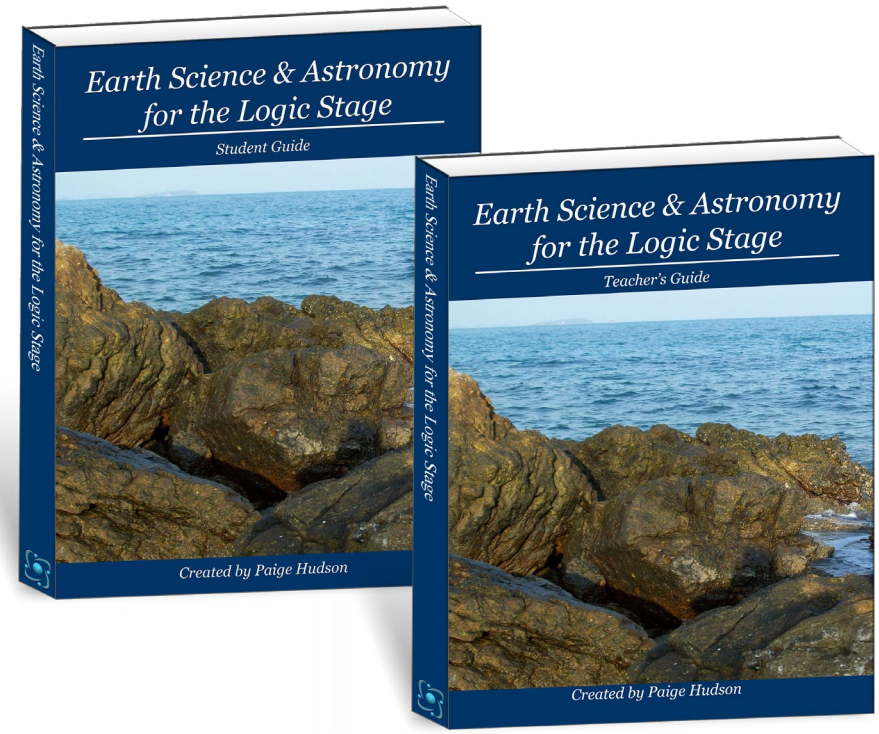


Earth Science and Astronomy for the Logic Stage Sample Packet

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

- ✓ The Teacher Guide (*beginning on pg. 3*)
- ✓ The Student Guide (*beginning on pg. 38*)

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

- https://elementalscience.com/collections/earth-science-astronomy-for-the-logic-stage

Earth Science & Astronomy for the Logic Stage
Teacher Guide Table of Contents

Earth Science & Astronomy 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' brain 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. *Earth Science & Astronomy 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 the 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 student should complete a science project. Their project should work through the scientific method from start to finish on a basic level, meaning that their question should be relatively easy to answer. The science fair project, scheduled as a part of unit three fulfills the requirements of this component.

Earth Science & Astronomy 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

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

you give quizzes or tests to the students. However, if you want to familiarize them with test-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 earth science and astronomy while teaching the basics of the scientific method. During the years, the students will work on their observation skills, learn to think critically about the information they are studying, and practice working independently. *Earth Science & Astronomy for the Logic Stage* is intended to be used with sixth through seventh grade students.

What this guide contains 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 *Earth Science & Astronomy for the Logic Stage*.

Student Guide

The Student Guide, which is sold separately, is designed to encourage independence in the students as they complete *Earth Science & Astronomy 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 and 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 it 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. 239 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 that 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 experiment, so that someone else could read their report and replicate their experiment. In the observation section, the students will write what they saw. Finally, in the conclusion section they will write whether or not their hypothesis was correct and share any additional information they have learned from the experiment. If the students' hypotheses were not correct, discuss why and have them include that on their experiment sheet.

Vocabulary & 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. So, these sketch assignments will 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 in the spine text, the *Kingfisher Science Encyclopedia* or the *Usborne Science Encyclopedia*. The students will read the assigned pages, and then discuss what they have read with you. After you have finished reading and discussing the reading assignment, you have three options for the students' writing assignment.

- ***Option 1: Have your student write an outline from the spine text.***
  A typical sixth grader completing this program should be expected to write a two level outline for the two page spread assigned for the week. This outline should include the main point from each paragraph on the page along with one to three supporting points.
- ***Option 2: Have your student write a narrative summary from the spine text.***
  A typical sixth grader completing this program should be expected to write a two to four paragraph summary (or six to ten sentences) 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 level outline or list of seven to nine facts for the two page spread. Next have the students do some additional reading on the topic from one or more of the

additional research assignments. Each topic will have pages assigned from these reference books for their research. The following encyclopedias are scheduled to be used as additional reference books:

- 🕮 *The DK Encyclopedia of Science, 2016 Edition* (DKEOS) – This resource is a slightly more advanced reference work than the *Kingfisher Science Encyclopedia*.
- 🕮 *DK Eyewitness Books: Astronomy, 2013 Edition* (DK Astro) – This resource is only for the astronomy study and is also approaching the high school level.
- 🕮 *Exploring the Night Sky, 1987 Edition* (ENS) – This is more of a stargazing guide, but several pages are scheduled throughout the astronomy unit.

Once the students complete the additional research reading, have them write a report of two 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 do school, either in science or in another subject. So, 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' report, 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 form). 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 report, have them glue a copy of it 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. 234-237.

Schedules

Earth Science & Astronomy for the Logic Stage is designed to take up to three to four 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. 245-246.

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 if 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 outline or report. 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 before hand 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 guide, so it is up to you whether or not to assign these.

☑ **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. You can choose to give the tests orally or copy them for the students to fill out.

What a typical two day schedule looks like

A typical two day schedule will take one and a half to two hours per day. Here's a breakdown of how a normal two day week would work using week one:

- **Day 1:** ***Define the vocabulary, do the experiment as well as complete the experiment sheet and record the dates.***

  Begin day 1 by having the students do the "Can I calculate the speed of light using a microwave?" experiment. Have them read the introduction and then perform the experiment using the directions provided. Next have them complete the necessary calculations, discuss their results with you and then write a conclusion for their experiment. Finish the day by having them look up and define "universe" using the

glossary in their guide and adding 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 pg. 386-387 in the *Kingfisher 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 two level outline of the spine text for Week 1

I. The universe consists of everything in space.
   A. The universe contains atoms, people, our Earth, our solar system and countless galaxies.
   B. We cannot see everything that is included in the universe.
II. Measuring distances in the universe is different than measuring distances on Earth.
   A. We use Astronomical Units to measure distances within our solar system.
   B. We use light years to measure distances in the universe outside of our solar system.
III. Everything in the universe is moving.
   A. Planets spin on their axis and orbit the Sun.
   B. Galaxies in the universe move with the expansion of the universe.

Sample Narrative Summary from the spine text only for Week 1

The universe is a dynamic entity that consists of everything in existence. It contains the smallest particles, like atoms as well as countless stars and galaxies. Our planet and solar system are all a part of the universe. It is so large that we cannot see everything that is included in the universe.

Astronomers cannot use the same unit to measure distances in the universe that they use on Earth. On Earth we use either the metric or the US Customary system to measure distances. However distances in the universe are too great to use meters or feet to measure. Instead astronomers use Astronomical Units to measure distances within our solar system and light years to measure distances in the rest of the universe.

The universe is always changing because it is constantly moving. The planets in our solar system are moving by spinning on their axis. The stars and other objects in our galaxy are moving by orbiting around a central point in the Milky Way. Then there are other galaxies that are moving with the expansion of the universe. Finally, the universe itself is continually expanding.

