduction to this experiment and write a description of what you think you will see.
2. Make a wet mount slide of the onion skin. Look at the slide under the microscope on low power (100x) and then on high power (400x). Draw what you see for each.
3. Next, make a wet mount slide of the celery stalk. Look at the slide under the microscope on low power (100x) and then on high power (400x). Draw what you see for each.
4. Complete the experiment sheet.

Vocabulary & Memory Work

Vocabulary: cell, mitosis

Memory Work—This week, work on memorizing the Five Kingdoms and their Basic Characteristics.

1. **Monerans** – Microscopic organisms that have a simple, single cell. (*Example: Bacteria*)
2. **Protists** – A variety of complex, but mainly single-celled organisms. (*Example: Algae*)
3. **Fungi** – Organisms that absorb food and reproduce by making spores. (*Example: Molds*)
4. **Plants** – Living things that have many cells and most carry out photosynthesis. (*Example: Trees*)
5. **Animals** – Organisms made up of many cells and live by eating food. (*Example: Humans*)

Sketch: Plant and Animal Cells

Label the following on the Plant Cell – cell wall, cell membrane, cytoplasm, vacuole, nucleus, chloroplasts

Label the following on the Animal Cell – nucleus, nucleolus, mitochondria, vacuole, endoplasmic reticulum, ribosome, cell membrane, lysosome, cytoplasm

Writing

🌀 Reading Assignment: *Usborne Science Encyclopedia* pp. 250-251 (Plant Cells), pp. 298-299 (Animals Cells)

🌀 Additional Research Readings

📖 The parts of a cell and what they do (including organelles): *UIDS* pp. 238-240

📖 Cells: *DKEN* pp. 20-21

Dates to Enter

- ⊕ 1595 – Zacharias Jansenn built the first microscope.
- ⊕ 1665 – The cell was first discovered and named by Robert Hooke.
- ⊕ 1839 – Cell theory was developed by Matthias Schleiden and Theodor Schwann.

Schedules for Week 1

Two Days a Week

<i>Day 1</i>	<i>Day 2</i>
<ul style="list-style-type: none"> <input type="checkbox"/> Define cell and mitosis on SG pg. 14 <input type="checkbox"/> Do the “What do plant cells look like?” experiment, then fill out the experiment sheet on SG pp. 18-19 <input type="checkbox"/> Enter the dates onto the date sheets on SG pp. 9-12 	<ul style="list-style-type: none"> <input type="checkbox"/> Read pp. 250-251 and 298-299 from the <i>Usborne Science Encyclopedia</i>, then discuss what was read <input type="checkbox"/> Color and label the “Plant & Animal Cell” sketch on SG pg. 17 <input type="checkbox"/> Prepare an outline or narrative summary; write it on SG pp. 20-21
<p><i>Supplies I Need for the Week</i></p> <ul style="list-style-type: none"> ✓ Microscope ✓ Slide ✓ Onion skin ✓ Celery stalk 	
<p><i>Things I Need to Prepare</i></p>	

Five Days a Week

<i>Day 1</i>	<i>Day 2</i>	<i>Day 3</i>	<i>Day 4</i>	<i>Day 5</i>
<ul style="list-style-type: none"> <input type="checkbox"/> Do the “What do plant cells look like?” experiment, then fill out the experiment sheet on SG pp. 18-19 	<ul style="list-style-type: none"> <input type="checkbox"/> Read pp. 250-251 and 298-299 from the <i>Usborne Science Encyclopedia</i>, then discuss what was read <input type="checkbox"/> Write an outline or list of facts on SG pg. 20 	<ul style="list-style-type: none"> <input type="checkbox"/> Define cell and mitosis on SG pg. 14 <input type="checkbox"/> Enter the dates onto the date sheets on SG pp. 9-12 <input type="checkbox"/> Color and label the “Plant & Animal Cell” sketch on SG pg. 17 	<ul style="list-style-type: none"> <input type="checkbox"/> Read one or all of the additional reading assignments <input type="checkbox"/> Prepare a report; write the report on SG pg. 21 	<ul style="list-style-type: none"> <input type="checkbox"/> Complete one of the Want More Activities listed OR <input type="checkbox"/> Study a scientist from the field of Biology
<p><i>Supplies I Need for the Week</i></p> <ul style="list-style-type: none"> ✓ Microscope ✓ Slide ✓ Onion skin ✓ Celery stalk 				
<p><i>Things I Need to Prepare</i></p>				

Additional Information Week 1

Notes

📌 **Mitosis** – The subject of mitosis will be covered again in the sketch for week 21.

Experiment Information

👉 **Note** – If you don't own a microscope, first have the students look at the slivers of celery and onion skin with a magnifying glass. Have them draw what they see in the 100x box, relabeling it "magnifying glass." Then, have them look at the following website and draw what the plant cells look like from there in the 400x box.

📄 <http://www.bbc.co.uk/education/guides/z9hyvcw/revision/2>

👉 **Introduction** – (from the Student Guide) All living things are made up of tiny building blocks called cells. Cells carry out the necessary functions of life for the animal and plant. The best way to see these cells is by using a microscope. In this experiment, you will use a microscope to view the basic building blocks of celery and onion.

How to make a wet mount slide

1. Collect a thin slice of the sample and place it on the slide. (Make sure the sample is very thin or else the cover slip will wobble and you won't get a very good view of the sample.)
2. Place one drop of water over the sample. (Make sure not to use too much water or else the cover slip will float away and again you won't be able to see the sample.)
3. Place the cover slip at a 45 degree angle, with one edge touching the water, and let go. The slide is ready to be viewed.

👉 **Results** – The students should be able to see plant cells in both the onion skin and the celery sliver at both the magnification powers. Their drawing for the 100x should include the cell shape (i.e., like bricks on a building). Their drawings for the 400x should include the cell wall, cell membrane, and the nucleus of each of the cells. The celery stalk will look similar to the onion skin, except in color.

👉 **Explanation** – This experiment was designed to be a simple introduction into using a microscope, making slides, and viewing cells.

