YOUNG EXPLORER SERIES

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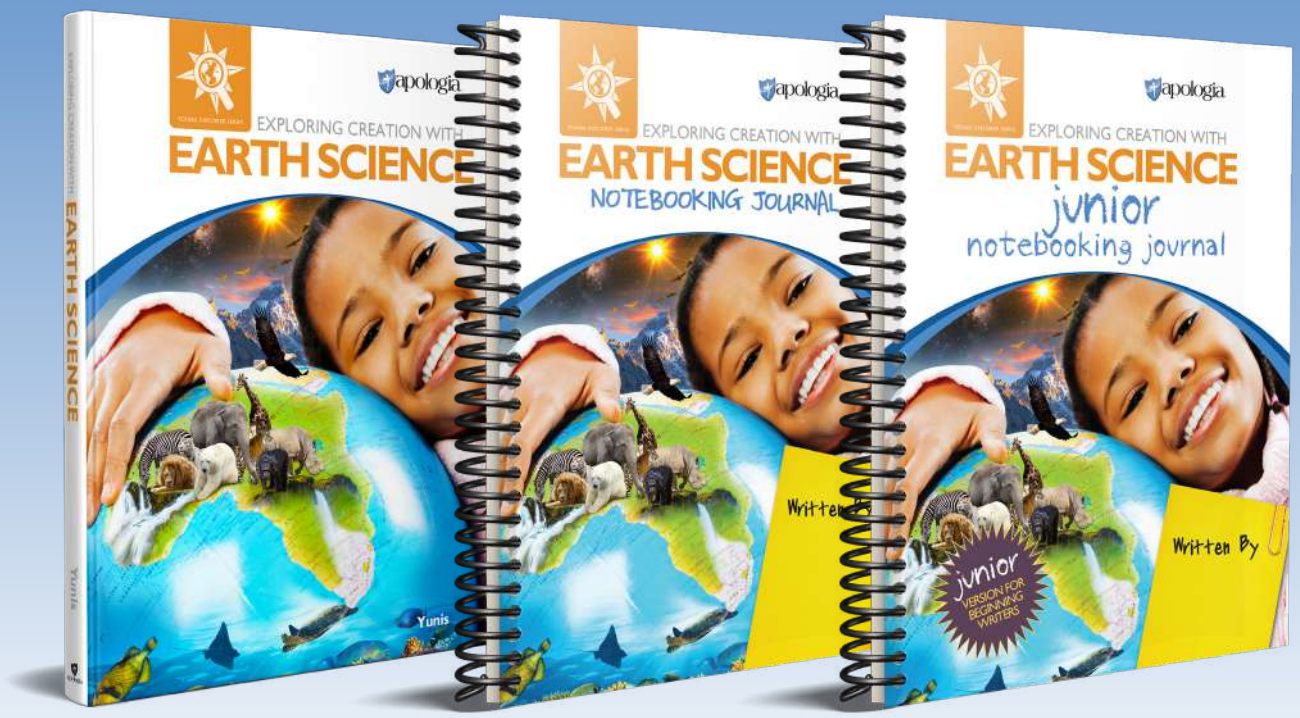
EXPLORING CREATION WITH

EARTH SCIENCE



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REGULAR NOTEBOOKING JOURNAL SAMPLE

FREQUENTLY ASKED QUESTIONS

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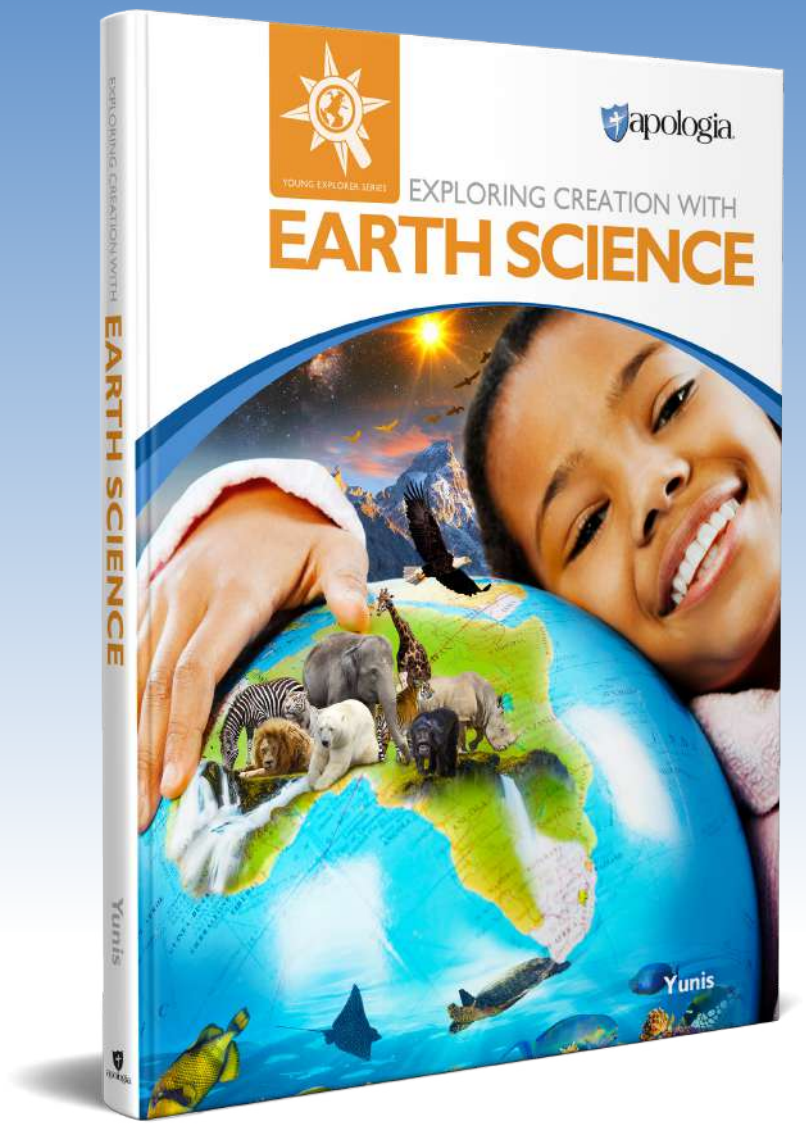

THIS IS THE START OF TEXTBOOK SAMPLE

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worldview

We each have our own worldview which means that we combine our thoughts, experiences, and beliefs with our knowledge to interpret the world we live in. And how we interpret our world influences how we interact with it. This textbook is written as a creation-based text.

Now every house is built by someone, but the One who built everything is God.

Hebrews 3:4 HCSB

Introduction

Thank you for choosing *Exploring Creation with Earth Science* as your science textbook this year. This course was written to help you understand and enjoy the beauty and wonder of our home planet, Earth. This year we are going to make time to be mesmerized and captivated with a wonder that goes beyond scientific description. It is my prayer that as we explore creation together you also fall deeper in love with our Creator.