What a typical five day schedule looks like

A typical five day schedule will take thirty to forty-five minutes per day. Here's a breakdown of how a normal five day week would work using week one:

- **Day 1:** ***Do the experiment and complete the experiment sheet***
  Begin day 1 by having the students do the "Can I calculate the speed of light using a microwave?" experiment. Have them read the introduction and then perform the experiment using the directions provided. Next have them complete the necessary calculations, 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 pg. 386-387 in the *Kingfisher Science Encyclopedia*. Then using the questions provided, discuss what they have read. Then have the students write a two level outline or a list of facts. Here's a sample list of facts:

Sample list of facts from the spine text for Week 1

1. The universe contains atoms, people, our Earth, our solar system and countless galaxies.
2. We cannot see everything that is included in the universe.
3. We use Astronomical Units to measure distances within our solar system.
4. We use light years to measure distances in the universe outside of our solar system.
5. Everything in the universe is moving.
6. Planets spin on their axis and orbit the Sun.
7. Galaxies in the universe move with the expansion of the universe.

- **Day 3:** ***Record the dates, define the vocabulary and complete the sketch.***
  Have the students look up and define "universe" using the glossary in their guide and adding 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 pg. 154-155 in the *The Usborne Science Encyclopedia*. Then have the students use their outline or list facts along with what they have just read to write a three to five paragraph summary of what they have learned. Here's a sample of what that summary could look like:

Sample Written Report for Week 1

The universe is the term used to describe all the atoms, people, planets, galaxies, and space that exists. It is large that we can't see most of the universe. Scientists use light years to measure distances in the portions of the universe that we can see. A light year is distance that light can travel within one year.

The universe is always changing because it is constantly moving. The planets in our solar system are moving by spinning on their axis. The stars and other objects in our galaxy are moving by orbiting around a central point in the Milky Way. Then there are other galaxies that are moving with the expansion of the universe. Finally, the universe itself is continually expanding.

The constant expansion of the universe and a week signal from deep space have led scientist to create the Big Bang theory as an

explanation of how the universe began. The Big Bang Theory states that a big bang created a huge fireball, which cooled and formed into tiny particles, called matter. This matter then spread out forming thick clouds of hydrogen and helium. Over time, these clouds separated and formed the galaxies and planets we know today.

- **Day 5:** ***Complete one of the Want More activities***
  Have the students spend some time observing the universe or use this day to discuss the Big Bang Theory.

The Science Fair Project

I have scheduled time for the students complete a science fair project during unit three. *Janice VanCleave's A+ Science Fair Projects* is excellent resources for choosing a project topics within the field of earth science or astronomy. You can call your local school system to see if it allows homeschooled students to participate in the local school science fair or get information on national science fairs from them. Another option would be to have the students present their project 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 earth science and astronomy you have two options for the elementary students when using this program with the middle school students:

- ***Option 1: Have the younger students use Earth Science & Astronomy for the Grammar Stage***
  I recommend this option if the younger students are in first through third grade and/or the older student is ready for some independence. You will need to rearrange the units in *Earth Science & Astronomy for the Logic Stage* so that all the students will remain on similar topics. I suggest that you do the units in the following order: Unit 4, Unit 6, Unit 5, Unit 2, Unit 3, and Unit 1.
- ***Option 2: Have the younger students use Earth Science & Astronomy for the Logic Stage along with the older students***
  I recommend this option if the younger students are in third through fourth grade and/or the older students are not ready to work independently. You will need to adjust the work load for the younger student. Here are some suggestions on how to do that:
  - ✓ Have them watch and observe the experiments. Do not expect them 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 it back to you;
  - ✓ Let them 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 read to them out of the *Usborne Science Encyclopedia*, which is scheduled as an additional research reading resource or you can use the following books instead:
  - 🕮 *DK First Space Encyclopedia, 2016 Edition*

📖 *DK First Earth Encyclopedia, 2010 Edition*

I have included a chart coordinating these resources in the Appendix of this guide on pp. 240-242.

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 on 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/esals

Final Thoughts

If you find that this program contains too much work, please tailor it to the needs of your student. As the author and publisher of this curriculum I encourage you to contact me with any questions or problems that you might have concerning *Earth Science & Astronomy 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 student enjoy *Earth Science & Astronomy for the Logic Stage*!

Book List

The following books were used when planning this study. (**Note—***The editions noted here are the most current editions. However, the past two editions of each of these resouces will also work.*)

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.

- 🕮 *The Kingfisher Science Encyclopedia, 2017 Edition* (KSE)
- 🕮 *The Usborne Science Encyclopedia, 2015 Edition* (USE)

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. The first encyclopedia was scheduled in previous logic stage programs.

- 🕮 *The DK Encyclopedia of Science, 2016 Edition* (DKEOS) – This resource is a slightly more advanced reference work than the *Kingfisher Science Encyclopedia*.
- 🕮 *DK Eyewitness Books: Astronomy 2013 Edition* (DK Astro) – This resource is only for the astronomy study and is also approaching the high school level.
- 🕮 *Exploring the Night Sky, 1987 Edition* (ENS) – This is more of a stargazing guide, but several pages are scheduled throughout the astronomy unit.

Sequence of Study

Astronomy Units (15 weeks)

Unit 1: Space (5 weeks)
- ✓ Universe
- ✓ Galaxies
- ✓ Stars
- ✓ Constellations
- ✓ Constellations: Research Project

Unit 2: Our Solar System (6 Weeks)
- ✓ Sun
- ✓ Inner Planets
- ✓ Earth/Moon
- ✓ Outer Planets
- ✓ Dwarf Planets
- ✓ Comets, Meteorites

Unit 3: Astronomers & Their Tools (4 Weeks)
- ✓ Astronomers
- ✓ Looking into Space
- ✓ Exploring Space
- ✓ Satellites

Earth Science Units (20 weeks)

Unit 4: Our Planet (7 weeks)
- ✓ Inside the Earth
- ✓ Maps and Mapping
- ✓ Rivers
- ✓ Oceans
- ✓ Glaciers
- ✓ Natural Cycles
- ✓ Biomes and Habitats

Unit 5: Geology (7 weeks)
- ✓ Continents
- ✓ Volcanoes
- ✓ Earthquakes
- ✓ Mountains

- ✓ Rocks
- ✓ Ores and Gems
- ✓ Erosion and Weathering

Unit 6: Weather (6 Weeks)

- ✓ Atmosphere
- ✓ Climates
- ✓ Weather
- ✓ Clouds
- ✓ Extreme Weather
- ✓ Forecasting

End-of-the-year Test (1 week)

Materials Listed by Week

Astronomy Units

Unit 1: Space

Week	Materials
1	Large chocolate bar, large plate, microwave
2	4 Types of Galaxies article (in appendix of SG), galaxy cards
3	Aluminum foil, large piece of cardboard (large enough to fit under the glass bowl), glass bowl, flashlight, scissors
4	Shoebox, black construction paper, pin, flashlight
5	*No supplies needed.*

Unit 2: Our Solar System

Week	Materials
6	2 glass jars or 2 clear glasses, Plastic wrap, 2 black tea bags, Water, Instant read thermometer
7	3 heavy duty plastic bottles, 3 balloons, 3 tsp of yeast (1 ½ packages), 3 TBSP of sugar, Water , White vinegar
8	Apple, Fork, Flashlight, Partner
9	Wooden Dowel, Foil, Paper clip, Toaster
10	Construction paper, Paints or crayons
11	Marble, Rubber bouncy ball, Foam ball, Tennis ball, Cake pan, Cornstarch, Ruler

Unit 3: Astronomers & Their Tools

Week	Materials
12-14	Materials will vary depending on the Science Fair Project that your student has chosen to do

Earth Science Units

Unit 4: Our Planet

Week	Materials
16	Modeling clay (you will need yellow, orange, red, blue, and green), Ruler
17	Blue balloon (with the continents drawn or printed on it), Flat map, Pin
18	Pitcher for water, Water, Cookie sheet, Paper cup, Straw, Dirt or sand, Small rocks, Clay or play dough, Books, Tape

Unit 4: Our Planet (continued)

