

**NOEO
SCIENCE
BIOLOGY 2
INSTRUCTOR'S GUIDE**

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INSTRUCTOR'S GUIDE**

Created by Dr. Randy Pritchard

noeo science
MOSCOW, IDAHO

Noeo Science Packages

**GRADES 1-3 /
AGES 5-8**

Biology 1
Chemistry 1
Physics 1

**GRADES 4-6 /
AGES 9-12**

Biology 2
Chemistry 2
Physics 2

**GRADES 7-8 /
AGES 12-15**

Chemistry 3
Physics 3

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800-488-2034 | www.noeoscience.com
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INTRODUCTION

Welcome to Noeo

Welcome to Noeo Science! Thank you for trusting us to provide you with quality materials for teaching science at home. We understand that many homeschooling parents do not have a science background and may feel a bit intimidated about teaching science . . . especially when it comes to the experiments! Our books and experiments have been carefully selected to be of the highest quality available, yet simple enough for even the most science-phobic teachers and students. We intensely searched through library catalogs, websites, and hundreds of books before deciding on what we believe are the “best-of-the-best.” We hope that you will agree and we’re always open to your comments and suggestions.

Our Instructor’s Guides provide a logical, focused progression through the books and experiments. Each week you will find an overview of what your student will learn as well as an answer key for the student lab manual reading and experiment questions. Multiple sources of information are used to teach each science topic. However, you won’t need to spend your time searching for books or cross-checking indexes to make the curriculum flow. That work has been done for you!

What does noeo mean?

noeo | (no eh’ o) | verb

1. To perceive with the mind, to understand, to have understanding.
2. To think upon, heed, ponder, consider. (*The New Testament Greek Lexicon*)
3. Train the brain.

ROMANS 1:20

For since the creation of the world His invisible attributes, His eternal power and divine nature, have been clearly seen, being **understood** through what has been made, so that they are without excuse.

noeo

The Noeo Philosophy

The essence of science is simply observing and describing God’s creation. When scientists make a new discovery, they are seeing another part of creation revealed. Ro-

mans 1:20 tells us that His attributes, power, and divine nature are clearly seen in what has been made.

While some scientists deny that their discoveries are evidence of God’s creation, there are many that do recognize His attributes in all of creation. Our children should not be protected from science because of some scientific theories that deny God. They should instead be immersed in the sciences so that “His invisible attributes, His eternal power and divine nature” will be clearly seen.

The Noeo Method

You will find that the Noeo Science curriculum is different from all the rest. Each year of science will fill your child with wonder and excitement as they build a strong foundational knowledge of science. They’ll be having so much fun that the learning will come naturally for them . . . and painlessly for you.

Noeo Science is variety-filled, with a structure that is best described as a balance between the classical method and the Charlotte Mason approach. We emphasize narration and summarization, vocabulary development, observation, and the scientific method. We do not promote rote memorization or tests, as we think that this approach is less valuable for long-term retention. The following table illustrates these characteristics:

TEACHING METHOD	CORRESPONDING NOEO SCIENCE CURRICULUM QUALITIES
<p>Classical</p>	<ul style="list-style-type: none"> • Emphasizes vocabulary development, especially in the younger years. • Develops critical thinking skills and logic through the use of the scientific method. • Incorporates the classical stages of learning, i.e., the Trivium (grammar, logic, and rhetoric).
<p>Charlotte Mason</p>	<ul style="list-style-type: none"> • Provides the best books available (including “living books”). • Utilizes a child’s natural curiosity to acquire knowledge. “Studies serve for delight”. • Uses narration and notebooks rather than worksheets, tests, or repetitive drills to evaluate learning.

We think it is important to learn science from a variety of sources, using a variety of teaching techniques. Our curriculum does not use the traditional, single textbook approach to science education. We think variety will encourage more interest in sci-

ence, particularly with younger students. All of the books are carefully selected to allow children to discover the beauty, complexity, orderliness, and wonder of God’s design. While some written work is expected, many hands-on activities are included within the bright, colorful, and well-written books. Living book biographies of many important scientists are included to provide a practical perspective.