Activities

The *Exploring Creation with Earth Science* course is carefully designed to provide fun, educational, and safe activities for you to conduct in and around your home. We have tested these activities. Accidents, however, can occur anywhere and at any time. Therefore, we urge you to be a safe scientist and follow safe experimental processes at all times. **Be sure adult supervision is provided for all activities.** Follow standard safety procedures and common sense. Never experiment and cook or eat with the same items, especially if you are using inedible or potentially toxic material. You should NEVER eat any item in an activity unless the lesson instructions are for an edible activity AND your parents have read the lesson, checked the materials, ensured there are no allergens, and given permission.

Course Website

To get the most out of this course, you should regularly visit the course website. It is designed to link you to materials that relate to Earth science. Please always practice safe Internet use. While we monitor our Book Extras sites, we do link to outside sources, and we cannot guarantee each site on a day-to-day basis. Adult supervision should be given to elementary-aged students to ensure safety. Please go to apologia.com and click on the Book Extras link to find instructions for accessing our Book Extras material. For this course, you will need the following password:

Godcreatedmyhome

Notebooking Journals

The 14 lessons in this book are in-depth and contain quite a bit of scientific information and hands-on activities. Each lesson should be broken up into manageable time slots depending on a child's age and attention span; this will vary from family to family. A suggested lesson plan is located in your *Notebooking Journal*. Whether you are using the regular or junior *Notebooking Journal*, this journal will be your place to document your studies in Earth science, record results of your activities, and create colorful memories.

When you read science textbooks you are studying important information discovered by great scientists throughout history. Keeping a student *Notebooking Journal* helps to document studies in your own words. Additionally, participating in science activities builds upon that knowledge as you conduct your own scientific studies.

A SPECIAL THANK YOU

A lot of love and research went into this textbook. I pray that your family is blessed with the knowledge it contains. It is with heartfelt gratitude that I say thank you to everyone who offered feedback. I also thank Lori Jaworski for her copy editing skills and Andrea Kiser Martin for the beautiful design of this book. It always amazes me when I see the difference between a manuscript and a final textbook. Together, it is our prayer at Apologia that this textbook will help you gain a deeper appreciation for and an understanding of the beauty of Creation.

How magnificent are Your works, Lord, how profound Your thoughts!
Psalm 92:5 HCSB

LESSON 1

THE OBSERVABLE UNIVERSE

worldview

When someone asks you, "Where do you live?" do you think about your neighborhood, your town, or even your country? Most people probably think about their mailing address. But we will learn that our home address extends to the planet we inhabit and even the far reaches of the universe. It's all connected, and we'll learn how.

How countless are Your works, LORD! In wisdom You have made them all.

Psalm 104:24 HCSB

Welcome

You might be reading this book on a swing under a tree in your backyard, or maybe you are sitting on your balcony in a big bustling city. But no matter where you are located on the planet Earth, you are home! And home is a great place to be.

We're going to spend this year together studying our home planet. And while you might think that you know all about your home planet, I hope that you will be surprised by the things you are going to learn. Right now, a sloth is moving slowly through a rainforest somewhere deep in the Amazon. You probably don't think about sloths on a daily basis. But they add to Earth's beauty. And right now, a whale is swimming in an ocean that you may or may not be able to see from your bedroom window. And that ocean is an important part of the Earth.

Winds in Africa blow huge amounts of dust across the ocean where that whale is swimming, and that dust fertilizes the rainforest home of that sloth. And believe it or not, you are connected to it all! It's true. That rainforest is producing oxygen for you to breathe. Clouds that form over the forest will rain in different places on our planet, giving us water to drink and keeping plants alive. No matter where you look, it's a beautiful planet that we call home, and it has *everything* necessary for life.

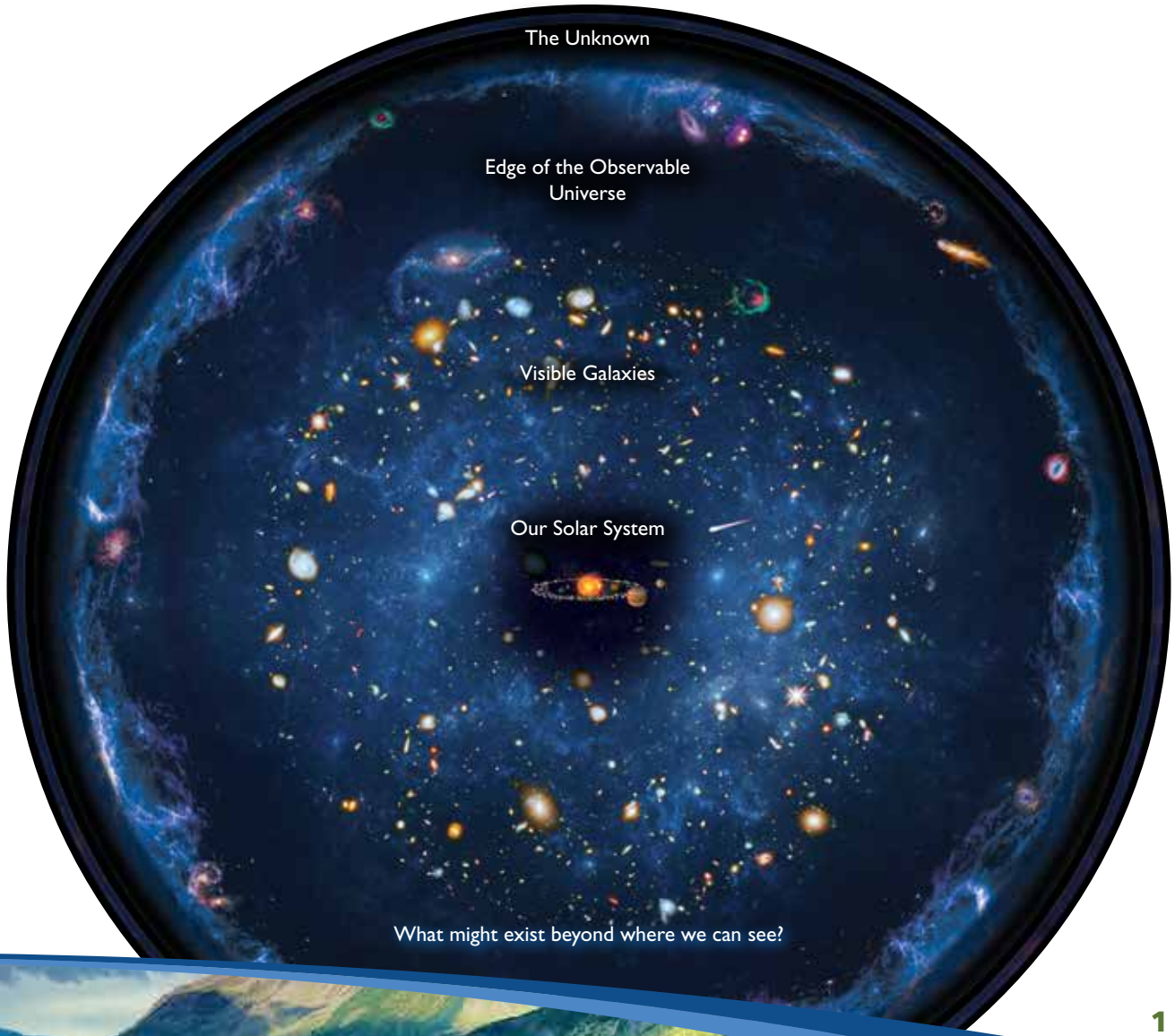
As we start our studies together, I want you to know that it is okay for you to question everything in science. In fact, I encourage you to do just that. Asking questions is what scientists do. We're going to journey together and be scientists turning over rocks and peering underwater to see what makes our planet such a great place to live.

