Elementary Earth Science

Investigate the Possibilities

THE EARTH

Its Structure & Its Changes

Tom DeRosa
Carolyn Reeves

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About the Authors

Tom DeRosa, as an experienced science educator and a committed creationist, has incorporated both his passions in the founding and the directing of the Creation Studies Institute, a growing national creation organization whose chief focus is education. His wealth of experience in the public school, Christian school, and homeschool markets for over 35 years has given special insights into what really works in engaging young minds. He holds a master's degree in education, with the emphasis of science curriculum. He is an author and sought-out, enthusiastic creation speaker who has a genuine love for the education of our next generation.

Carolyn Reeves is especially skilled at creating ways to help students develop a greater understanding of not just scientific concepts, but also how these are applied within the world around us. Carolyn retired after a 30-year career as a science teacher, finished a doctoral degree in science education, and began a new venture as a writer and an educational consultant. She and her husband make their home in Oxford, Mississippi, where they are active members of North Oxford Baptist Church. The Reeves have three children, three in-law children, and eleven grandchildren.

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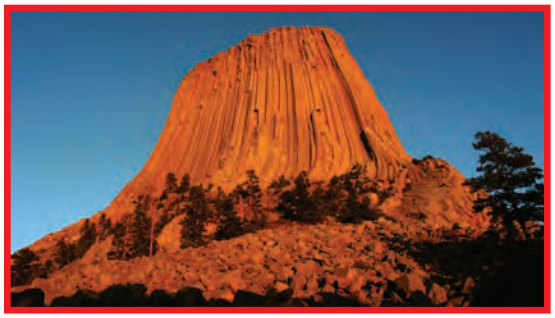
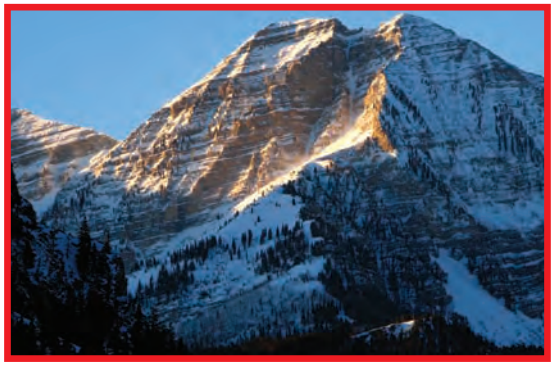




INTRODUCTION

You will not find this subject boring! Geology is a fascinating subject to study. It is also mysterious, because we have to make our best guesses about some of the features we find on the earth. The "Devil's Tower" in Wyoming is a puzzle to scientists. It's a huge stump-shaped formation made up of five or six-sided columns of hard rock that are almost 900 feet tall.

The Grand Canyon is one of the most spectacular places on earth. People marvel as they look at a mile-deep opening in the earth composed of layers and layers of multicolored rocks and ask how this came to be.

In the Rocky Mountains, road cuts expose twisted layers of rocks, and people wonder what in the world happened to them. Hundreds of miles of caves have formed in Kentucky, containing unbelievably beautiful features.

Earthquakes and volcanoes have puzzled and frightened people for thousands of years. It has only been in the past few years that the ocean floor has been explored, revealing the highest mountains and the deepest canyons on earth.

We are still learning how to use the natural resources of the earth wisely. Water, soil, mineral ores, oil, and gas have not always been treated in the best ways.

As you study the lessons in this book, keep in mind that many of the topics are still unsolved mysteries. Scientists know many facts about the earth and have some interesting explanations for what happened in the past. However, when it comes to reconstructing the past, many mysteries remain.

The authors of this book believe that a worldwide catastrophic flood, along with accompanying earthquakes, volcanic eruptions, and other powerful processes, produced most of the earth's rock layers and other features. We are unapologetic about this belief, even though many geologists propose that the earth's features were shaped gradually over millions and millions of years.

We encourage you to examine the evidence for yourselves. Some of you may be amazed to see strong evidence for the Genesis Flood. You may be surprised to see evidence that some rock layers, mountains, and valleys formed in a few hours, days, weeks, or years rather than millions of years.

We recommend the following Internet websites as quick additional references:

- www.creationstudies.org
- www.answersingenesis.org
- www.icr.org
- www.creationresearch.org
- www.nlpg.com

Scientists

Isaac Newton.....(1642–1727)
James Hutton .....(1726–1797)
Charles Lyell .....(1797–1875)
Charles Darwin .....(1809–1882)
Henry M. Morris.....(1918–2006)

HOW TO USE THIS BOOK

Each investigation gives students a chance to learn more about some part of God's creation. To get the most out of this book, students should do each section in order. Many science educators believe science is best learned when students begin with an investigation that raises questions about why or how things happen, rather than beginning with the explanation.