👉 **Take if Further** – Purchase a set of slides to view. View all the slides in your set that have to do with cells. Examine the difference and the similarities.

Discussion Questions

Plant Cells, pp. 250-251

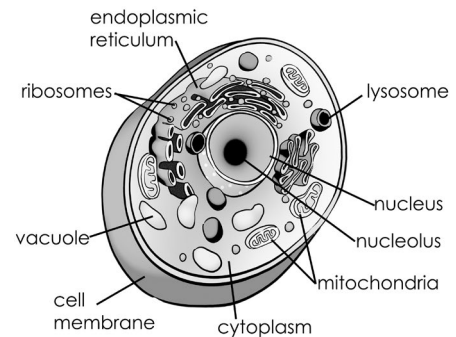
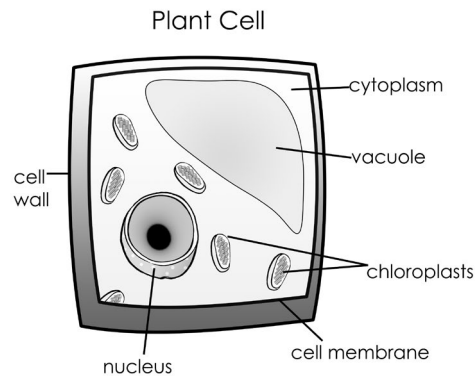
4. What are three of the basic parts of a plant cell and what does each do? (Answers should be: Three parts of the plant cell are _____, _____, and _____. The _____ does _____, and so on. Answers should come from the following information: Cell wall – made of cellulose and helps the cell keep its shape, Cell membrane – found just under the cell wall, Vacuoles – fluid-filled sacs that store liquids such as sap for the plant cell, Nucleus – controls the activity in the cell, Cytoplasm – gel-like fluid surrounding the nucleus that contains the organelles of a cell, Chloroplasts – chlorophyll, which makes food for the plant and gives it a green color.)

- Are all plant cells the same? (*No*) Why or why not? (*Plant cells have different shapes and structures depending on the job they have in the cell.*)
- What are the two stages of cell division in a plant cell? (*The two stages of cell division in a plant are called mitosis and cytokinesis.*) What happens in each of them? (*During mitosis, the nucleus divides, creating two parts; each part becomes a new nucleus. During cytokinesis, a cell plate forms along the dividing line and a new cell wall builds up along the plate.*)
- What are the three types of plant tissue? (*The three types of plant tissue are dermal tissue, ground tissue, and vascular tissue.*)

Animal Cells, pp. 298-299

- What are three of the basic parts of an animal cell and what does each do? (*Answers should be: Three parts of the animal cell are _____, _____, and _____. The _____ does _____, and so on. Answers should come from the following information: Cell membrane – holds the contents of the cell together and acts as a barrier, Nucleus – controls the activity in the cell, Cytoplasm – gel-like fluid surrounding the nucleus that contains the organelles of a cell, Golgi complex – stores and distributes substances, Nucleolus-make the ingredients for ribosomes, Mitochondria – converts simple substances into energy, Vacuoles-storage sacs for liquids or fats, Endoplasmic reticulum – used to transport materials in the cell, Centrioles – play a role in cell division, Ribosomes – help to make proteins, Lysosomes – destroy invading bacteria.*)
- Explain how cells come together to form organs. (*Individual cells group together to form tissues. Several different types of tissues then group together to form organs. The organs group together to form systems and the systems group together to form a living individual called an organism.*)

Sketch Assignment Week 1



Animal Cell

Want More

- Microscope Work** – Purchase a prepared slide of an animal or plant cell and have the students look at it under the microscope. Students should then complete the microscope worksheet found on pg. 257 of the Appendix.
- Jello Cell** – Have the students make a jello replica of a cell. Use a margarine container for the cell membrane, jello for cytoplasm, a grape for the nucleus and use your imagination for materials for the remaining organelles.

Student Assignment Sheet Week 2

DNA and Genetics

Experiment: DNA Extraction

Materials

- | | |
|--|------------------------------|
| ✓ Banana Slices | ✓ Zipper-style plastic bag |
| ✓ Dish soap | ✓ Coffee filter |
| ✓ Salt | ✓ Funnel |
| ✓ Ice-cold isopropyl alcohol (70% or higher) | ✓ Wooden coffee stirrer |
| | ✓ Test tube (or clear glass) |

Procedure

1. Read the introduction to this experiment.
2. Make the extraction solution by measuring out $\frac{1}{2}$ cup of water (120 mL). Add 2 tablespoons (35 mL) of liquid dish soap and 1 teaspoon (5 grams) of salt. Mix well.
3. Add several slices of banana to the baggie – about a third of a banana will do. Using your hands, squish the outside of the baggie to mash up the banana. Then, add 1 to 2 tablespoons (15 to 30 mL) of extraction solution. Keep squishing for about a minute or so to make sure that some of the DNA is released into the solution. (**Note**—If you have time, you can let the mixture sit for ten to fifteen minutes so that even more DNA is released.)
4. Line the funnel with the coffee filter and place the funnel in the test tube. Then, pour the contents of the baggie into the lined funnel and gently squeeze the liquid into the test tube. You want the tube to be about a quarter to a third full.
5. Slowly pour 2 to 3 tablespoons (30 to 45 mL) of the ice-cold alcohol into the test tube, so that you create a layer of alcohol resting on your fruit layer.
6. Watch what happens. Use the wooden coffee stirrer to gently stir the solution and collect any of the material you can see.
7. Draw conclusions and complete the experiment sheet.

Vocabulary & Memory Work

- Vocabulary: DNA, genes, chromosomes
- Memory Work—Continue to work on memorizing the Five Kingdoms and their Basic Characteristics.

Sketch: DNA to Chromosomes

- Label the following – DNA strand, Coiled chromatin, Chromosomes, Nucleus, Cell

Writing

- 🌀 Reading Assignment: *Kingfisher Science Encyclopedia* pg. 135 Genes and Chromosomes
- 🌀 Additional Research Readings
 - 📖 Genetics: *USE* pp. 380-381, *UIDS* pp. 324-325
 - 📖 Gene Therapy: *USE* pp. 382-383

Dates to Enter

- 🕒 1953 – James Watson and Francis Crick explain the double helix structure of DNA.