Week	Materials
19	Aluminum bread pan or Plastic bin, Air dry clay, Water, Sand (1 cup), 2 Straws
20	Glacier Melt Model (make using cup, water, pebbles, sand), Large cutting board with a handle, Large rubber band
21	Cup, Baggie, Water, Rubber band
22	Paper towels, Wax paper, Rubber band, Water

Unit 5: Geology

Week	Materials
23	Marshmallow creme (or whipping cream), Graham crackers, 3 Plates, Bowl with water
24	Mentos™, Cardboard cereal box, 1-Liter bottle of cola (or orange soda), 1 Can of Great Stuff™ Foam, Paints, Aluminum oil
25	Partner, Slinky, Rope
26	Several different colors of crayons, Grater, Butter knife, Pencil sharpener, Foil, Bowl, Warm water, Foil muffin cups
27	7 to 10 Rocks collected from outside, Rock & Mineral field guide, Plastic baggie, Sharpie Marker, White-out
28	5 to 8 More rocks collected from outside, Rock & Mineral field guide, Foam board, Sharpie Marker, White-out
29	Dirt or sand, Grass seed, Water, Pitcher, 2 Aluminum Pans ***NOTE:*** *You will need to plant your grass seed mountain at least 7 days before doing this experiment so that it will grow in time to do the experiment.*

Unit 6: Weather

Week	Materials
30	3 Cups, 2 Colors of food coloring, Hot and cold water
31	3 Foil muffin cups, Soil from outside, Sand, Water , Desk lamp
32	Balloon, Two permanent markers of different colors, A partner
33	2 Liter bottle, Water, Matches
34	Large clear round container, Warm water , Red food coloring, Blue ice cubes
35	Battery powered toothbrush, Sound recording device

Astronomy Unit 1

Space

Astronomy Unit 1: Space
Overview of Study

Sequence of Study

Week 1: Universe (Optional: Big Bang Theory)
Week 2: Galaxies
Week 3: Stars
Week 4: The Big and Little Dipper
Week 5: Constellations

Materials by Week

Week	Materials
1	Large chocolate bar, large plate, microwave
2	4 Types of Galaxies article (in appendix of SG), galaxy cards
3	Aluminum foil, large piece of cardboard (large enough to fit under the glass bowl), glass bowl, flashlight, scissors
4	Shoebox, black construction paper, pin, flashlight
5	Shoebox planetarium from previous week, black construction paper, pin & a flashlight

Vocabulary for the Unit

1. **Universe –** The collection of all the matter, space, and energy that exists, also known as the cosmos.
2. **Galaxy –** A body held together by gravity that is made of millions of stars, gas, and dust.
3. **Cluster –** A group of galaxies that are found close together.
4. **Supercluster –** The largest structure in the universe, composed of many galaxy clusters.
5. **Star –** A massive, hot, shining ball of gas.
6. **Nebulae –** Clouds of dust and gas found in space.
7. **Black hole –** Formed by a collapsed star, has a very strong gravitational pull.
8. **Constellation –** The pattern that a group of stars seems to make in the sky.
9. **Planetarium –** A device used to project images of the stars or depict the solar system.
10. **Zodiac –** The twelve constellations through which the sun, moon, and planets appear to move.

Memory Work for the Unit

Types of Stars

1. Blue giant – A large, hot star off the main sequence.
2. Red giant – An older star with a cooler outer layer.
3. Neutron star – The tightly-packed collapsed core of a larger star.
4. Main-sequence star – A star plotted in the left-to-right band across the HR diagram.

5. Black hole – A gravitationally dense region of space-time where nothing can escape, not even light.
6. White dwarf – A stellar core remnant of a low to medium mass star.
7. Red dwarf – A cool, small star on the main sequence.

Constellations of the Zodiac

1. Aquarius
2. Aries
3. Cancer
4. Capricorn
5. Gemini
6. Leo
7. Libra
8. Pisces
9. Sagittarius
10. Scorpio
11. Taurus
12. Virgo

Notes

Student Assignment Sheet Astronomy Week 1
Universe

Experiment: Can I calculate the speed of light using a microwave?

Materials

- ✓ Large chocolate bar
- ✓ Large plate
- ✓ Microwave
- ✓ Ruler

CAUTION

Melted chocolate is very hot and can burn, DO NOT touch!

Procedure

1. Read the introduction to this experiment and answer the question.
2. Unwrap the chocolate bar and place it on the plate. Remove the turntable from your microwave and set the plate inside.
3. Begin by heating the chocolate bar for 1 minute; check to see if it has begun to melt. (*You are looking to see if there are two spots that have begun to melt. You DO NOT want the entire chocolate bar to melt.*) If the bar has not begun to melt, continue to heat it for 30-second intervals, checking each time to see if melting has begun.
4. Once melting has begun, carefully remove the plate from the microwave and measure the distance between the centers of the two melted points.
5. Record the distance on your experiment sheet and complete the calculations.
6. Draw conclusions and complete your experiment sheet.

Vocabulary & Memory Work

- ☐ Vocabulary: universe
- ☐ Memory Work – Work on memorizing the Types of Stars.

Sketch Assignment: Contents of the Universe

- 🖼 Label the following: Earth, Our Solar System, Milky Way Galaxy, Cluster of Galaxies, The Universe

Writing Assignment

- Reading Assignment: *Kingfisher Science Encyclopedia* pg. 386-387 The Universe
- Additional Research Readings
  - 🕮 Big Bang Theory: *KSE* pg. 388-389
  - 🕮 The Universe: *USE* pg. 154-155

Dates to Enter

- 1929 – Edwin Hubble proves that the universe is expanding.
- 1965 – Scientists find heat waves in the universe that they believe are leftover from a vast explosion.
- 1992 – The satellite *Cosmic Background Explorer* traces background radiation and ripples in the universe that are thought to be leftover from the Big Bang.

Schedules for Week 1

Two Days a Week

Day 1	Day 2
☐ Define universe on SG pg. 14 ☐ Do the "Can I calculate the speed of light?" experiment, then fill out the experiment sheet on SG pp. 18-19 ☐ Enter the dates onto the date sheets on SG pp. 8-12	☐ Read pp. 386-387 from the *Kingfisher Science Encyclopedia*, then discuss what was read ☐ Color and label the "Contents of the Universe" sketch on SG pg. 17 ☐ Prepare an outline or narrative summary, write it on SG pp. 20-21
Supplies I Need for the Week ✓ Large chocolate bar ✓ Large plate ✓ Microwave ✓ Ruler	
Things I Need to Prepare	

Five Days a Week

Day 1	Day 2	Day 3	Day 4	Day 5
☐ Do the "Can I calculate the speed of light?" experiment, then fill out the experiment sheet on SG pp. 18-19	☐ Read pp. 386-387 from the *Kingfisher Science Encyclopedia*, then discuss what was read ☐ Write an outline or list of facts on SG pg. 20	☐ Define universe on SG pg. 14 ☐ Enter the dates onto the date sheets on SG pp. 8-12 ☐ Color and label the "Contents of the Universe" sketch on SG pg. 17	☐ Read one or all of the additional reading assignments ☐ Prepare your report, write the report on SG pg. 21	☐ Complete one of the Want More Activities listed **OR** ☐ Study a scientist from the field of Astronomy
Supplies I Need for the Week ✓ Large chocolate bar ✓ Large plate ✓ Microwave ✓ Ruler				
Things I Need to Prepare				

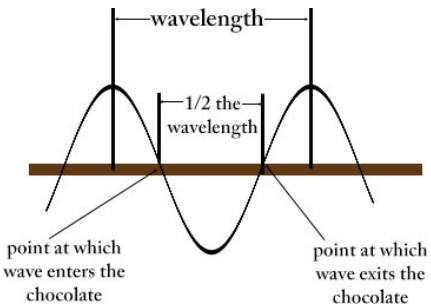
Additional Information Astronomy Week 1

Experiment Information

- **Introduction –** (*from the Student Guide*) The universe is the vast expanse of space in which all things are found. It contains us, our planet, our solar system, our galaxy and at least 100 billion other galaxies. Astronomers have studied what they call the observable universe since Galileo invented the first telescope in 1609. As astronomers began to record their observations, they found the need to calculate distances, so that they could give approximate locations for the objects in the universe. Since the distances in the universe are so large, astronomers began to use light years to calculate them. A light year is the distance a wavelength of light will travel in one year, or about 5.88 trillion miles. In this experiment, you are going to try to calculate the speed of light, which scientists then multiply by the time in one year to calculate a light year.
- **Results –** Depending on the strength of your microwave, the students will measure the distance between the two spots to be between five to ten centimeters. Here is a sample calculation for a student that measured a 6 centimeters (0.06 meters) distance in a 2450 Mega Hertz (MHz) microwave.