To understand our home planet, we have to take a look at the bigger picture of creation. Earth is the only home we have, so learning all about it, including its cosmic address, is important if we want to appreciate the beauty of God's gift to us.

The Observable Universe

Let's start our studies with the biggest address we know something about; it's called the **observable universe.** Why do we call it that? Well, that is a good question and the answer is simple. Our universe is so big that we can only see so far, even with the best technology that we have. Think about it. You can see what is in your backyard and if you use binoculars, you can see even farther. But you can't see what's beyond that, right? Some things are just too far away.

Astronomers are scientists who study outer space. They use telescopes and spacecraft to explore deep into space, but even with the best technology, they can only see so far. After that distance, we don't know what is out there in space. But we do know that our universe is getting bigger and bigger with time. It's expanding! Things are getting even more and more distant. Let's do an activity to help you understand our expanding universe.



Activity 1.1
Expanding Universe Putty

You will need:

- Bottle of clear craft glue
- 2 small mixing bowls
- Borax powder
- Water
- Spoon
- Blue and red food coloring
- Silver sparkles (the more the better)
- 2 marbles or other small objects
- Small zipper-style plastic bag

You will do:

1. Place about 1/4 cup of clear glue into a bowl, dilute it with 1/4 cup of water, and stir. The glue will get thinner.
2. Add 6 drops of blue food coloring and 3 drops of red food coloring and stir to get a nice, deep, dark color.
3. In the second bowl, put 1 tsp. of borax. Add 1/2 cup of water to cover the powder and stir. It's OK if there is some extra borax that doesn't dissolve.
4. Tilt the borax solution bowl to keep any undissolved crystals at the bottom. One spoonful at a time, add the borax liquid to the glue mixture and stir. You will see it thicken with each spoonful. You want the final material to be gooey and able to flow; you do not want it to be too thick and rubbery.
   a. If your mixture gets too thick, add only water and knead your material until it breaks down a bit.
   b. If your mixture doesn't get thick enough, add a little more borax to the water bowl and slowly add that to your glue bowl.
5. Mix in your sparkles (add a lot) and knead them throughout your putty. They should become part of your putty and not be loose.
6. When you have a good consistency, add your 2 marbles and mix them into your putty. Look at their distance from each other and then stretch out your putty. Note what happens to the marbles (and even the sprinkles) as your putty expands. Do this a couple of times.
7. Enjoy playing with your expanding universe putty. Please keep it away from small children and pets who might mistake it for food. Also keep it away from carpet and furniture where it could create a gooey mess or stain.
8. Store your putty in a zipper-style plastic bag to keep it soft.

Expanding Our Minds

What did you learn from the expanding universe thinking putty activity? Well, I hope you noticed 3 things.

1. You should have been able to see that objects in your putty, like the marbles and sparkles, got farther away from each other as your putty expanded. Why is that an important observation? Well, you might

think that as the universe expands, it will cause objects that we can see in the observable universe today to one day be unobservable. But, as long as there are objects in the sky emitting or reflecting light that we can see today, we will always see them no matter how far away they move. The light is always traveling toward us faster than the objects are moving away.

So, why do we care that the universe is expanding if we can still see the lights in the night sky? Well, what we may never see would be the lights in the current unobservable universe that will always be too far away for their light to ever reach us.

2. You might have observed that your universe got flat as it stretched since you could only pull it left and right with your hands. It's important that you realize that the universe is expanding in every direction sort of like a balloon that is expanding in all directions at the same time.

3. It's important to know that we look out into the universe from our position on Earth. Pretend one of the marbles is Earth. If you were on the marble, it would look like everything is moving away from you. We must be in the middle of the expansion, right? No! It looks the same from every position. You can see this if you now look at the other marble. It feels like we are at the center because that is the only frame of reference that we have. No matter where you are in the universe, it looks like it is expanding. Let's do a quick activity to understand frame of reference.

Activity 1.2
Understanding Frame of Reference

You will need:

- Yourself
- Several different rooms in your home

You will do:

1. We are going to pretend that each room is a different galaxy in the universe, and you are a star in that galaxy. Stand in the center of your first room and look around. It looks like you are the center of everything, right? But is that really true?
2. Stand in the next room and look around. You are once again the center even though you have changed your position to a completely different room.
3. Pick a third room a little farther away from the first 2 rooms and stand in the center of it. It should still feel as if you are in the center of it all. How is that possible?

What did you learn from this quick activity? I hope you could see that no matter which "galaxy" you were in, the rest of the "universe" seemed like it centered around you. No matter which sparkle you were on in your putty, it would seem as if you were at the center of the universe. Pretty amazing!

Take a minute to think about all of this. We can only see so far with the technology we currently have, and the universe is expanding. What might be beyond the observable universe? Is there more universe that is expanding? Scientists currently believe that the unobservable universe probably looks like our observable universe. But we may never know for sure, or maybe one day you'll be the first scientist to find out what is there! We certainly do live in a universe full of mystery, wonder, and awe.