Occasionally, a book may introduce a particularly secular viewpoint. We view these times as an opportunity for discussions and encourage you not to skip over or “cover up” this information. We do not provide “canned” answers for these discussions, but encourage instructors to study the issues for themselves and to pray for guidance and understanding in providing answers to each student’s unique questions.

Just as creation is orderly and well organized, we think a good science curriculum should follow an orderly design. Each year of the curriculum will focus on biology, chemistry, or physics. Each of these three foundational sciences is studied independently for an entire year rather than jumping randomly from one subject to another without reason. The study of biology, chemistry, and physics is then repeated at a higher level and in more detail upon the completion of each three-year course of study (e.g. biology in 1st and 4th grade, chemistry in 2nd and 5th grade, etc.). Subjects that overlap multiple science disciplines, such as geology, weather, and astronomy, are included at logical points within the three major science studies. For example, astronomy is studied in parallel with the study of gravity within the physics curriculum.

NOEO COURSE	APPROXIMATE AGES	GRADE EQUIVALENT	CLASSICAL TRIVIUM STAGE
Biology I Chemistry I Physics I	5-8	1-3	Early Grammar
Biology II Chemistry II Physics II	9-12	4-6	Late Grammar or Early Logic
Chemistry III Physics III	12-15	7-9	Late Logic or Early Rhetoric

Our curriculum is designed on a 4-day per week schedule. If you would prefer to do science twice weekly, then simply complete the first two days of scheduled readings and assignments on your first day, and the last two days of reading and

assignments on your second day. Alternatively, you may wish to do all of the reading on the first day and the assignments and experiments on the second day. The key is to understand what works best for you and your children and to adjust the schedule as necessary.

The daily time necessary to complete the assignments will vary with individual student ability and will be based on the content being studied. We provide the following table as a guideline of the approximate time that you can expect to spend on daily assignments:

	4-DAY SCHEDULE	2-DAY SCHEDULE
Grades 1-3	15-20 minutes	30-40 minutes
Grades 4-6	20-30 minutes	40-60 minutes
Grades 7-9	30-40 minutes	60-80 minutes

Noeo Experiment Guide

Science is not a spectator sport. The best way for your child to learn and truly comprehend science is by doing hands-on experiments and activities. We know that this is one of the most dreaded parts of science for many homeschool families; that's why we were determined to put together high quality, straightforward experiments.

Noeo provides a strong foundation in science without wreaking havoc on your daily schedule. Each experiment and activity builds on the material that you cover in the week's readings, but don't worry—at the end of each experiment there is a section that explains what should have happened, and why it happened. So, if you decide to change things up, it won't be an issue.

The experiment kits come with any items that are normally difficult—or just plain inconvenient—to find. Both the Experiment Guide and Instructor's Manual have a complete supply list at the back, showing you which materials we're providing, and which materials you'll need from home. And yes, the home materials are real, honest-to-goodness, home materials—things for school, from your cabinets, and your pantry. Watch as your student progresses through these well organized, fully explained experiment kits, while actually having fun learning science.

You might notice that in between the Experiments there are some Activities and Optional Activities. Activities include the supplies you'll need, but they don't require as much explanation as Experiments, and your student won't be answering questions

about them. Optional Activities are fun, optional things to do related to the reading of the week—most of the time they’re outings or family activities, or they need materials that we didn’t want to require you to buy.

Experiment Kits

There are 4 experiment kits, including all of the wild and wacky materials that you would normally spend hours (and let’s face it: way too much money) sourcing on Amazon. Each kit lists its contents sorted by what you’ll need for each week’s experiments. Why 4 kits? It’s much less overwhelming than opening a box full of loose food dye and pipettes. But there is an even better reason: say your child opens their Noeo box, and sees a toy car for an experiment 20 weeks away. Realistically, that car is toast. With the materials sorted into kits, the materials are a little easier to manage—and you only have a few weeks to make sure you don’t lose that car, instead of 36.

Student Lab Manual

In the Student Lab Manual, your student will answer questions about key points both from their reading and experiments. The experiment questions in particular are centered around drawing results, making observations, asking questions, and making connections—all things that will slowly introduce your student to the scientific method and lab reports.