  Calculation #1: 0.06 m x 2 = 0.12 m (wavelength)
  Calculation #2: 2450 MHz x 1,000,000 = 2,450,000,000 Hz (cycles per second)
  Calculation #3: 0.12 m x 2,450,000,000 Hz =294,000,000 m/s (close to the speed of light)

  When the students complete the calculations, they should see that their speed is close to the actual speed of light (299, 792, 452 m/s).
- **Explanation –** Microwave ovens have an electromagnetic wave that has the same frequency and wavelength as light. In a microwave, the energy, or heat, is concentrated at the peaks of the waves. So the chocolate will melt first at the points where the wavelength entered and exited the chocolate bar (*see diagram*). If you measure the distance between the centers of the two melted spots, you are measuring the distance between two nodes of a standing wave, which is half of the wavelength. You then multiple that times 2, to get the full wavelength. Then multiple the wavelength by the frequency or number of hertz, or cycles per second (which you can find on the back of your microwave). This will give you the speed in meters per second, which should be close to the speed of light.



- **Troubleshooting –** This is a challenging experiment for middle schoolers. In case you don't get the right results, here are a few troubleshooting tips.
  - *You only saw one melted hole in the center of your chocolate bar.*
    Solution – Be sure your chocolate bar is at least 12 cm long and make sure that your plate is not spinning. You may need to remove both the plate and the spinner from your microwave before doing this experiment.
  - *Your answer is way off from the speed of light.*
    Solution – Units! In this experiment we used several units of measurement that are

common in science, but may not be familiar to the students. I have included a chart explaining each of the units for your reference.

Unit Abbreviation	What it stands for	What it's used for
cm	Centimeters	Measurement of length 100 cm = 1 m
m	Meters	
MHz	Mega Hertz	Frequency or cycles per second, 1MHz = 1,000,000 Hz
Hz	Hertz	
m/s	Meters per Second	Measurement of speed

- *If you are still having problems, the following video will give you a good visual reference of this experiment.*
  - https://www.youtube.com/watch?v=kpB1wezpJeE

Discussion Questions

1. How can we see other galaxies? (*We can see other galaxies by using a telescope*.) How many do we know about? (*Astronomers know about approximately 100 billion galaxies that can be seen from Earth.*)
2. How do astronomers measure distances in the universe? (*Within our solar system, astronomers use the Astronomical Unit (AU) to measure objects. The AU is equal to the distance between the Earth and the Sun, which is about 93 million miles. Outside of our solar system, astronomers use light years to measure objects in the universe. A light year is the distance that light travels in one year, which is about 5.88 trillion miles*.)
3. What does everything in the universe do? (*Everything in the universe moves.*)

Additional Notes

If you want to introduce your students to the Big Bang theory, this is the week to do so. The pages for this are scheduled as an additional resource reading assignment, which gives you the option to assign them or not. I want to encourage you to do so, even if you don't hold to the Big Bang theory as the truth of how the universe began. In today's world, most astronomers do believe in the Big Bang theory. It is often referred to as the most plausible explanation for the origins of the universe, so it is important that students are familiar with what it says. It is also equally as important that as teachers/parents, we share with our students what we hold to be true about the origins of the universe. I believe that logic stage is a good time to begin having those discussions. If you do decide to include these pages, here are some discussion questions for you to use.

1. Explain the Big Bang theory.(*Many astronomers believe that there was a huge explosion that created a large amount of energy. This energy was then transformed into subatomic particles, which after 300,000 years, turned into a soup of elements. After a billion years, gravity pulled the elements into clouds, which then formed the first galaxies and stars.*)
2. What evidence do astronomers use to support the Big Bang theory? (*Astronomers use the fact that galaxies are moving farther apart to support the Big Bang theory. They use this fact because it suggests that the galaxies were once concentrated in a single place*.)

3. What evidence for the Big Bang still eludes scientists? (*Scientists still haven't found the majority of the universe's matter or the stuff that the universe is composed of.*)
4. What do many cosmologists believe will happen to our universe? (*Many cosmologists believe that our universe will expand to a certain point and then it will begin to contract. Eventually it will collapse inward and implode in an event they call the Big Crunch. This will destroy everything, but it will be followed by another Big Bang.*)

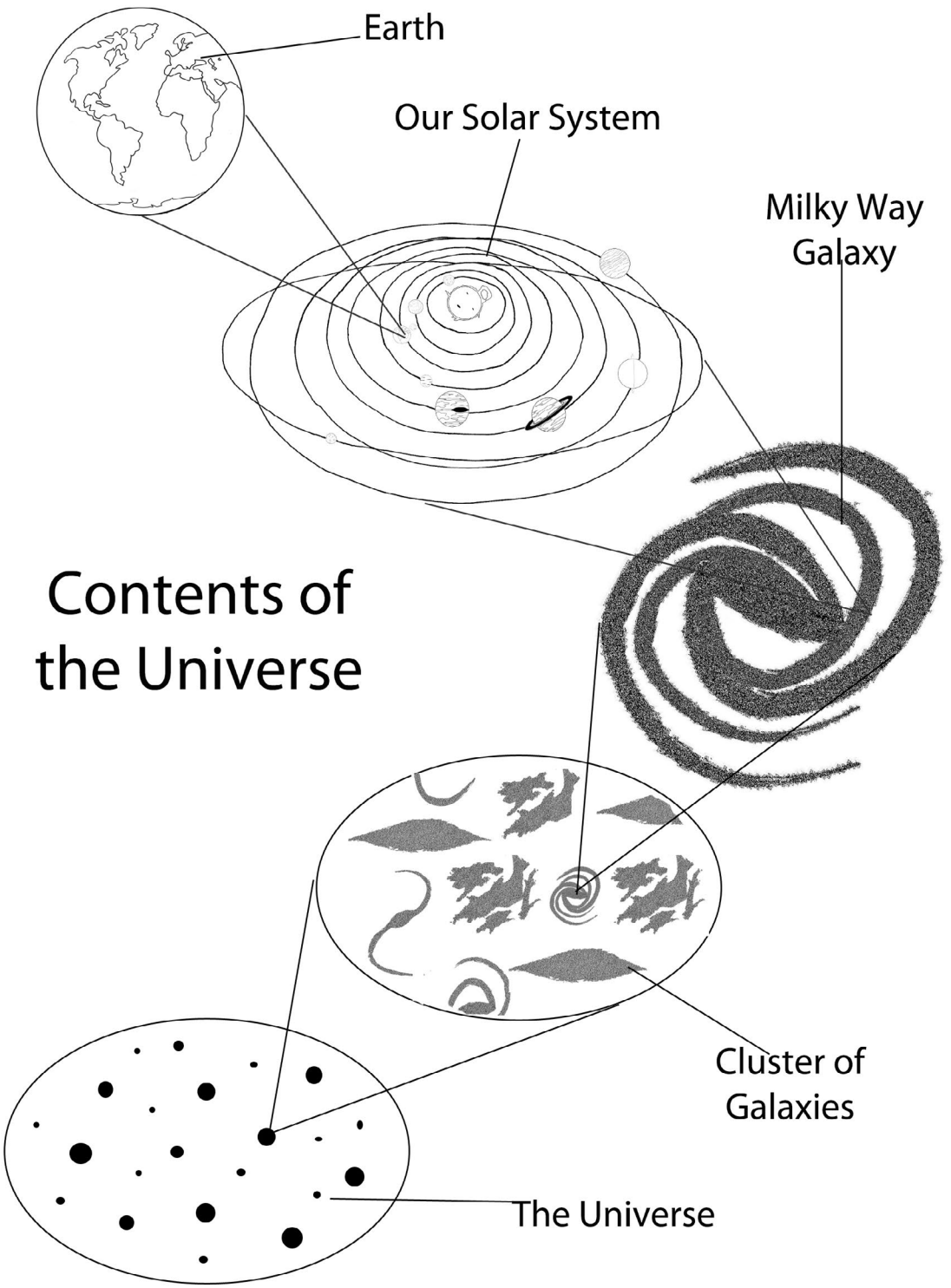
I have also included a couple of questions to help you and your students as you examine the Big Bang Theory in your homeschool.