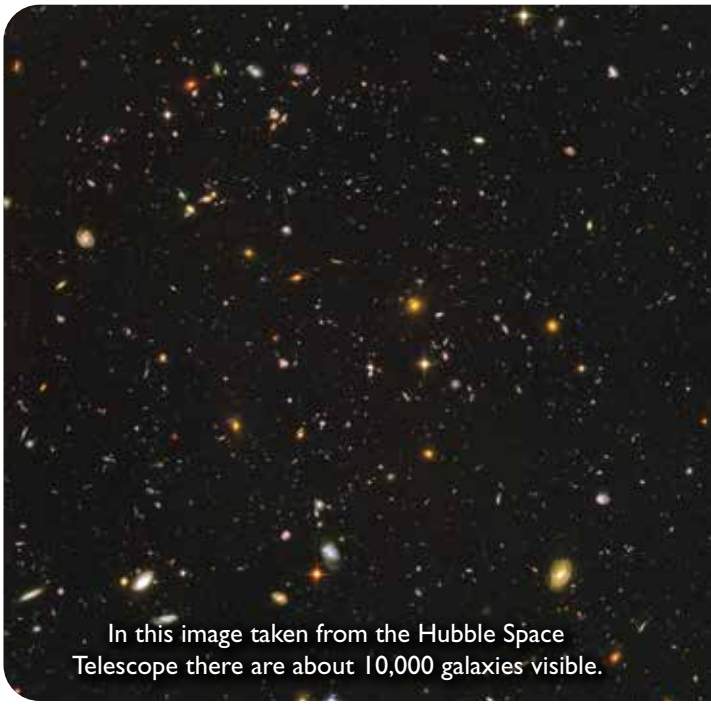
By faith we understand that the universe was created by God's command, so that what is seen has been made from things that are not visible.
Hebrews 11:3 HCSB

Take a moment to explain to someone else in your own words what the observable universe is and why we say it is observable. Explain (and maybe even demonstrate with your expanding universe thinking putty) how the universe is getting bigger and what that means for the current objects in the observable universe. Our knowledge of the universe might be limited, but our imaginations do not need to be. What do you think is beyond the observable universe?

Our Place in Space

Astronomy is the branch of science that studies the observable universe beyond Earth's atmosphere. It is important for you to realize that our Earth is part of the universe, so you are a part of the universe!

Let's work our way in from the edge of what we can see. We'll start with the basic fact that there are lots and lots of observable galaxies. What is in a galaxy? Well, a **galaxy** is a group of billions of stars, planets, dust, and gas all moving together. From far away, a galaxy can look like one star. Think back to your expanding universe putty. You can imagine that each piece of glitter was a separate galaxy. That seems like a lot, right? Some scientists think that there could be as many as 2 trillion galaxies in our observable universe. That's a huge number! If you were going to count nonstop to 2 trillion, it would take you more than 60,000 years! I don't know anyone who has that many candles on a birthday cake. The observable universe has more galaxies than we can count in our lifetime.



In this image taken from the Hubble Space Telescope there are about 10,000 galaxies visible.

3 Galaxy Shapes

We are going to talk about 3 main galaxy shapes. They are **elliptical, spiral,** and **irregular.** Elliptical galaxies are shaped like an elongated sphere and are brightest at their centers. Spiral galaxies have a bright center like the elliptical galaxies, but they also have arms that spiral out from their centers. Spiral galaxies are the most common form of galaxy found in the universe. Irregular galaxies, as you might suspect from their name, have no regular shape.

Activity 1.3

Create a Galaxy Mobile

You will need:

- 3 black wire hangers
- Metallic chenille sticks
- Thread
- Tape

You will do:

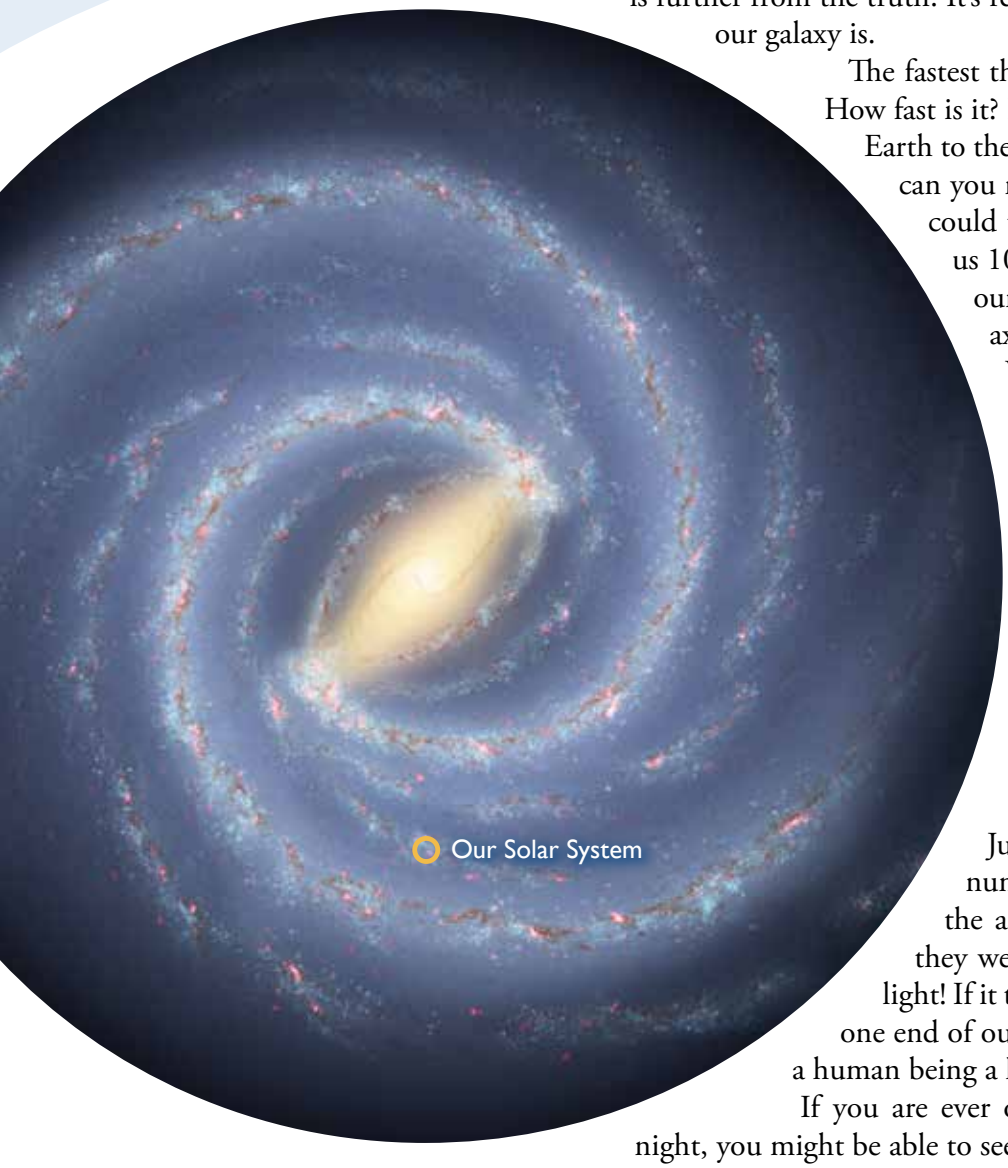
irregular galaxies elliptical galaxies spiral galaxies

1. Use a chenille stick to attach the 3 wire hangers together.
2. Turn the base of the 3 hangers to form a 3D shape and use another chenille stick to hold them in place. Set this aside.
3. Cut a piece of thread (between 12 and 18 inches) and use one end to tie a knot in the middle of a chenille stick. Twist the chenille stick around to form a galaxy shape—either elliptical, spiral, or irregular. Set it aside.
4. Repeat step 3 until you have made lots of galaxies in lots of shapes. Remember that the spiral galaxy shape is the most common, so make lots of them.
5. Find a place where you can hang and easily access your project and use tape to attach your galaxies at different heights around your hangers.
6. Display your galaxy mobile where you can share your knowledge about the mysteries of our universe.