Schedules for Week 2

Two Days a Week

Day 1	Day 2
<input type="checkbox"/> Define DNA, genes, and chromosomes on SG pg. 15 <input type="checkbox"/> Do the “DNA Extraction” experiment, then fill out the experiment sheet on SG pp. 24-25 <input type="checkbox"/> Enter the dates onto the date sheets on SG pp. 9-12	<input type="checkbox"/> Read pg. 135 from the <i>Kingfisher Science Encyclopedia</i> , then discuss what was read <input type="checkbox"/> Color and label the “DNA to Chromosomes” sketch on SG pg. 23 <input type="checkbox"/> Prepare an outline or narrative summary; write it on SG pp. 26-27
<p><i>Supplies I Need for the Week</i></p> <ul style="list-style-type: none"> ✓ Banana Slices, Dish soap, Salt ✓ Ice-cold isopropyl alcohol (70% or higher) ✓ Zipper-style plastic bag, Coffee filter, Funnel, ✓ Wooden coffee stirrer, Test tube (or clear glass jar) 	
<p><i>Things I Need to Prepare</i></p>	

Five Days a Week

Day 1	Day 2	Day 3	Day 4	Day 5
<input type="checkbox"/> Do the “DNA Extraction” experiment, then fill out the experiment sheet on SG pp. 24-25 <input type="checkbox"/> Enter the dates onto the date sheets on SG pp. 9-12	<input type="checkbox"/> Read pg. 135 from the <i>Kingfisher Science Encyclopedia</i> , then discuss what was read <input type="checkbox"/> Write an outline or list of facts on SG pg. 26	<input type="checkbox"/> Define DNA, genes, and chromosomes on SG pg. 15 <input type="checkbox"/> Color and label the “DNA to Chromosomes” sketch on SG pg. 23	<input type="checkbox"/> Read one or all of the additional reading assignments <input type="checkbox"/> Prepare a report; write the report on SG pg. 27	<input type="checkbox"/> Complete one of the Want More Activities listed <p style="text-align: center;">OR</p> <input type="checkbox"/> Study a scientist from the field of Biology
<p><i>Supplies I Need for the Week</i></p> <ul style="list-style-type: none"> ✓ Banana Slices, Dish soap, Salt ✓ Ice-cold isopropyl alcohol (70% or higher) ✓ Zipper-style plastic bag, Coffee filter, Funnel, ✓ Wooden coffee stirrer, Test tube (or clear glass jar) 				
<p><i>Things I Need to Prepare</i></p>				

Additional Information Week 2

Experiment Information

- ☞ **Introduction** – DNA is the stuff that tells our cells what to do and how to look. It resides in the nucleus of a cell, so as you can imagine, it is quite tiny. In fact, you normally need a very powerful microscope to see DNA for yourself. In today’s experiment, you are going to try to extract DNA and cause it to join up into a mass you can see.
- ☞ **Results** – The students should see something that looks like cotton fluff in the test tube after the alcohol is added.
- ☞ **Explanation** – When the students mashed up the fruit, they were breaking down some of the cell walls mechanically. This caused part of the DNA to head out into the solution. Then, the extraction solution that the students added chemically broke down the cell walls of the fruit. When the students added the alcohol, the DNA in the solution precipitated out, or joined back up together to form a solid. The cotton fluff the students saw in the test tube is a mass of DNA, as well as proteins, which have bonded together.
- ☞ **Troubleshooting** – Be sure the alcohol is ice-cold. The colder it is, the more DNA will precipitate out.
- ☞ **Take it Further** – Have the students try different kinds of fruit (like grapes or strawberries) or veggies (like an onion) to see if the DNA yield is more or less. The students can also try extracting some of their own DNA by swishing a little water around in their mouths and then spitting the liquid out into a bag. They should then add the extraction the extraction solution and follow the procedure as before.

Discussion Question

1. What is the structure of DNA? (*DNA consists of two inter-locked strands that twist around each other in a structure known as a double helix.*)
2. Where are chromosomes found and what do they contain? (*Chromosomes are found in the nucleus of the cell. They contain genes, which are a set of instructions for an organism.*)
3. What is DNA made up of? (*DNA is made up of genes.*)
4. How do genes always occur? (*Genes always occur in pairs.*)
5. How are genes passed? (*Genes are passed from parent to offspring.*)

Want More

- 📖 **DNA Tower** – Have the students make a DNA tower using the directions from the following post:

📖 <http://elementalblogging.com/homeschool-science-corner-dna/>

- 📖 **Punnett Square** – Have the students complete the Punnett Square worksheet found in the Appendix on pp. 251-252.

Answers:

1.

GG	GG
Gg	Gg

50%, 50%, 0%

2.

GG	Gg
Gg	gg

25%, 50%, 25%

3.