Younger students may need to “narrate” their descriptions and observations to you or an older sibling. It’s completely up to you to determine the length and amount of detail you expect from your student, but we do encourage you to increase this expectation over time.

Instructor’s Guide

Schedules, answers keys, lists of books and home supplies—it’s all here. Everything you need to make Noeo work for you is right here in the Instructor’s Guide. A list of the supplied books is provided, so that you can keep an eye on exactly which books you need for the course.

Lists of both home and included supplies are at the back of the book. The materials list is organized by weeks; so, if an experiment calls for a carrot, you won’t be stuck with a slowly decomposing root vegetable in your fridge until you need it thirty weeks later.

Every week, you can refer to our provided schedule (flexible enough that you could do it all in 1 day if you’ve got an enthusiastic scientist, or stretch it out as much as you

need), overview of the week's subject matter, and answers to both reading and experiment questions. If your student ends up begging to do more, no need to worry—you don't work for your curriculum, Noeo works for you.

Resource List

Books

- *Animals: A Visual Encyclopedia*, by DK
- *The Body Book*, by Donald M. Silver and Patricia J. Wynne
- *Usborne Science and Experiments: The World of the Microscope*
- *Usborne Science Encyclopedia (Internet-linked)*

Optional:

- *Explore Evolution: The Arguments for and Against Neo-Darwinism*, by Stephen C. Meyer
(see note in Week 24)

Supplies

- *Carson 100x-250x High Power Pocket Microscope*
- *Microscope Slide Preparation Kit*, by Amscope Microscope
- *48 piece Color-coded prepared Plastic Microscope Slides with Plant, Insect, Mammal, Bird, and Fish specimens*, by Amscope Microscope
- *Noeo Experiment Kits 1-4*

**DAILY LESSON
PLANS FOR
READING &
EXPERIMENTS**



unit 1:
THE
M I C R O S C O P I C
W O R L D

Week 1: The Microscope	15
Week 2: Using Your Microscope.....	19
Week 3: Microscopy and Cells	23
Week 4: Classification.....	27



Week 1: The Microscope

Schedule

	DAY 1	DAY 2	DAY 3	DAY 4
<i>The World of the Microscope</i>	pp. 4, 10–11	pp. 12–13	pp. 14–15	p. 16
<i>Experiment Guide</i>	Make a Simple Microscope	Hairs	Making a Temporary Mount	

Overview

Let's begin with a review of the definition of science: When we say "science," we mean two different things. First, science refers to the process by which people observe, question, and test the natural world. This is sometimes called the scientific method. Noeo provides regular experiments to help develop this side of science. However, science isn't all experimentation. Second, "science" also refers to the body of knowledge that other people (scientists) have discovered by using the scientific process. That's why some weeks of Noeo will have you reading great books about what others have discovered.

One more note before you start on Unit 1: Biology is the scientific process applied to the study of life itself, from the smallest living things to the biggest. You'll be observing and reading about as many living creatures as possible this year in Biology 2. This week and next, you'll need to get very familiar with one of the coolest tools for doing that this year: the microscope. Be patient, because it takes practice and skill to be able to observe specimens with a microscope. That's why you'll have a few more instructions than usual as you get comfortable.

Reading Questions

DAY 1

1. What did Antonie van Leeuwenhoek make? **He made his own simple microscopes which had a single lens and was handheld.**

2. What did Robert Hooke draw? **He drew pictures of cork cells.**
3. What are electron microscopes able to do? **They are able to magnify things hundreds of times more than optical microscopes.**

DAY 2

1. What are the differences in appearance between human hair, sheep hair, and dog hair (p. 12)? **Human hair is thin and interlocking, sheep hair is like little squares, and dog hair comes in rows.**
2. What are bottom and top lighting? **They are the lights in the bottom and top of a microscope.**
3. What are cavity and ring slides? **They are slides prepared for examining pond creatures in a drop of water.**
4. What are slide cover slips? **They are covers for objects on slides that prevent the objects from drying out.**

DAY 3

1. What is a nucleus? **The nucleus is an organelle that controls everything that happens in the cell.**
2. What is the cytoplasm? **The cytoplasm is the contents of the cell other than the nucleus.**
3. What is the cell membrane? **The cell membrane is a thin layer which holds the cell's contents.**
4. What is the cell wall? **The cell wall is a thick membrane of plant cells.**
5. What are chloroplasts? **Chloroplasts are the part of plant cells that make food from sunlight and make leaves green.**