I hope you made a lot of galaxies for your mobile. I added about 20 galaxies to mine. Can you imagine what it would look like if you added 200 galaxies? That would be a lot! It's hard to imagine that there could be 2,000,000,000,000 galaxies in the observable universe.

The Milky Way Galaxy

Does Earth reside in a specific galaxy? You bet it does! Our galaxy is a spiral-shaped galaxy called the Milky Way. You might think that our galaxy must be rather small since it seems like a dot in the universe. Nothing is further from the truth. It's really hard to imagine just how large our galaxy is.



The fastest thing we know is the speed of light. How fast is it? Let's just say that light can go from Earth to the Moon in about 1 second. How far can you run in a second? Light is fast! If we could travel as fast as light, it would take us 100,000 years to go from one end of our galaxy to the other end of our galaxy. We can't travel as fast as light. We can't even get close to its speed. How fast can we travel? Well, the astronauts who went to the Moon were moving pretty fast. Let's look at some numbers.

Speed of light
671,000,000 mph
(miles per hour)

Astronaut speed
25,000 mph

Just by looking at the size of the numbers, you can see that even though the astronauts were moving pretty fast, they were not anywhere near the speed of light! If it takes light 100,000 years to go from one end of our galaxy to the other, it would take a human being a lot longer to explore that distance!

If you are ever outside on a really clear and dark night, you might be able to see part of our galaxy. It can look like a blurry line of stars in the sky. Look at the NASA image with the tiny box. In just that tiny little section of our Milky Way galaxy, there are a lot of stars. It is estimated that our Milky Way galaxy could be made up of about 400 billion stars!

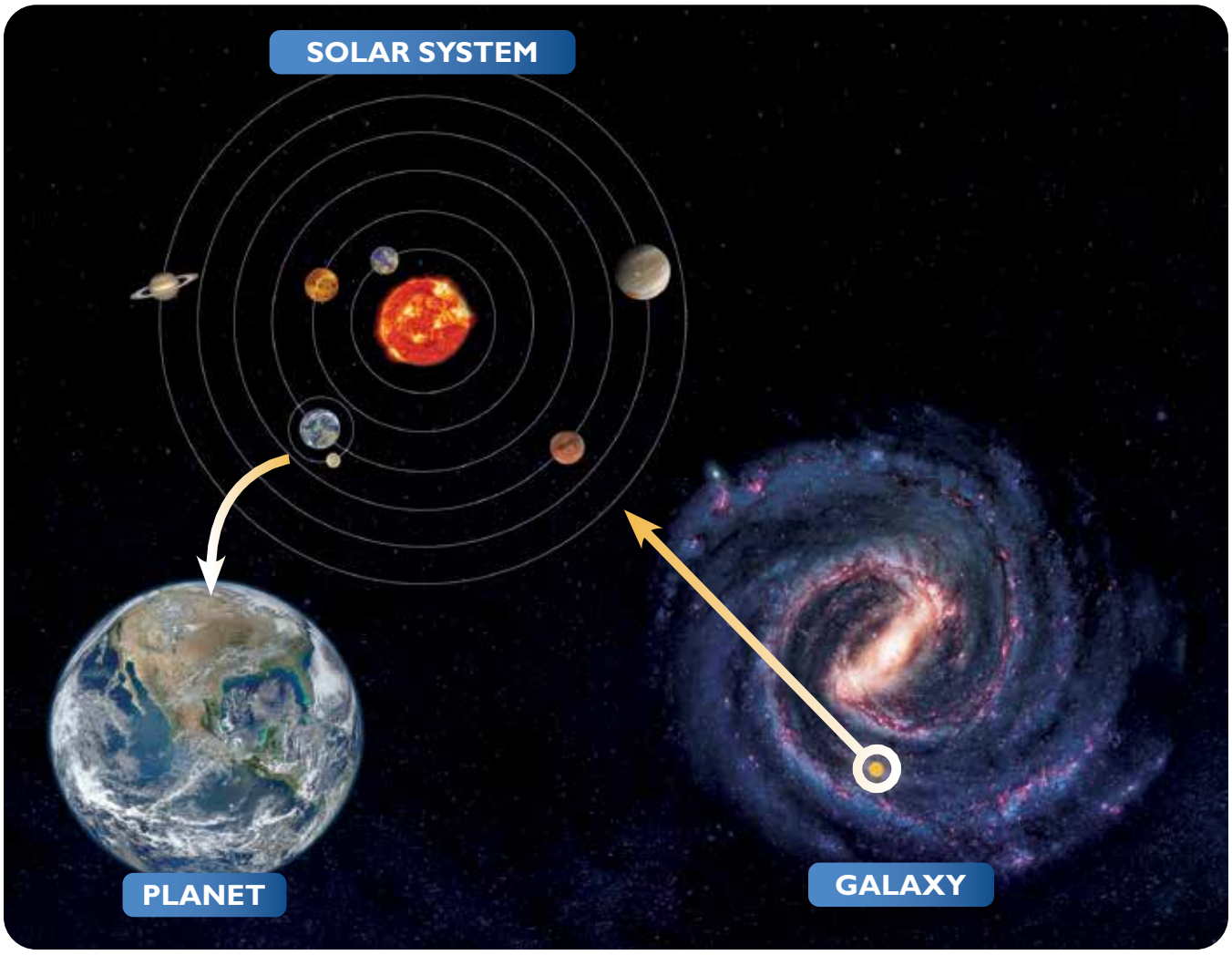
Take a moment to explain to someone else in your own words whether you could count all of the galaxies in the observable universe. Can you name (and maybe show on your galaxy mobile) the 3 main shapes of galaxies? What is the name of the galaxy we live in?

Our Solar System

We're getting closer to home now. Inside our Milky Way galaxy, our solar system consists of our Sun and the planets Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune.

Even though we are getting closer to home, the size of our solar system is still very large. The farthest spacecraft we have sent away from the Earth are *Voyager* 1 and 2. It took 12 years for them to get beyond Neptune. It took them 40 years to go beyond the edge of our solar system. So, while we can explore our solar system, it's not that easy.