Gg	Gg
gg	gg

0%, 50%, 50%

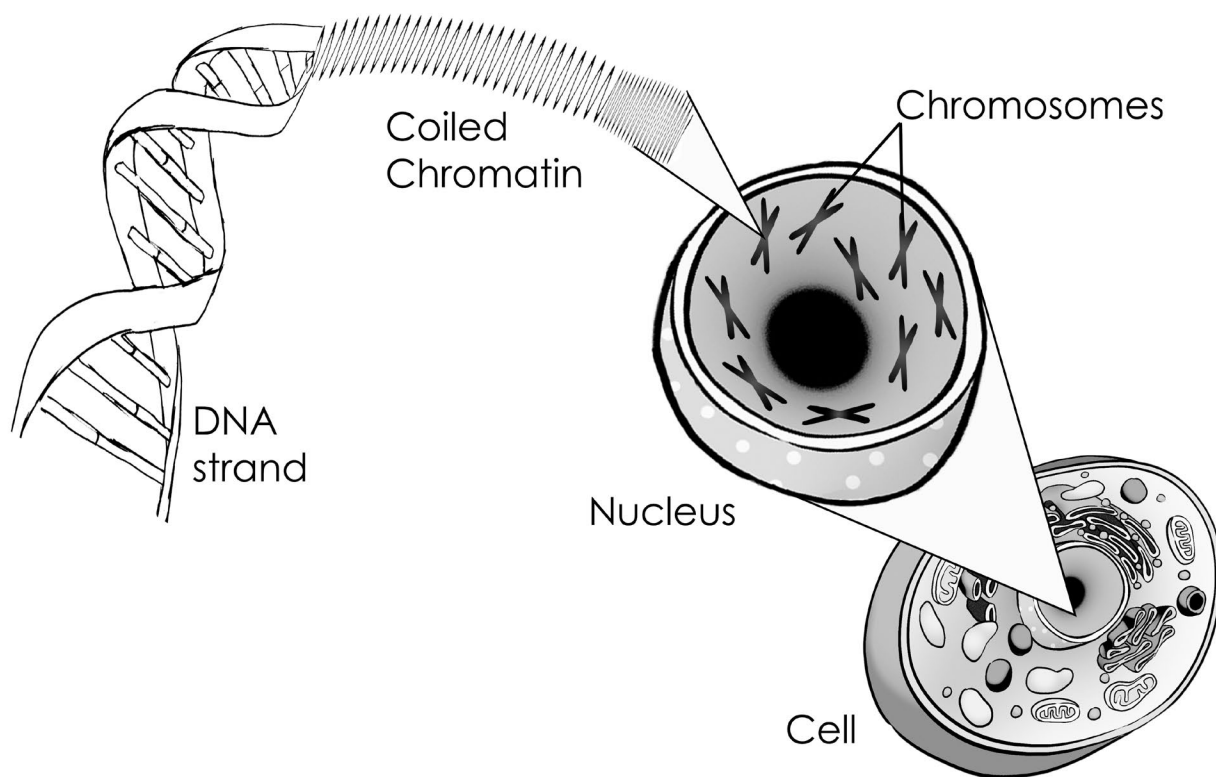
4.

Gg	Gg
Gg	Gg

0%, 100%, 0%

Sketch Assignment Week 2

DNA to Chromosomes



Appendix

Punnett Square Worksheet

Coded within the DNA of an organism are thousands of genes. Each of these genes contain the code for certain characteristics. Genes are passed down from the parents to the offspring. They come in pairs, called alleles, which are either dominant or recessive. The combination of these alleles determines which characteristic can be displayed.

Gregor Mendel, an Austrian monk, discovered this principle as he conducted an experiment with peas in the 1860's. He observed that his pea plants had different traits – tall or short plants, wrinkled or smooth pods, green or yellow peas, and white or purple flowers. He conducted an experiment in which he controlled the breeding of the plants through pollination.



Through this experiment, he discovered that some traits appeared more often than others. We now know that those traits are dominant. The other traits that appear less frequently are known as recessive. We also know that hybrid offspring result from a combination of a dominant trait and a recessive trait. Typically the dominant trait masks or covers the appearance of the recessive trait.

Thanks to the work of Reginald Punnett, we have a graphic representation of what Mendel discovered, known as the Punnett Square. Using this tool, we can predict the potential offspring of a set of parents.

A Sample Punnett Square

Let's look at the Punnett Square for the tall/short allele genes (T = tall gene, t = short gene). The possible combinations you could get would be dominant tall (TT), hybrid tall (Tt), and recessive short (tt).

So, if you have a dominant tall (TT) parent and a hybrid tall (Tt) parent, here is what their possible offspring would look like:

	T	T
T	TT	TT
t	Tt	Tt

This Punnett square shows us that these parents have a 50% chance of producing a dominant tall offspring, a 50% chance of producing a hybrid tall offspring, and a 0% chance of producing a recessive short offspring.

Practice Problems

For the sample problems, let's look at possible Punnett Squares for the pea color allele genes (G = green pea gene, g = yellow pea gene). The possible combinations you could get would be dominant green pea (GG), hybrid green pea (Gg), and recessive yellow pea (gg).

1. Complete the Punnett Square for a parent with a dominant green pea allele and another parent with the hybrid green pea allele.
2. Complete the Punnett Square for two parents with the hybrid green pea allele.

	G	G
G		
g		

- _____ % chance of a dominant green pea offspring
- _____ % chance of a hybrid green pea offspring
- _____ % chance of a recessive yellow pea offspring

3. Complete the Punnett Square for a parent with a recessive yellow pea allele and another parent with the hybrid green pea allele.

	g	g
G		
g		

- _____ % chance of a dominant green pea offspring
- _____ % chance of a hybrid green pea offspring
- _____ % chance of a recessive yellow pea offspring

	G	g
G		
g		

- _____ % chance of a dominant green pea offspring
- _____ % chance of a hybrid green pea offspring
- _____ % chance of a recessive yellow pea offspring

4. Complete the Punnett Square for a parent with a dominant green pea allele and another parent with the recessive yellow pea allele.

	G	G
g		
g		

- _____ % chance of a dominant green pea offspring
- _____ % chance of a hybrid green pea offspring
- _____ % chance of a recessive yellow pea offspring

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Biology for the Logic Stage Letter to the Student

Dear Student,

Welcome to your journey through biology, which is the study of living things. This year you will examine the various structures of life and how they operate. You will look at plants, animals, and the human body along your voyage. This guide is written to you, so enjoy your journey!

What does this guide contain?

First, this guide includes the Date Sheets and Unit Materials for each of the units. The Unit Materials include the Vocabulary Sheet for the unit, weekly Student Assignment Sheets, blank sketches, experiment sheets, and space for each of your writing assignments. After the Unit Materials, you will find the Appendix of this guide. In it you will find a list of all the memory work for the year, a glossary, and a place to record any additional activities you have done that pertain to biology.