1. **Theory vs. Fact**
   - In science, what is a theory? (*The word theory comes from the ancient Greek word theoria, which means "a looking at, viewing or beholding". In science, a theory is an analytical tool used for understanding, explaining or making predictions about a certain subject matter. Theories are meant to be tested by experimentation and observation to determine if they are fact.*)
   - In science, what is fact? (*The word fact is comes from the Latin word factum, which means "a thing done or performed". In science, a fact is an objective and verifiable observation. Facts can be verifiable through repeatable experimentation.*)
2. **Origins**
   - Where did the energy for the Big Bang come from? (*We know from the first law of thermodynamics that energy is conserved. The first law of thermodynamics states: Energy can be neither created nor destroyed. It can only change forms. Therefore the energy for the Big Bang had to come from somewhere. If the Big Bang is true, where did the original energy for it come from? There's no real answer to this question, it's something that scientists are still trying to figure out and one of the main reasons that the Big Bang theory remains a theory instead of fact.*)

Want More

- **Observe the Universe –** There are many things about our universe that can be observed from Earth by the naked eye or by using a telescope. Take some time this week to record what you can observe. Go outside at night, take pictures of what you see and use a field guide to identify what you have observed (*Exploring the Night Sky* or *Usborne Discovery Astronomy* are two good options.) Have the students create a mini-book or journal detailing what they have seen. You can add to this project as you continue to work your way through the astronomy units.

Sketch Assignment Week 1



Student Assignment Sheet Astronomy Week 2
Galaxies

Experiment: Identifying Galaxies

Materials

- ✓ Galaxy cards (See Appendix pg. 247)

Procedure

1. Read the introduction to this experiment and answer the question.
2. Read "Four Types of Galaxies" found on pg. 246 of the SG Appendix. Then, fill in the Galaxy Information Chart on your experiment sheet with the information.
3. Next, look at each of the galaxy cards, determine which type of galaxy they are by using the information included, and then check your answers with your teacher.
4. Write what you have learned in the conclusion section of your experiment sheet.

Vocabulary & Memory Work

- ☐ Vocabulary: galaxy, cluster, supercluster
- ☐ Memory Work – Continue to work on memorizing the Types of Stars.

Sketch Assignment: 4 Types of Galaxies

- 🖼 Label the following: irregular galaxy, elliptical galaxy, spiral galaxy and barred spiral galaxy

Writing Assignment

- ✍ Reading Assignment: *Kingfisher Science Encyclopedia* pg. 390-391 Galaxies
- ✍ Additional Research Readings
  - 🕮 Galaxies: *USE* pg. 156-157
  - 🕮 Our Galaxy and Beyond: *DK Astro* pg. 62-63

Dates to Enter

- 🕒 1784 – Charles Messier finds several blurry objects that he records as nebulae. These are later discovered to be galaxies.
- 🕒 1845 – Lord Rosse draws the galaxy M51, without knowing what it is.
- 🕒 1924 – Edwin Hubble presents the first evidence of other galaxies.

Schedules for Week 2

Two Days a Week

Day 1	Day 2
☐ Define galaxy, cluster, supercluster on SG pg. 14 ☐ Do the "Identifying Galaxies" experiment, then fill out the experiment sheet on SG pp. 24-25 ☐ Enter the dates onto the date sheets on SG pp. 8-12	☐ Read pp. 390-391 from the *Kingfisher Science Encyclopedia*, then discuss what was read ☐ Prepare an outline or narrative summary, write it on SG pp. 26-27 ☐ Color and label the "4 types of galaxies" sketch on SG pg. 23
Supplies I Need for the Week ✓ Galaxy Information Sheet ✓ Galaxy Trading Cards	
Things I Need to Prepare	

Five Days a Week

Day 1	Day 2	Day 3	Day 4	Day 5
☐ Do the "Identifying Galaxies" experiment, then fill out the experiment sheet on SG pp. 24-25	☐ Read pp. 390-391 from the *Kingfisher Science Encyclopedia*, then discuss what was read ☐ Write an outline or list of facts on SG pg. 26	☐ Define galaxy, cluster, supercluster on SG pg. 14 ☐ Enter the dates onto the date sheets on SG pp. 8-12 ☐ Color and label the "4 types of galaxies" sketch on SG pg. 23	☐ Read one or all of the additional reading assignments ☐ Prepare your report, write the report on SG pg. 27	☐ Complete one of the Want More Activities listed **OR** ☐ Study a scientist from the field of Astronomy
Supplies I Need for the Week ✓ Galaxy Information Sheet ✓ Galaxy Trading Cards				
Things I Need to Prepare				

Additional Information Astronomy Week 2

Experiment Information

- **Introduction –** (*from the Student Guide*) All galaxies are massive celestial bodies made up of stars, gas and dust. They are held together by gravity and classified by their shape. There are four main types of galaxy shapes, spiral, elliptical, barred spiral, and irregular. In this experiment, you are going to read more about each type of galaxy shape and then identify several galaxies using what you have learned.
- **Galaxy Cards –** The galaxy cards can be found in the Appendix of this guide on pg. 247-250. Simply print them out, fold them in half and glue them together.
- **Results –** The students' charts should look like this:

Type of Galaxy	Spiral	Elliptical	Barred Spiral	Irregular
Shape	pinwheel shaped	round or oval shape	pinwheel shaped with a bar of stars, dust & gas running across the center	no regular shape
Bulge & Disks	bulge and thin disk present	bulge, but no disk	bulge and thin disk present	may show signs of a disk and a halo
Gas & Dust	rich in gas & dust	little cool gas & dust	rich in gas & dust	usually rich in gas & dust
Types of Stars	young & old stars are present	mainly old stars are present	young & old stars are present	young & old stars are present
Examples (from Galaxy Cards)	NGC 7217 Messier 100 Andromeda	NGC 4881 NGC 3377	NGC 4156 Milky Way	NGC 5253

Discussion Questions

1. What is the name of the galaxy our solar system is in? (*Our solar system is found in the Milky Way Galaxy*.)
2. How are galaxies classified? (*Galaxies are classified according to their shape.*)
3. What are two things that astronomers believe help to determine the shape of a galaxy? (*Astronomers believe that the amount of material, the speed of spin and the rate at which stars form all help to determine the shape of a galaxy.*)
4. Describe the typical active galaxy. (*The typical active galaxy has a luminous core that emits huge jets of material. The center also has a glowing ring of gas and dust that surrounds a black hole.*)
5. Which cluster of galaxies does the Milky Way belong to? (*The Milky Way belongs to the Local Group cluster of galaxies*.)