Still, over the last 50 years, many spacecraft have visited the other planets in our solar system. We have landed spacecraft on planets, moons, and asteroids. Each one of these is different than Earth so we still have much to learn about our cosmic neighborhood. It will be a while before we can explore other areas in our galaxy.

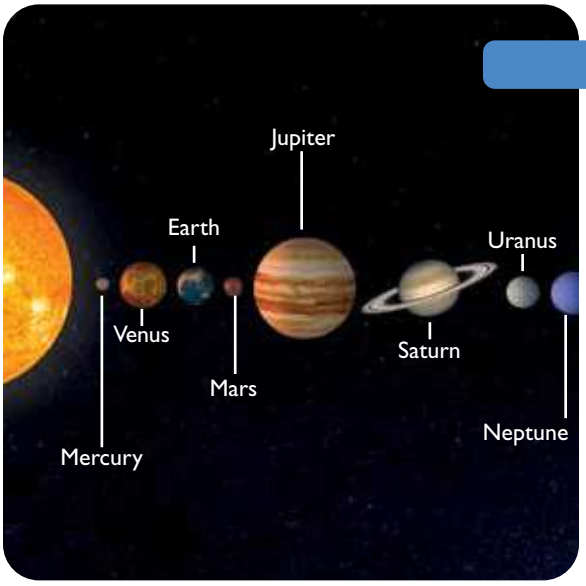


Your Cosmic Address

We started this lesson by talking about our home address. Do you still think of your home address in the same way as you did before you started this lesson? I hope not. Your cosmic address doesn't end with your country or even your planet. Let's end our lesson traveling outward as we see what we can say about our address if we start with our planet, Earth.

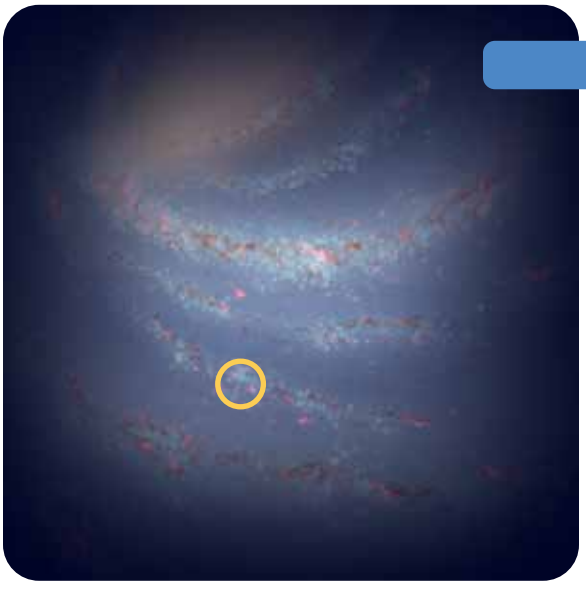
EARTH

Earth is our home planet. It's the only home we have. We can explore the other planets in our solar system, but humans haven't yet walked on their surfaces or tried to live there. As far as we know, nothing lives on any planet in our solar system except Earth. We have not found bacteria, plants, animals, or intelligent beings. Earth is a special planet; it is a gift from God.



SOLAR SYSTEM

Earth looks tiny when you compare it to the size of our solar system. The Sun is the star at the center of our solar system. Did you know that you could fit over one million Earths inside the Sun? The Sun is that big! Eight planets orbit the Sun. They are Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune. We explore the planets in our solar system by sending spacecraft to orbit or land on their surfaces. This is essentially as far as we have been with spacecraft.



INTERSTELLAR NEIGHBORHOOD

At this point, we use telescopes to explore space. Our solar system resides in an area known as an interstellar neighborhood. There are other stars besides our Sun in this neighborhood. Remember how fast light travels? Well, you would have to travel as fast as light for over 4 years to get to the next closest star. That might seem reasonable to you, but you know we can't travel as fast as light. With our current speeds, the Earth would age about 80,000 years before we could get there. That's a long time and we are still on one of the spiral arms in our Milky Way galaxy.

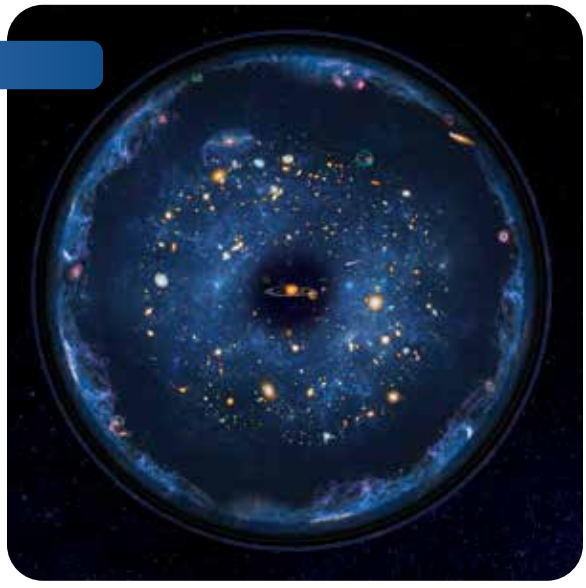
MILKY WAY GALAXY

Our interstellar neighborhood would just be a small dot of light among many in our Milky Way galaxy. Remember that scientists have estimated that there could be 400 billion stars in our Milky Way galaxy! Our Sun is just one of them. Our galaxy is very big, but the universe has trillions of galaxies. In fact, the Milky Way galaxy's closest neighbor is called the Andromeda galaxy. It is also a spiral galaxy, and it is the farthest object in the sky that you can see with your own eyes. How far away do you think it is? Well, if you turned on a really powerful light and aimed it at the Andromeda galaxy, it would take that light 2.5 million years to get there!

OBSERVABLE UNIVERSE

It's hard to comprehend how many galaxies there just might be in the observable universe! Maybe 2 trillion galaxies isn't even a big enough number. And each of these galaxies have billions of stars and planets to explore.