Student Assignment Sheets

The Student Assignment Sheets contain your weekly assignments for each week. Each of the student assignment sheets contains the following:

- ✓ **Experiment** – Each week will revolve around a weekly topic. You will be assigned an experiment to complete that poses a question about what you are studying. Each Student Assignment Sheet contains the list of materials you will need and the instructions to complete the experiment. This guide also includes experiment sheets for you to fill out each week. In each of these experiments, you will use the scientific method.

A Word about the Scientific Method —The scientific method is a method for asking and answering scientific questions. This is done through observation and experimentation. The following steps are key to the scientific method:


- 1. Ask a Question** – The scientific method begins with asking a question about something you observe. Your questions must be about something you can measure. Good questions begin with how, what, when, who, which, why, or where.
- 2. Do Some Research** – You need to read about the topic from your question so that you can have background knowledge of the topic. This will keep you from repeating the mistakes that have been made in the past.
- 3. Formulate a Hypothesis** – A hypothesis is an educated guess about the answer to your question. Your hypothesis must be easy to measure and answer the original question you asked.
- 4. Test with Experimentation** – Your experiment tests whether your hypothesis is true or false. It is important for your test to be fair. This means that you may need to run multiple tests. If you do, be sure to only change one factor at a time so that you can determine which factor is causing the difference.


- 5. Record and Analyze Observations or Results** – Once your experiment is complete, you will collect and measure all your data to see if your hypothesis is true or false. Scientists often find that their hypothesis was false. If this is the case, they will formulate a new hypothesis and begin the process again until they are able to answer their question.
- 6. Draw a Conclusion** – Once you have analyzed your results, you can make a statement about them. This statement communicates your results to others.

Each of your experiment sheets will begin with a question and an introduction. The introduction will give you some background knowledge for the experiment. The experiment sheet also contains sections for the materials, a hypothesis, a procedure, an observation, and a conclusion. In the materials section, you need to fill out what you used to complete the experiment. In the hypothesis section, you need to predict the answer to the question posed in the lab. In the procedure section, you need to write a step-by-step account of what you did during your experiment. In other words, you need to provide enough detail so that someone else could read your report and replicate your experiment. In the observation section, you need to write what you saw and observed as well as any results you measured. Finally in the conclusion section, you need to write whether or not your hypothesis was correct and any additional information you have learned from the experiment. If your hypothesis was not correct, discuss why with your teacher and then include why your experiment did not work on your experiment sheet.


Safety Advisory—Do not perform any of the experiments marked “⚠ CAUTION ” on your own. Be sure you have adult supervision.

- ☐ **Vocabulary and Memory Work** – Throughout the year, you will be assigned vocabulary and memory work for each unit. Each week, you will need to look up the word in the glossary on pp. 255-262 and fill out the definitions on the Unit Vocabulary Sheet found at the beginning of each unit. You may also want to make flash cards to help you work on memorizing these words. Each week, you will also have a memory work selection. Simply repeat this selection until you have it memorized, and then say the selection to your teacher. There is a complete listing of the memory work selections in the Appendix on pp. 247-249.
- 🖍 **Sketch** – Each week, you will be assigned a sketch to complete. Color the sketch and label it with the information given on the Student Assignment Sheet. Be sure to give your sketch a title.
- 📖 **Writing** – Each week, you will be writing an outline and/or a narrative summary. The student assignment page will give you a reading assignment for the topic from your spine text, either *The Usborne Science Encyclopedia* or *The Kingfisher Science Encyclopedia*. After you have finished the assignment, discuss what you have read with your teacher. Your teacher will let you know whether to write an outline or a narrative summary from your reading. Your teacher may also assign additional research reading out of the following books:

 *The Usborne Science Encyclopedia, 2015 Edition (USE)*

 *The Kingfisher Science Encyclopedia, 2017 Edition (KSE)*

 *DK Encyclopedia of Nature, 2007 Edition (DKEN)*

 *Usborne Illustrated Dictionary of Science, 2012 Edition (UIDS)*

(Note—*The editions noted here are the most current editions. However, the past two editions of each of these spines will also work.***)**

Once you finish the additional reading, prepare a narrative summary about what you have learned from your reading. Your outlines should be one-level main topic style outlines and your narrative summaries should be one to three paragraphs in length, unless otherwise assigned by your teacher.

- ⊕ **Dates** —Each week, dates of important discoveries within the topic and dates from the readings are given on the student assignment sheet. You will enter these dates onto one of four date sheets. The date sheets are divided into the four time periods laid out in *The Well-Trained Mind* by Susan Wise Bauer and Jessie Wise (Ancients, Medieval-Early Renaissance, Late Renaissance-Early Modern, and Modern). These sheets are found in the ongoing projects section of this guide. You can choose to just write the dates and information on the sheet or you can draw a timeline in the space provided and enter your dates on that.


How to schedule this study

Biology for the Logic Stage is designed to take up to three hours per week. You, along with your teacher, can choose whether to complete the work over five days or over two days. Below are two options for scheduling to give you an idea of how you can schedule your week:

- ✓ A typical two-days-a-week schedule
 - ⊕ **Day 1** – Define the vocabulary, do the experiment, complete the experiment page, and record the dates.
 - ⊕ **Day 2** – Read assigned pages and discuss together, prepare the science report or outline, and complete the sketch.
- ✓ A typical five-days-a-week schedule
 - ⊕ **Day 1** – Do the experiment and complete the experiment page.
 - ⊕ **Day 2** – Record the dates and define the vocabulary.
 - ⊕ **Day 3** – Read assigned pages and discuss together and complete the sketch.
 - ⊕ **Day 4** – Prepare the science report or outline.
 - ⊕ **Day 5** – Complete one of the Want More activities from the Teacher Guide.

Additional Resources

The following page contains quick links to the activities suggested in this guide along with several helpful downloads:

 <https://elementalscience.com/blogs/resources/bls>

Final Thoughts

As the author and publisher of this curriculum, I encourage you to contact me with any

questions or problems that you might have concerning *Biology for the Logic Stage* at support@elementalscience.com. I will be more than happy to answer them as soon as I am able. I hope that you will enjoy *Biology for the Logic Stage*!