Want More

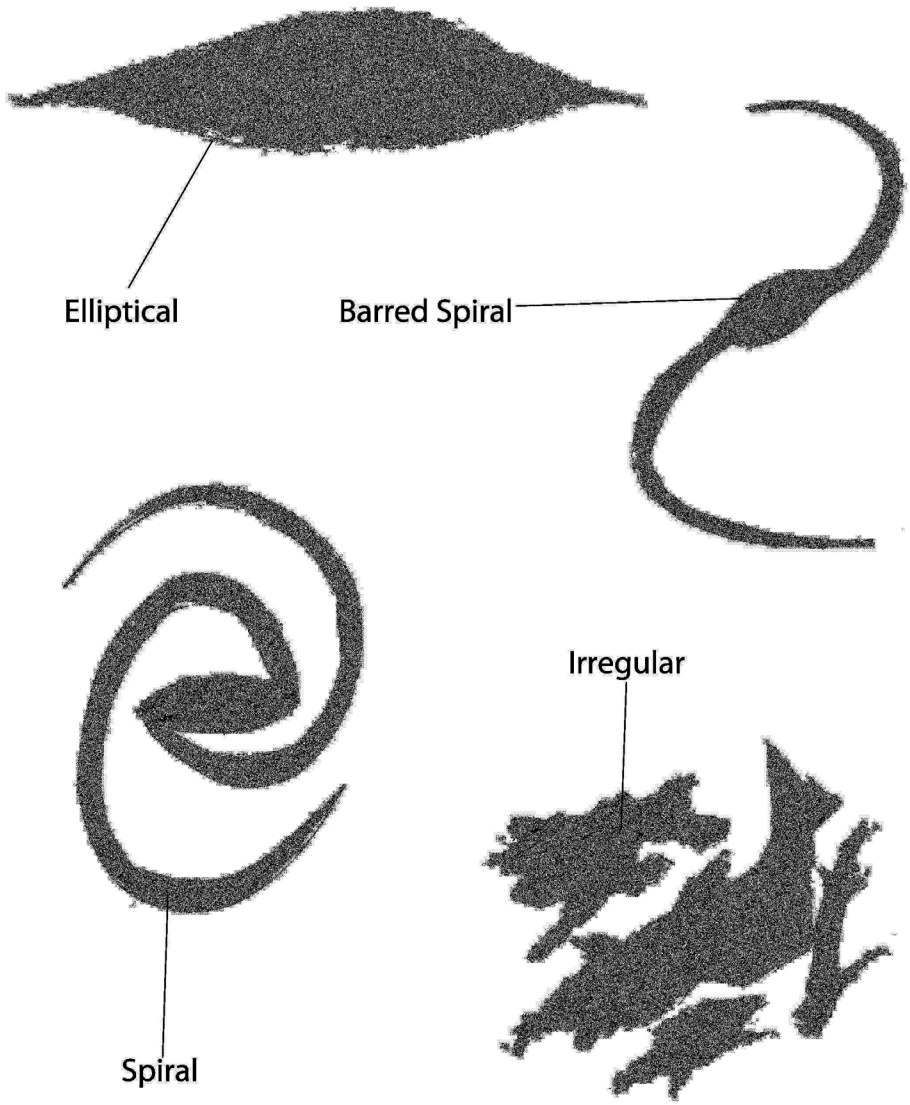
- **Galaxy Cards –** Print out an extra set of galaxy cards and use them to play games like Go

Fish or Memory. You could also have the students match the information to the galaxy for more of a challenge.

- **Deep Space Art –** Have the students make a chalk drawing of the planets and the galaxy. Directions can be found at the following website:
  - http://www.deepspacesparkle.com/2009/03/planets-and-galaxy-project-for-fifth/

Sketch Assignment Week 2

4 Main Types of Galaxies



Appendix

Galaxy Cards

NGC 7217

- Found in the Pegasus constellation
- Pinwheel shaped
- Contains mostly new stars
- Has a large bulge with tightly wrapped arms

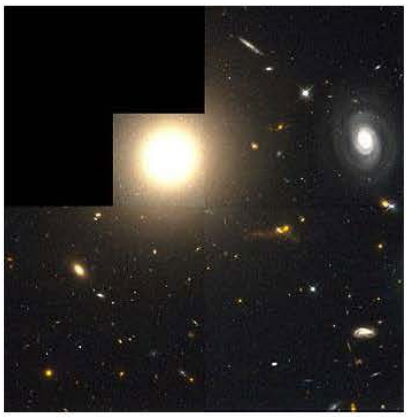
Messier 100

- Found in the Virgo cluster in the Northern Hemisphere
- Pinwheel shaped with a small central bulge
- Contains mostly young stars, as well as large amounts of gas and dust
- Has loose, lumpy spiral arms

NGC 4156

- Found in the Canes Venatici constellation
- Contains many new stars with large amounts of gas
- There is a "bar" of stars, dust and gas running across the center of this galaxy
- Pinwheel shaped

NGC 4881

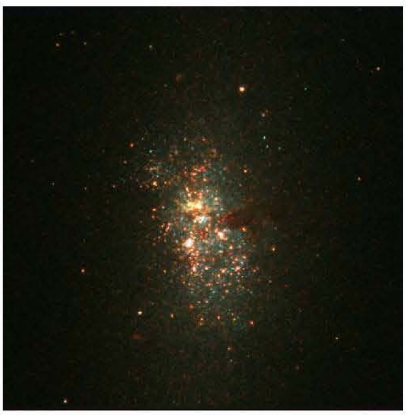


- Ball-shaped galaxy
- Contains mostly older stars and a small amount of gas
- Found in the Canes Venatici constellation
- 352 million light years away from Earth

NGC 3377

- Part of a dozen galaxies that cluster together in the constellation Leo
- Contains mostly older stars and a small amount of gas
- Has a well-defined oval shape
- Contains a black hole at the center

NGC 5253



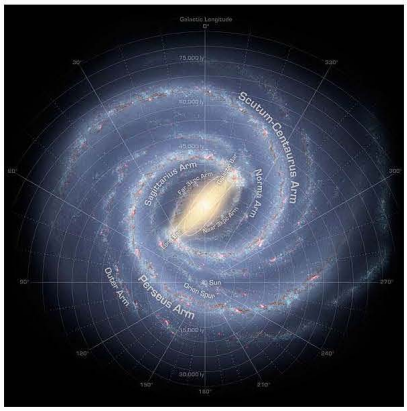
Big Stellar Clusters in the Blue Dwarf Galaxy NGC 5253

- Found in the constellation Centarus
- Contains both young and old stars
- Has no definite structure
- Contains large amounts of gas and dust
- Dwarf galaxy

Andromeda

- Found in the Andromeda constellation
- Contains young and old stars
- Pinwheel shape
- Contains close to one trillion stars
- Approximately 2.5 million light years from Earth

Milky Way



- Our solar system is located on the Orion Spur of this galaxy
- Contains young and old stars
- There is a "bar" of stars, dust and gas running across the center of this galaxy
- Contains close to 200 billion stars

Earth Science & Astronomy for the Logic Stage
Student Guide Table of Contents

Earth Science & Astronomy for the Logic Stage
Letter to the Student

Dear Student,

Welcome to your journey through earth science and astronomy. Earth science is the study of the Earth, while astronomy is the study of space. This year you will examine the various landforms on the Earth, the weather, our solar system, and what can be found in space. You will look at mountains, tornadoes, planets, and stars along your voyage. This guide is written to you, so enjoy your journey!

What this guide contains

First, this guide includes your date sheets and unit sheets. The unit sheets include your vocabulary words, weekly student assignment sheets, sketches, experiment sheets, and space for each of your writing assignments. After your unit sheets, you will find the appendix of this guide. In it you will find a list of all your memory work for the year, a glossary, and a place to record any additional activities you have done that pertain to earth science and astronomy.