DAY 4

1. What are bacteria? **Bacteria are very tiny organisms made up of just one unit which is simpler than and very different from plant or animal cells.**
2. Where do they live? **They can live in other living things or in dead plants and animals.**
3. What are cocci and bacilli? **Cocci are bacteria that are spherical shaped, and bacilli are bacteria that are rod-shaped.**

Experiment: Make a Simple Microscope

MATERIALS

Included in Kit

- cardstock
- toothpick (to poke a hole)

From Home

- tape
- cling film
- scissors
- book or newspaper

EXPERIMENT QUESTIONS

1. What were you able to see through your simple microscope? Draw it here.
2. Whose simple microscope were you imitating in this experiment? **You were imitating Antonie van Leeuwenhoek's simple microscope.**

Experiment: Under the Microscope—Hairs

MATERIALS

Included in Kit

- microscope
- slide

From Home

- tape
- hairs
- feathers, optional

EXPERIMENT QUESTIONS

1. What were you able to see through your microscope? Draw it here.
2. What did the hair from the adult's head look like? **Answers will vary.**
3. What did the hair from the child's head look like? **Answers will vary.**
4. What did the hair from your pet look like? **Answers will vary.**
5. What did the feather from a bird look like? **Answers will vary.**

Experiment: Making a Temporary Mount

MATERIALS

Included in Kit

- microscope
- tweezers
- pipette
- slide (from your microscope kit)
- cover slip (from your microscope kit)

From Home

- cutting board
- knife (use with an adult's help)
- onion

EXPERIMENT QUESTIONS

1. What were you able to see through your microscope? Draw it here.
2. Sketch the magnified onion.



Week 2: Using Your Microscope

Schedule

	DAY 1	DAY 2	DAY 3	DAY 4
<i>The World of the Microscope</i>	p. 17	pp. 20–21	pp. 22–23	
<i>Experiment Guide</i>	Band-Aid	Paper		Sugar Crystals & Rocks

Overview

It's very important that you get comfortable with your microscope. You'll get more practice observing things under the microscope as you continue to learn about the microscopic world. Specifically, you'll get more practice using your microscope at different levels of magnification.

Reading Questions

DAY 1

1. What are viruses? **Viruses are the smallest type of organism known to man.**
2. Do viruses exist on their own? **No, they invade the cells of living things and force the cells to make more of them.**
3. Why were they discovered long after the discovery of bacteria? **They are too small to be seen with the naked eye.**

DAY 2

1. What are plankton? **Plankton are all microscopic plants and animals living near the surface of water.**
2. What are algae? **Algae are plants which live in the sea and have no roots, leaves, or flowers.**
3. What are hydroids? **Hydroids are collections of animals which look like plants.**
4. What are bryozoans? **Bryozoans are colonies of animals which look like hydroids and form crusty mats on seaweed and rocks.**

DAY 3

1. What are flagellates? **They are algae that have one or more whip-like flagella which they use to move around.**
2. What are diatoms? **They are algae that have an outer case made of silica.**
3. What are ciliates? **They are freshwater animals that are covered in tiny hairs called cilia which they use to move around.**
4. What are rotifers? **They are freshwater animals that have a foot which they use to attach themselves to objects.**

DAY 4

Experiment

Experiment: Under the Microscope—Band-Aid

MATERIALS

Included in Kit

- microscope

From Home

- band-aid
- shirt or rag

EXPERIMENT QUESTION

1. What were you able to see through your microscope? Draw it here.

Experiment: Under the Microscope—Paper

MATERIALS

Included in Kit

- microscope

From Home

- copy paper
- notebook paper
- toilet paper

EXPERIMENT QUESTION

1. What were you able to see through your microscope? Draw it here.

Experiment: Under the Microscope—Sugar Crystals & Rocks

MATERIALS

Included in Kit

- microscope

From Home

- white sugar
- small rocks
- blank slide (from your microscope kit)

EXPERIMENT QUESTION

1. What were you able to see through your microscope? Draw it here.