Sincerely,
Paige Hudson
BS Biochemistry, Author

Ancients 5000 BC-400 AD

Medieval-Early Renaissance 400AD-1600AD

Late Renaissance-Early Modern 1600 AD-1850 AD

Modern 1850 AD-Present

Biology

Unit 1

Biological Building
Blocks

Unit 1: Introduction & Ecology

Vocabulary Sheet

Define the following terms as they are assigned on the Student Assignment Sheet.

1. Cell – _____

2. Mitosis – _____

3. DNA – _____

4. Genes – _____

5. Chromosomes – _____

6. Classification – _____

7. Kingdom – _____

8. Species – _____

9. Nutrient – _____

10. Food Chain – _____

11. Food Web – _____

12. Ecosystem – _____

13. Ecology – _____

14. Habitat – _____

Student Assignment Sheet Week 1

Cells

Experiment: What do plant cells look like?

Materials

- ✓ Microscope
- ✓ Slide
- ✓ Onion skin
- ✓ Celery stalk

Procedure

Note—If you have never used a microscope before, please ask the teacher to demonstrate how to use a microscope before beginning this experiment.

1. Read the introduction to this experiment and write a description of what you think you will see.
2. Make a wet mount slide of the onion skin. Look at the slide under the microscope on low power (100x) and then on high power (400x). Draw what you see for each.
3. Next, make a wet mount slide of the celery stalk. Look at the slide under the microscope on low power (100x) and then on high power (400x). Draw what you see for each.
4. Complete the experiment sheet.

Vocabulary & Memory Work

- Vocabulary: cell, mitosis
- Memory Work—This week, work on memorizing the Five Kingdoms and their Basic Characteristics.

1. **Monerans** – Microscopic organisms that have a simple, single cell. (*Example: Bacteria*)
2. **Protists** – A variety of complex, but mainly single-celled organisms. (*Example: Algae*)
3. **Fungi** – Organisms that absorb food and reproduce by making spores. (*Example: Molds*)
4. **Plants** – Living things that have many cells and most carry out photosynthesis. (*Example: Trees*)
5. **Animals** – Organisms made up of many cells and live by eating food. (*Example: Humans*)



Sketch: Plant and Animal Cells

- Label the following on the Plant cell – cell wall, cell membrane, cytoplasm, vacuole, nucleus, chloroplasts
- Label the following on the Animal Cell – nucleus, nucleolus, mitochondria, vacuole, endoplasmic reticulum, ribosome, cell membrane, lysosome, cytoplasm

Writing

🌀 Reading Assignment: *Usborne Science Encyclopedia* pp. 250-251 (Plant Cells), pp. 298-299 (Animals Cells)

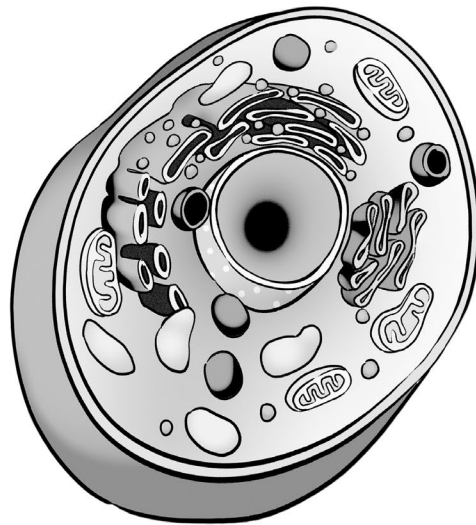
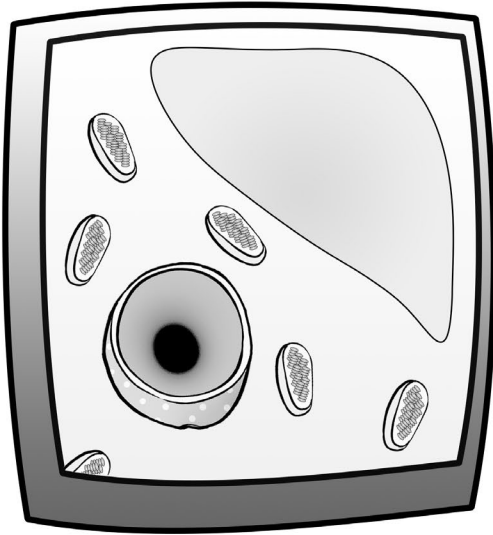
🌀 Additional Research Readings

-  The parts of a cell and what they do (including organelles): *UIDS* pp. 238-240
-  Cells: *DKEN* pp. 20-21

Dates to Enter

- ⊕ 1595 – Zacharias Janssen built the first microscope.
- ⊕ 1665 – The cell was first discovered and named by Robert Hooke.
- ⊕ 1839 – Cell theory was developed by Matthias Schleiden and Theodor Schwann.

Sketch Assignment Week 1



Experiment: What do plant cells look like?

Introduction

All living things are made up of tiny building blocks called cells. Cells carry out the necessary functions of life for the animal and plant. The best way to see these cells is by using a microscope. In this experiment, you will use a microscope to view the basic building blocks of celery and onion.