Student Assignment Sheets Explained

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

- ✓ **Weekly Topic & Experiment**

  Each week will revolve around a weekly topic to be studied. You will be assigned an experiment to complete that poses a question about the topic studied. Your student assignment sheets contain the list of materials you will need and the instructions to complete the experiments. This guide also includes an experiment sheet for you to fill out. Each of the experiments will have you 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 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 listed section you need to fill out what you used to complete the experiment. In the hypothesis section you need to predict what the answer to the question posed in the lab is. In the procedure section you need to write step by step what you did during your experiment so that someone else could read your report and replicate your experiment. In the observation section you need to write what you saw. 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.

☐ **Vocabulary & 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 your glossary and fill out the definitions on the Unit Vocabulary sheet found at the beginning of each unit in this guide. 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 to work on. 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 of this guide.

🖼 **Sketches**

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 Assignment**

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 *Kingfisher Science Encyclopedia* or the *Usborne 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 spine text reading. Your teacher may also assign additional research reading out of the following books:

📖 *The DK Encyclopedia of Science* (DKEOS)
📖 *Astronomy DK Eyewitness Book* (DK Astro)
📖 *Exploring the Night Sky* (ENS)

Once you finish the additional reading, prepare a narrative summary about what you have learned from your reading. Your outlines should be two-level main topic style outlines

and your narrative summaries should be two to four paragraphs in length, unless otherwise assigned by your teacher.

- **Dates to Be Entered**

  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, 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 if you want you can draw a time line in the space provided and enter your dates on that.

How to schedule this study

Earth Science & Astronomy 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 day 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 day 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,

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 *Earth Science & Astronomy 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 *Earth Science & Astronomy for the Logic Stage*!

Sincerely,
Paige Hudson, BS Biochemistry, Author

Ancients 5000 BC–400 AD

Medieval-Early Renaissance 400AD-1600 AD

Late Renaissance-Early Modern 1600 AD-1850 AD

Modern 1850 AD-Present

Modern 1850 AD-Present

Astronomy Unit 1

Space

Astronomy Unit 1: Space
Vocabulary Sheet

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

1. Universe – _____

2. Galaxy – _____

3. Cluster – _____

4. Supercluster – _____

5. Star – _____

6. Nebulae – _____

7. Black hole – _____

8. Constellation – _____

9. Planetarium – _____

_____

_____

10. Zodiac – _____

_____

_____

Student Assignment Sheet Astronomy Week 1
Universe

Experiment: Can I calculate the speed of light using a microwave?

Materials

- ✓ Large chocolate bar
- ✓ Large plate
- ✓ Microwave
- ✓ Ruler

CAUTION

Melted chocolate is very hot and can burn, DO NOT touch!

Procedure

1. Read the introduction to this experiment and answer the question.
2. Unwrap the chocolate bar and place it on the plate. Remove the turntable from your microwave and set the plate inside.
3. Begin by heating the chocolate bar for 1 minute; check to see if it has begun to melt. (*You are looking to see if there are two spots that have begun to melt. You DO NOT want the entire chocolate bar to melt.*) If the bar has not begun to melt, continue to heat it for 30-second intervals, checking each time to see if melting has begun.
4. Once melting has begun, carefully remove the plate from the microwave and measure the distance between the centers of the two melted points.
5. Record the distance on your experiment sheet and complete the calculations.
6. Draw conclusions and complete your experiment sheet.

Vocabulary & Memory Work

- ☐ Vocabulary: universe
- ☐ Memory Work – Work on memorizing the Types of Stars.

Sketch Assignment: Contents of the Universe

- 🖼 Label the following: Earth, Our Solar System, Milky Way Galaxy, Cluster of Galaxies, The Universe

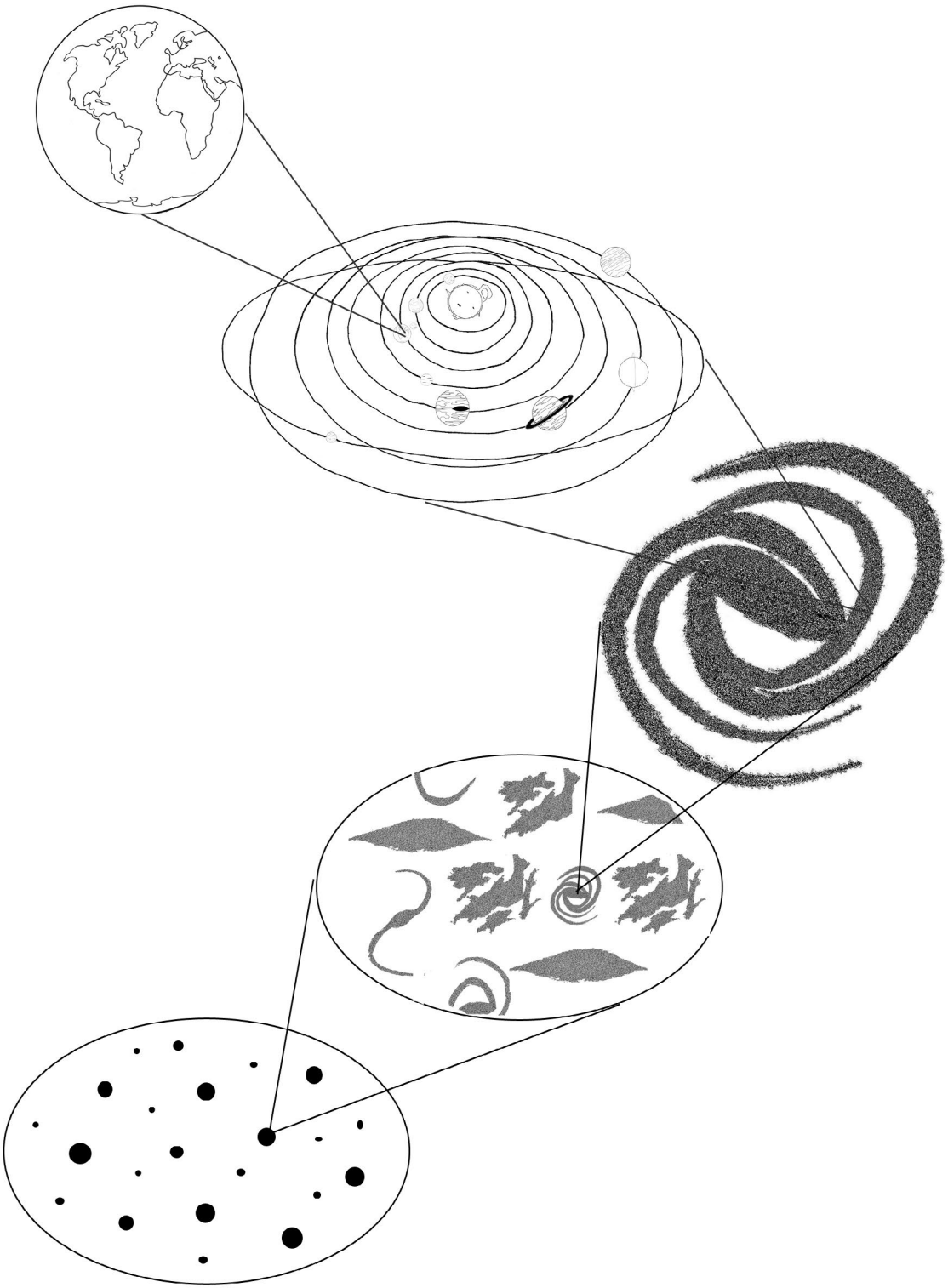
Writing Assignment

- Reading Assignment: *Kingfisher Science Encyclopedia* pg. 386-387 The Universe
- Additional Research Readings
  - 🕮 Big Bang Theory: *KSE* pg. 388-389
  - 🕮 The Universe: *USE* pg. 154-155

Dates to Enter

- 1929 – Edwin Hubble proves that the universe is expanding.
- 1965 – Scientists find heat waves in the universe that they believe are leftover from a vast explosion.
- 1992 – The satellite *Cosmic Background Explorer* traces background radiation and ripples in the universe that are thought to be leftover from the Big Bang.