THE UNIVERSE



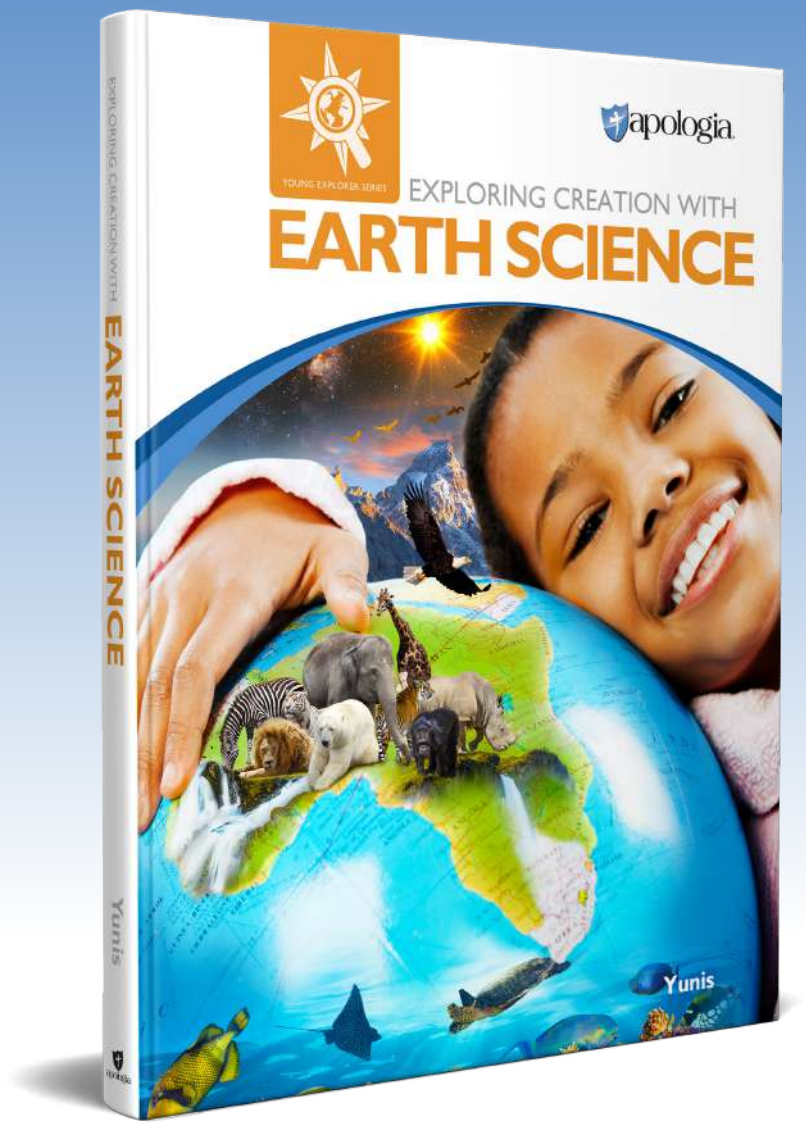
And now we're back where we started at the beginning of this lesson. What do you think is out there?

You might think it is odd that we started our studies of the Earth by learning a little about the universe. Why do you think we did that? If you think about it, it is really hard to imagine that space is so large, contains trillions of galaxies, and as far as we know has only one planet that is capable of supporting life. Our Earth is so truly special. God gave you a beautiful home planet. I hope that you will look at your galaxy mobile and wonder just what else might exist in our universe. Mostly I pray that you know how beloved you are as a child of God.

When I consider your heavens, the work of your fingers,
The moon and the stars, which you have set in place,
What is mankind that you are mindful of them,
Human beings that you care for them?
Psalm 8:3–4 NIV

What Do You Remember?

Why do we talk about the observable universe instead of just saying the universe? What is the name of the galaxy that we live in? Can you name the 3 types of galaxies we discussed? Do we know of any other planet that has life? What was your favorite part of this lesson?



THIS IS THE START OF THE LABORATORY LIST

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SUPPLY LIST

Lesson 1

- Adult supervision
- Bottle of clear craft glue
- 2 small mixing bowls
- Borax powder
- Water
- Spoon
- Blue and red food coloring
- Silver sparkles (the more the better)
- 2 marbles or other small objects
- Small zipper-style plastic bag
- Rooms in your home
- 3 black wire hangers
- Metallic chenille sticks
- Thread
- Tape

Lesson 2

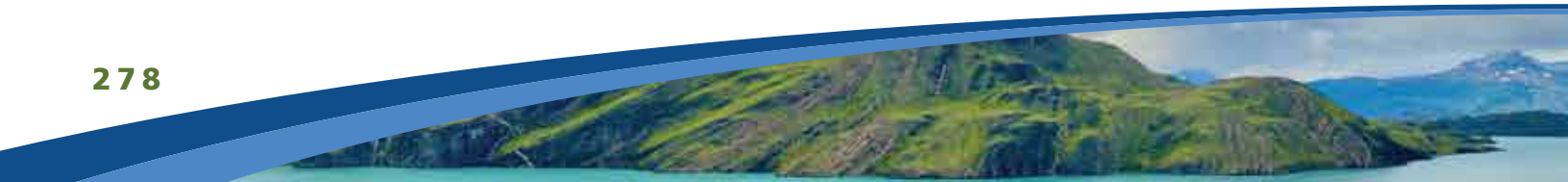
- Adult supervision
- Small, clear, glass container (preferably spherical)
- Small pebbles
- Dirt
- Blue floral gel beads
- Small plant
- Water
- 2 magnets
- Small Etch A Sketch™ (available at most dollar stores)

Lesson 3

- Adult supervision
- 24" white balloon
- Pack of white tissue paper (about 30–50 sheets)
- Scissors
- White school glue
- Water
- 2 bowls
- Spoon
- Thread
- Paper grocery bag
- Blank piece of paper (or your *Notebooking Journal*)
- Small dish to trace
- Pencil
- Ruler
- Crayons
- Strip of 4" × 1" paper

Lesson 4

- Adult supervision
- Rooms in your home
- Paper (or your *Notebooking Journal*)
- Pencil
- Markers
- Orange or grapefruit
- Sharpie
- Knife
- 3 map pages printed from Book Extras
- Scissors
- Tape
- Your geosphere from lesson 3
- Bowl
- String
- Your globe



Lesson 5

- Adult supervision
- Your globe
- Pencil(s)
- Paint (brown and blue)
- Paintbrush
- Paper plate
- Water bowl
- Paper towels
- Internet (optional)
- Pot
- Water
- Egg
- Stove
- Butter knife
- Piece of paper
- Saltine crackers
- Countertop
- Borax
- Water
- Spoon
- Container(s) that can hold hot water (mason jars, coffee mugs, Pyrex® cups)
- Food coloring (optional)
- Chenille sticks (white works best)
- Thread
- Tape
- Aluminum Foil
- Magnifying glass
- Ice cream (Pick your favorite flavor)
- Chocolate chips
- Bowl
- Microwave
- Serving cup
- Plate
- Chocolate bar
- Marshmallows
- Sprinkles
- Graham crackers
- Starburst Minis candies
- Chocolate chip cookie recipe
- Chocolate chip cookie ingredients
- Cookie tray
- Oven

Lesson 6

- Adult supervision
- A nice day
- Shovel
- Glass jar (optional)
- Magnifying glass
- Places to dig
- White sheet (other light colors will work too)
- Water
- Your globe
- Tissue paper (one sheet)
- Glue
- Bowl
- Brown paint
- Internet (optional)
- 1 T Butter
- 1 t Flour
- Plate

Lesson 7

- Adult supervision
- Your *Notebooking Journal* (or another notebook)
- Colored pencils
- Different water bodies
- Your globe
- Permanent marker
- Paint
- Internet (optional)