Hypothesis

I think that the cells will look like _____

Materials

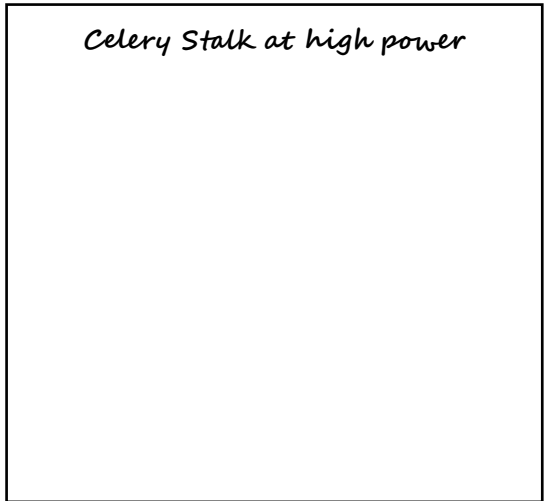
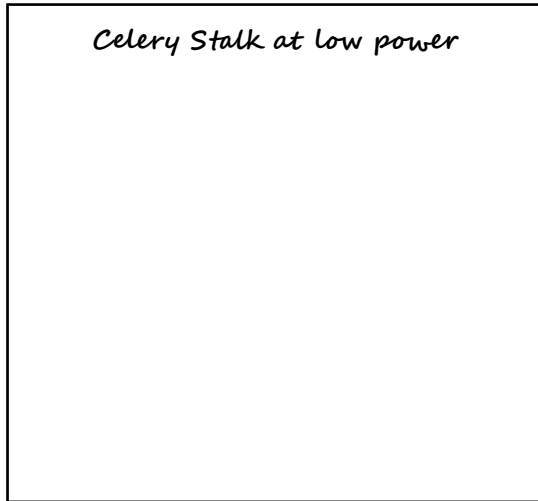
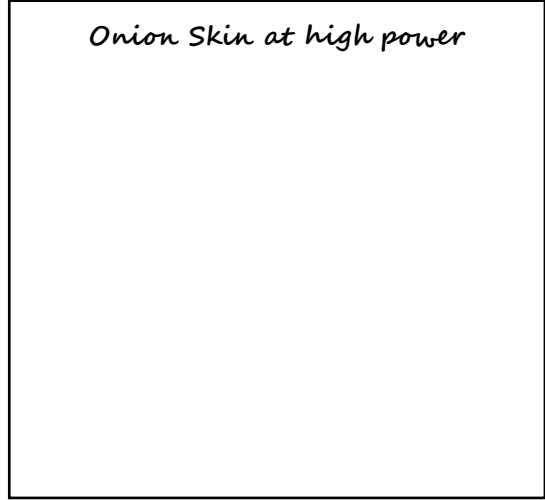
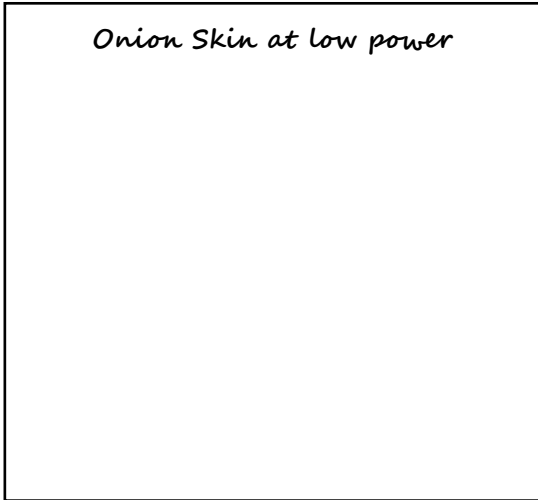
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

How to make a wet mount slide

1. Collect a thin slice of the sample and place it on the slide. (*Make sure the sample is very thin or else the cover slip will wobble and you won't get a very good view of the sample.*)
2. Place one drop of water over the sample. (*Make sure not to use too much water or else the cover slip will float away and again you won't be able to see the sample.*)
3. Place the cover slip at a 45 degree angle, with one edge touching the water, and let go. The slide is ready to be viewed.

Procedure

Observations



Conclusion

Written Assignment Week 1

Discussion Questions

Plant Cells, pp. 250-251

1. What are three of the basic parts of a plant cell and what does each do?
2. Are all plant cells the same? Why or why not?
3. What are the two stages of cell division in a plant cell? What happens in each of them?
4. What are the three types of plant tissue?

Animal Cells, pp. 298-299

1. What are three of the basic parts of an animal cell and what does each do?
2. Explain how cells come together to form organs.

Written Assignment Week 1

Student Assignment Sheet Week 2

DNA and Genetics

Experiment: DNA Extraction

Materials

- | | |
|--|------------------------------|
| ✓ Banana Slices | ✓ Zipper-style plastic bag |
| ✓ Dish soap | ✓ Coffee filter |
| ✓ Salt | ✓ Funnel |
| ✓ Ice-cold isopropyl alcohol (70% or higher) | ✓ Wooden coffee stirrer |
| | ✓ Test tube (or clear glass) |

Procedure

1. Read the introduction to this experiment.
2. Make the extraction solution by measuring out ½ cup of water (120 mL). Add 2 tablespoons (35 mL) of liquid dish soap and 1 teaspoon (5 grams) of salt. Mix well.
3. Add several slices of banana to the baggie – about a third of a banana will do. Using your hands, squish the outside of the baggie to mash up the banana. Then, add 1 to 2 tablespoons (15 to 30 mL) of extraction solution. Keep squishing for about a minute or so to make sure that some of the DNA is released into the solution. (**Note**—*If you have time, you can let the mixture sit for ten to fifteen minutes so that even more DNA is released.*)
4. Line the funnel with the coffee filter and place the funnel in the test tube. Then, pour the contents of the baggie into the lined funnel and gently squeeze the liquid into the test tube. You want the tube to be about a quarter to a third full.
5. Slowly pour 2 to 3 tablespoons (30 to 45 mL) of the ice-cold alcohol into the test tube, so that you create a layer of alcohol resting on your fruit layer.
6. Watch what happens. Use the wooden coffee stirrer to gently stir the solution and collect any of the material you can see.
7. Draw conclusions and complete the experiment sheet.

Vocabulary & Memory Work

- Vocabulary: DNA, genes, chromosomes
- Memory Work—Continue to work on memorizing the Five Kingdoms and their Basic Characteristics.