The learning progression recommended for this book is: Engage, Investigate, Explain, Apply, Expand, and Assess. In each lesson, students will be introduced to something that is interesting, they will do an investigation, they will find a scientific explanation for what happened, they will be able to apply this knowledge to other situations and ideas, they will have opportunities to expand what they learned, and there will be multiple assessments.

Think about This **(Engage)** — Students should make a note of what they know or have experienced about the topic. If this is a new topic, they could write some questions about what they would like to learn.

The Investigative Problem(s) — Students should be sure to read this so they will know what to be looking for during the investigation.

Gather These Things — Having everything ready before starting the investigation will help students be more organized and ready to begin.

Procedures and Observations **(Investigate)** — Students should first follow the instructions given and make observations of what happens. There will usually be opportunities for students to be more creative later.

The Science Stuff **(Explain)** — This section will help students understand the science behind what they observed in the investigation. The explanations will make more sense if they do the investigation first.

Making Connections **(Apply)** — Knowledge becomes more permanent and meaningful when it is related to other situations and ideas.

Dig Deeper **(Expand)** — This is an opportunity for students to expand what they have learned. Since different students will have different interests, having choices in topics and learning styles is very motivating. All students should aim to complete one "Dig Deeper" project each week, but the teacher may want older students to do more. Generally, students will do at least one project from each lesson, but this is not essential. It is all right for students to do more than one project from one lesson and none from another.

What Did You Learn? **(Assess)** — The questions, the investigations, and the projects are all different types of assessments. For "What Did You Learn?" questions, students should first look for answers on their own, but they should be sure to correct answers that might not be accurate.

Additional opportunities for creative projects and contests are found throughout the book. For grading purposes, they can be counted as extra credit or like a "Dig Deeper" project.

Nurture Wisdom and Expression

Each book contains information about early scientists and engineers. Students need to see that they were regular people who had personal dreams and who struggled with problems that came into their lives. Students may be surprised to realize how many of the early scientists believed that understanding the natural world gave glory to God and showed His wisdom and power.

In addition to the science part, students will find creation apologetics and Bible mini-lessons. The apologetics will clear up many of the misconceptions students have about what science is and how it works. Both the apologetics and Bible lessons should lead to worthwhile discussions that will help students as they form their personal worldviews.

Students with artistic and other creative interests will have opportunities to express themselves. For example, some of the apologetics are written in narrative form and are suitable for drama presentations. As scientists are introduced and researched, students can also present what they have learned as time-dated interviews or news accounts. Remember, if the scientists are included in a drama presentation, they should be represented as professionals, not as stereotyped, weird-looking people.

Combined Teacher/Student Book

In addition to this text, you may also want to utilize the combined teacher's guide and student journal. This book includes insights and suggestions to help you in more effectively working with your student(s). Worksheets and journal pages for the student are on perforated pages that can easily be taken out and copied for your convenience.

INVESTIGATION #1

Orange You Going to Map the Earth?

Think about This

Dustin and Elizabeth were trying to find the countries of Togo and Greenland on the globe. "Look, Togo is in Africa next to the Atlantic Ocean, a little north of the equator, so I guess it's pretty hot there," Dustin said as he finally located the little country.

"Greenland is easy to find, and it is probably much colder than Togo. I wonder why it looks bigger on the wall map than it does on the globe?" Elizabeth said.

Have you ever wondered how a round globe of the earth could show the same countries and oceans as a flat map of the earth? Have you ever wondered how much information you could find out about different countries from looking at a map? Let's find out some answers!

Procedure & Observations

Part A

1. Draw a line from the flower end to the stem end of the orange with the black marker to represent a longitudinal line going from the North Pole to the South Pole. Draw five more longitudinal lines in the same way, keeping them spaced about the same distance apart.

2. Now make several dots with your marker halfway between the "poles" and connect the dots by drawing a line around the center of the orange to represent the equator. Draw a few more lines above and below this line to represent latitudinal lines. Make them parallel to the "equator." Notice that these lines get smaller and smaller as you move toward the "poles."

3. Draw some landmasses with your green marker to represent continents. Don't worry about drawing continents with accurate sizes and shapes.

The Investigative Problems

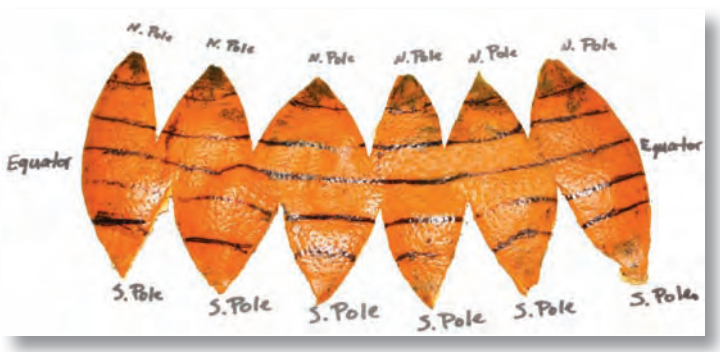
How can the countries on a round earth be shown on a flat map?