Sketch Assignment Week 1



Experiment: Can I calculate the speed of light using a microwave?

Introduction

The universe is the vast expanse of space in which all things are found. It contains us, our planet, our solar system, our galaxy and at least 100 billion other galaxies. Astronomers have studied what they call the observable universe since Galileo invented the first telescope in 1609. As astronomers began to record their observations, they found the need to calculate distances, so that they could give approximate locations for the objects in the universe. Since the distances in the universe are so large, astronomers began to use light years to calculate them. A light year is the distance a wavelength of light will travel in one year, or about 5.88 trillion miles. In this experiment, you are going to try to calculate the speed of light, which scientists then multiply by the time in one year to calculate a light year.

Hypothesis

Can I calculate the speed of light using a microwave? Yes No

Materials

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

Procedure

_____

_____

_____

_____

_____

_____

_____

_____

Observations

Distance from the center of one melted chocolate spot to the center of the next melted chocolate spot	
in cm (centimeters)	
in m (meters)	

Results

Calculation #1: _____ x 2 = _____
(distance measured in m) (wavelength in m)

Calculation #2: _____ x 1,000,000 (Hz/MHz) = _____
(Mega Hertz(MHz), from the back of the microwave) (Cycles per second in Hz)

Calculation #3: _____ x _____ = _____
(wavelength in m) (Cycles per second in Hz) (speed of light m/s)

Conclusion

Written Assignment Week 1

Discussion Questions

1. How can we see other galaxies?
2. How do astronomers measure distances in the universe?
3. What does everything in the universe do?

Written Assignment Week 1

Student Assignment Sheet Astronomy Week 2
Galaxies

Experiment: Identifying Galaxies

Materials

- ✓ Galaxy cards (Your instructor will provide these cards.)

Procedure

1. Read the introduction to this experiment and answer the question.
2. Read "Four Types of Galaxies" found on pg. 246 of the Appendix. Then, fill in the Galaxy Information Chart on your experiment sheet with the information.
3. Next, look at each of the galaxy cards, determine which type of galaxy they are by using the information included, and then check your answers with your teacher.
4. Write what you have learned in the conclusion section of your experiment sheet.

Vocabulary & Memory Work

- ☐ Vocabulary: galaxy, cluster, supercluster
- ☐ Memory Work – Continue to work on memorizing the Types of Stars.

Sketch Assignment: 4 Types of Galaxies

- 🖼 Label the following: irregular galaxy, elliptical galaxy, spiral galaxy and barred spiral galaxy

Writing Assignment

- ✍ Reading Assignment: *Kingfisher Science Encyclopedia* pg. 390-391 Galaxies
- ✍ Additional Research Readings
  - 🕮 Galaxies: *USE* pg. 156-157
  - 🕮 Our Galaxy and Beyond: *DK Astro* pg. 62-63

Dates to Enter

- 🕒 1784 – Charles Messier finds several blurry objects that he records as nebulae. These are later discovered to be galaxies.
- 🕒 1845 – Lord Rosse draws the galaxy M51, without knowing what it is.
- 🕒 1924 – Edwin Hubble presents the first evidence of other galaxies.

Sketch Assignment Week 2

Experiment: Identifying Galaxies

Introduction

All galaxies are massive celestial bodies made up of stars, gas and dust. They are held together by gravity and classified by their shape. There are four main types of galaxy shapes, spiral, elliptical, barred spiral, and irregular. In this experiment, you are going to read more about each type of galaxy shape and then identify several galaxies using what you have learned.

Conclusion

Galaxy Information Chart

Type of Galaxy				
Shape				
Presence of Bulges & Discs				
Presence of Gas & Dust				
Types of Stars				
Examples **(from Galaxy Cards)**				

Written Assignment Week 2

Discussion Questions

1. What is the name of the galaxy our solar system is in?
2. How are galaxies classified?
3. What are two things that astronomers believe help to determine the shape of a galaxy?
4. Describe the typical active galaxy.
5. Which cluster of galaxies does the Milky Way belong to?

Written Assignment Week 2

Appendix

Astronomy Memory Work

Unit 1

Types of Stars

1. Blue giant – A large, hot star off the main sequence.
2. Red giant – An older star with a cooler outer layer.
3. Neutron star – The tightly-packed collapsed core of a larger star.
4. Main-sequence star – A star plotted in the left-to-right band across the HR diagram.
5. Black hole – A gravitationally dense region of space-time where nothing can escape, not even light.
6. White dwarf – A stellar core remnant of a low to medium mass star.
7. Red dwarf – A cool, small star on the main sequence.

Constellations of the Zodiac

1. Aquarius
2. Aries
3. Cancer
4. Capricorn
5. Gemini
6. Leo
7. Libra
8. Pisces
9. Sagittarius
10. Scorpio
11. Taurus
12. Virgo

Unit 2

Planet Order *(along with the planet's gravity relative to Earth)*

1. Sun
2. Mercury (Gravity: 0.38)
3. Venus (Gravity: 0.90)
4. Earth (Gravity: 1 or 9.8 m/s2) [Moon (Gravity: 0.17)]
5. Mars (Gravity: 0.38)
6. Jupiter (Gravity: 2.34)
7. Saturn (Gravity: 0.93)
8. Uranus (Gravity: 0.90)
9. Neptune (Gravity: 1.13)

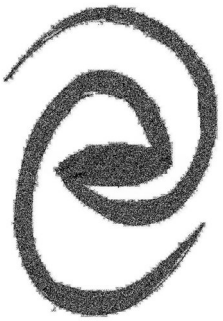
Unit 3

Ten Nearest Galaxies and Their Type

1. Milky Way (spiral)
2. Sagittarius (elliptical)
3. Large Magellanic Cloud (irregular)
4. Small Magellanic Cloud (irregular)

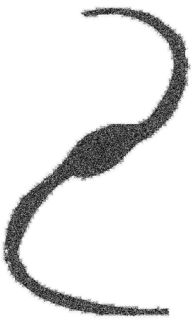
The Four Types of Galaxies

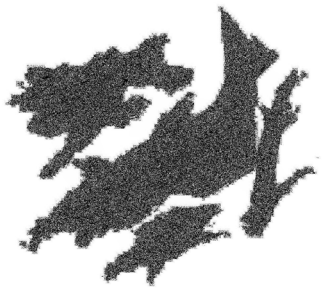
Our universe contains four main classes of galaxy shapes that astronomers know about. The first class is the spiral galaxy. These galaxies have a pinwheel shape with a bulge and thin disk in the center. Spiral galaxies are rich with gas and dust. They contain both young and old stars. Many of these galaxies have been named and cataloged because they are the brightest and easiest to spot in the sky.



The second class of galaxy shapes is the elliptical galaxy. They have a round or oval shape with a bulge in the center, but no disk. Elliptical galaxies have a little cool dust and gas. They contain mostly older stars. Astronomers believe that elliptical galaxies are the most numerous in the universe.

The third type of galaxy shape is the barred spiral galaxy. They have a pinwheel shape with a bar of gas, dust and stars running through the center. Barred spiral galaxies are generally rich in gas and dust. They contain both young and old stars. Some astronomers consider the barred spiral to be a subsection of the spiral class, but most consider the barred spiral to be a separate galaxy shape.





The final type of galaxy shape is the irregular galaxy. These galaxies are shaped just like the name implies, with no regular shape. Irregular galaxies are usually rich with gas and dust. They contain both young and old stars. This class contains a hodgepodge of shapes, basically anything that is not spiral or elliptical in shape.

These are the four fundamental classes of galaxy shapes. Astronomers break each class down into further subclasses to help identify various galaxies. They use the shape of the galaxy and how they believe it was formed to classify each galaxy. Even with all the knowledge we have today, astronomers still have a poor understanding of how a galaxy is formed, so shape remains the best way to identify these starry collections.

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