Sketch: DNA to Chromosomes

- Label the following – DNA strand, Coiled chromatin, Chromosomes, Nucleus, Cell

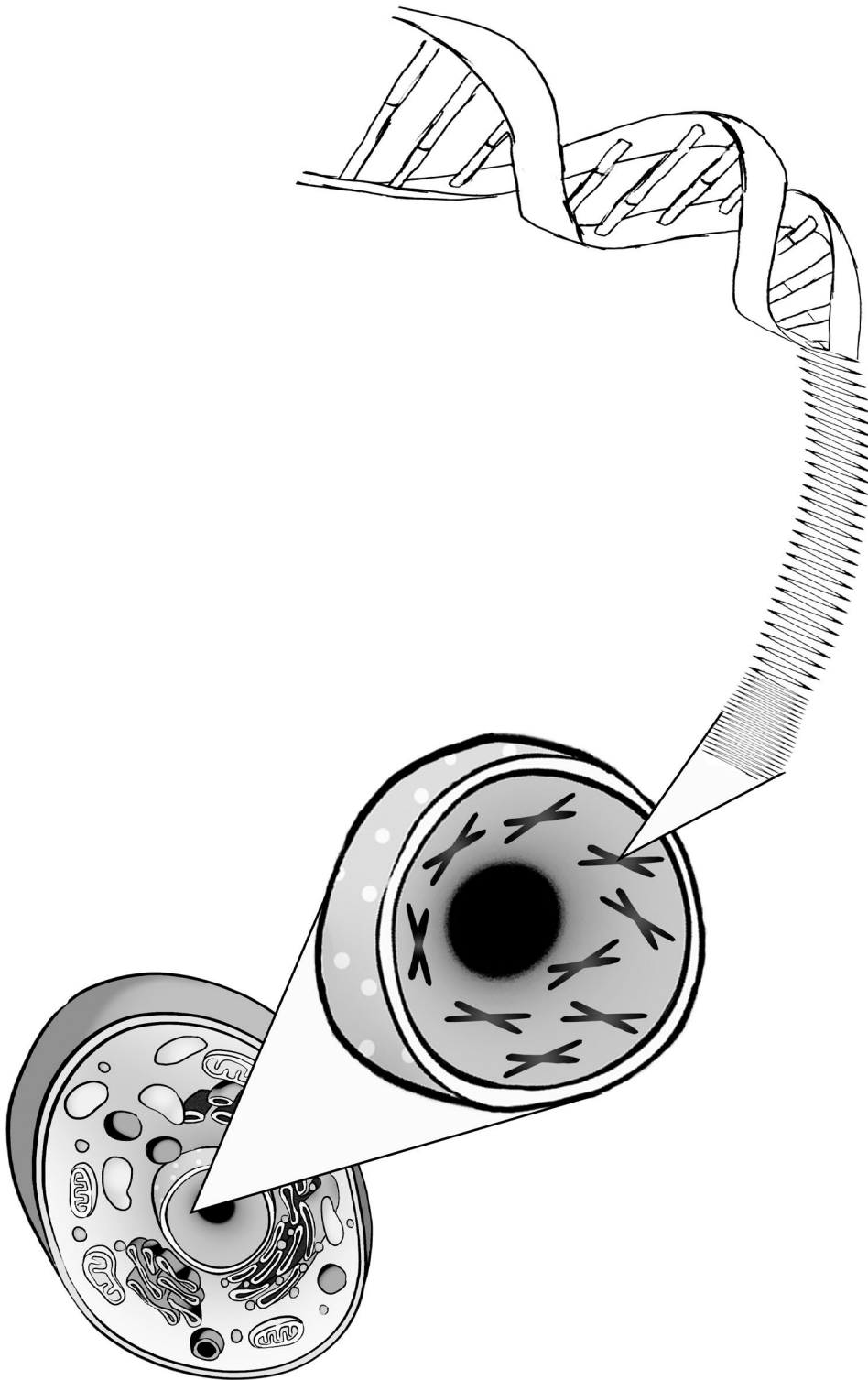
Writing

- 🌀 Reading Assignment: *Kingfisher Science Encyclopedia* pg. 135 Genes and Chromosomes
- 🌀 Additional Research Readings
 - 📖 Genetics: *USE* pp. 380-381, *UIDS* pp. 324-325
 - 📖 Gene Therapy: *USE* pp. 382-383

Dates to Enter

- ⊕ 1953 – James Watson and Francis Crick explain the double helix structure of DNA.

Sketch Assignment Week 2



Experiment: DNA Extraction

Introduction

DNA is the stuff that tells our cells what to do and how to look. It resides in the nucleus of a cell, so as you can imagine, it is quite tiny. In fact, you normally need a very powerful microscope to see DNA for yourself. In today's experiment, you are going to try to extract DNA and cause it to join up into a mass you can see.

Materials

_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Procedure

Observations

Picture of what happened in the test tube


Results

Conclusion

Appendix

Memory Work by Unit

Unit 1: Biological Building Blocks

Divisions of Life

1. Kingdom
2. Phylum
3. Class
4. Order
5. Family
6. Genus
7. Species

(The following mnemonic can help you as you work on memorizing these:

King Phillip Can Only Find his Green Shoes)

Five Kingdoms and their Basic Characteristics

1. **Monerans** – Microscopic organisms that have a simple, single cell. *(Example: Bacteria)*
2. **Protists** – A variety of complex, but mainly single-celled organisms. *(Example: Algae)*
3. **Fungi** – Organisms that absorb food and reproduce by making spores. *(Example: Molds)*
4. **Plants** – Living things that have many cells and most carry out photosynthesis. *(Example: Trees)*
5. **Animals** – Organisms made up of many cells and live by eating food. *(Example: Humans)*

Unit 2: Plants

Photosynthesis Equation

Carbon Dioxide + Water + Energy from the Sun \longrightarrow Carbohydrates + Oxygen

Parts of a Flowering Plant

1. **Root** – It helps to anchor the plant and absorb nutrients.
2. **Stem** – It holds the plant up and serves as the transport system for the plant.
3. **Leaf** – It absorbs sunlight and produces energy for the plant through chlorophyll.
4. **Flower** – It is the reproductive part of the plant.
5. **Seed** – It contains the material necessary to grow a new plant.

Parts of a Flower

1. Petals
2. Sepals
3. Pistil
4. Stigma
5. Style
6. Ovary
7. Ovules
8. Stamen
9. Anther
10. Pollen



elemental science

Are you ready to start?

Learn about ecology, plants, invertebrates, vertebrates, and the human body by purchasing *Biology for the Logic Stage* here:

🔗 <https://elementalscience.com/collections/biology-for-the-logic-stage>



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