Lesson 8

- Adult supervision
- 15 pounds (bags of flour or hand weights will work)
- Backpack (or other strong container with straps)
- Index card
- Glass (with a small diameter)
- Water
- A balloon
- 2 different sized glasses
- 1 cup measuring cup
- Water glass
- Warm water
- Match
- Zipper-style plastic bag full of ice

Lesson 9

- Adult supervision
- Your globe
- Flashlight
- Friend
- Markers or paint
- Pencil
- Paper (or your *Notebooking Journal*)
- A few friends or family members who live near you
- Internet access
- Colored pencils or markers
- Maps (in text)
- The outdoors

Lesson 10

- Adult supervision
- TV newscast
- Internet access
- Paper (or your *Notebooking Journal*)
- Colored pencils
- Smart phone (optional)
- Clear glass
- Water
- Ice cubes
- Thermometer
- Helium-filled balloon
- Blank postcard (or card stock)
- Permanent marker
- Zipper-style plastic bag
- String
- Tape
- Stamp
- Pencil

Lesson 11

- Paper (or your *Notebooking Journal*)
- Colored pencils
- Pictures and printer (optional)
- Glue or tape (optional)
- Your globe
- Paint and paint supplies
- Stickers (optional)
- Internet (optional)

Lesson 12

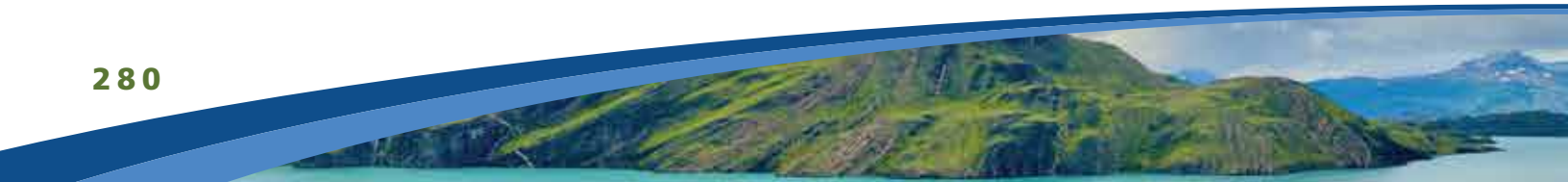
- Adult supervision
- Paper (or your *Notebooking Journal*)
- Colored pencils
- Internet access
- Poster Board (or large piece of paper)
- Markers
- Magazines (optional)
- Scissors (optional)
- Tape or glue (optional)

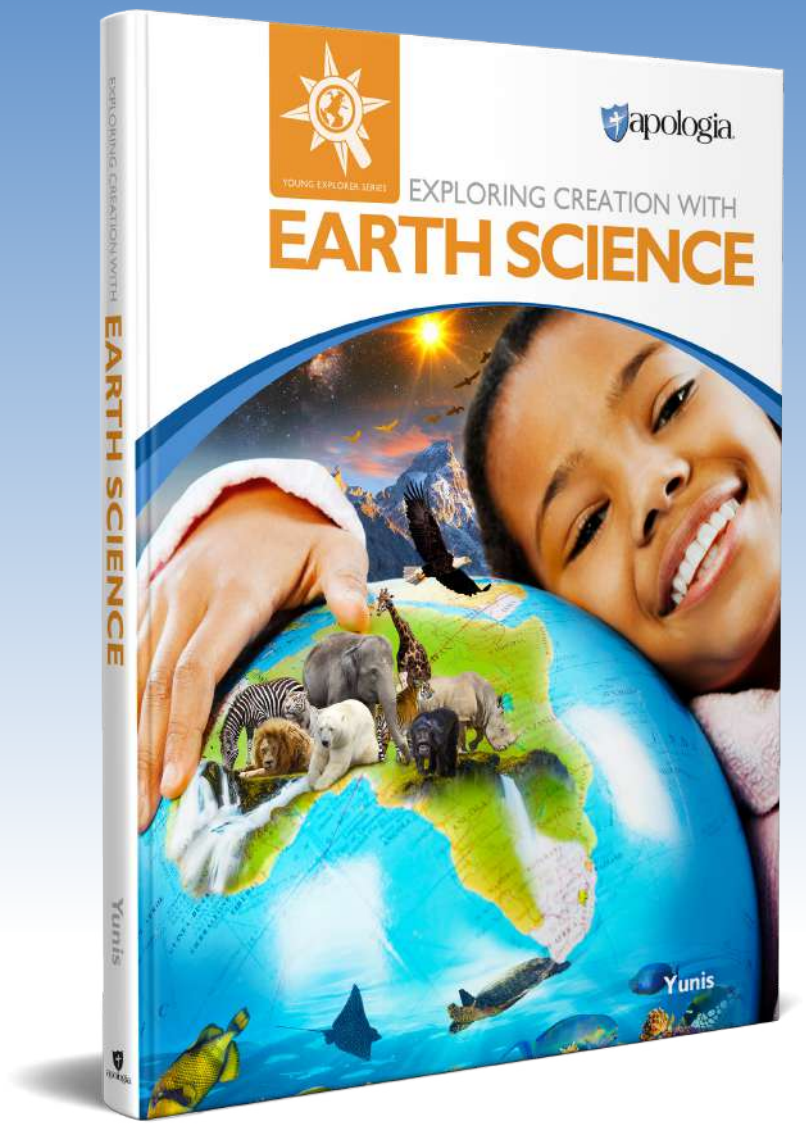
Lesson 13

No supplies are needed for Lesson 13

Lesson 14

- Paper (or your *Notebooking Journal*)
- Pencil





THIS IS A SAMPLE OF THE SUGGESTED WEEKLY SCHEDULE

THIS IS A PREVIEW. THE NUMBER OF PAGES DISPLAYED IS LIMITED.

apologia

WEEK 2

❒ **LESSON 1 – THE OBSERVABLE UNIVERSE**
Textbook p. 21–24
NJ p. 31–33, 38–39, 42

❒ **LESSON 2 – LIFE IN THE HABITABLE ZONE**
Textbook p. 26–29
Activity 2.1
NJ p. 46

WEEK 3

❒ **LESSON 2 – LIFE IN THE HABITABLE ZONE**
Textbook p. 30–36
Activity 2.2
NJ p. 47–51, 53

❒ **LESSON 3 - SPHERES OF THE EARTH**
Textbook p. 38–41
Activity 3.1
NJ p. 58–61

WEEK 4

❒ **LESSON 3 - SPHERES OF THE EARTH**
Textbook p. 41–45
Activity 3.2
NJ p. 62–63

❒ **LESSON 3 - SPHERES OF THE EARTH**
Textbook p. 45–50
Activity 3.3
NJ p. 64–65, 67