What do lines on the map tell us?

4. Cut the skin of the orange with the fruit peeler along each "longitudinal line" down to within one centimeter (just under half an inch) of the "equator." Cut both north and south of the orange, but don't cut across the "equator" yet. **(This will require adult supervision.)**

5. When you have finished making these cuts, use your plastic knife to finish making one cut that goes all the way from "pole" to "pole." Using the dull side of the plastic knife, carefully begin to remove the skin from the orange. Try to keep the whole skin in one piece.

6. Lay the peel down and flatten carefully, allowing the places you cut to separate, as in the diagram.



Part B

1. Make a diagram of your flattened orange peel and label the north and south poles, the equator line, the longitudinal lines, the latitudinal lines, and the continents.

2. Compare the orange peel "map" with a flat map of the world. Compare with a globe if one is available.

3. Are the areas close to the poles really as large as they are drawn on a flat map of the world?

4. You only drew six longitudinal lines on your orange map. How many longitudinal lines are usually shown on a world map?

5. The longitudinal lines on a globe get closer together as they get closer to the poles. The latitudinal lines on a globe make smaller and smaller circles as they get closer to the poles. Make careful observations of your flat map of the world.

6. Does the flat map show these changes in the longitudinal and latitudinal lines?

The Science Stuff

The orange peel is a model of a flat map of the world. Scientific models are used to make comparisons with other things, which may be too small to see or may be difficult to understand. Most students need a little help understanding how all the countries and oceans of the world can be placed on a flat map when the earth is actually round. Let's first look at the basic terms and features by referring to a flat map of the world.

The lines that go up and down and connect the North Pole and the South Pole are called longitudinal lines. Most world maps show 24 longitudinal lines that correspond (more or less) to the 24 times zones.

In order to have a starting point for counting lines on a sphere, the longitudinal line that was chosen to be 0° was the one that passes through the Royal Observatory at Greenwich, England. It is sometimes referred to as the Greenwich Meridian or the Prime Meridian.

The equator is a line that circles the earth halfway between the North Pole and the South Pole. Other lines that circle the earth above and below the equator are known as latitudinal lines. The places at and near the equator tend to be hot all year. Places near the North and South Poles tend to be cold all year. Places farther away from the poles and the equator tend to have four seasons — spring, summer, fall, and winter.

Finding where a longitudinal line and a latitudinal line intersect can identify any place on the earth. Maps only label the main lines, but there are many other lines that are not shown on a map. Hurricanes can be tracked if you know the exact longitudinal and latitudinal lines that cross it. Exact positions can be obtained from special satellites in orbit above the earth and transmitted to a Global Positioning System. Ships in the middle of the ocean can identify their positions with a GPS system and radio for help if they need it.

Greenwich, England

Your orange peel model may look like the earth has many North and South Poles. To avoid the broken look, mapmakers stretch out the northern and southern countries and oceans to be continuous. This causes the countries near the Poles on a flat map of the world to appear distorted. For example, on a flat map, Greenland may appear larger than it does on a globe. Also, on a globe, the distance between any two longitudinal lines is much farther apart at the equator than they are near the Poles. Globes are more accurate than flat maps, but they would not work on the flat pages in a book.

Making Connections

The time zones are not exactly lined up with the longitudinal lines, but each time zone is approximately 15°. The earth is divided into 24 longitudinal lines that are 15° apart. There are four times zones in the United States. If it is 10:00 a.m. in Seattle, Washington (Pacific Time Zone), and you move east (to the right), the time goes up an hour as you cross into another time zone. That means the time in New York City is 1:00 p.m. (Eastern Time Zone). Have you ever wondered why it just couldn't be 10:00 a.m. all over the world at the same time? Most everyone expects 10:00 a.m. to be the time between breakfast and lunch, but if there weren't different time zones, 10:00 a.m. would be in the middle of the night for many countries.

The longitudinal line on the opposite side of the world, 180° from the Greenwich Meridian, is known as the International Date Line. The date changes if you cross this line!

Global Positioning Systems (GPS) are used in many vehicles today. If you ride in a vehicle that has a GPS system, the GPS sends and receives signals from a satellite above the earth that can identify your exact location. GPS systems can even give you directions for how to get to a specific address.

Dig Deeper

- On a map, the Geographic North Pole and the Geographic South Pole are labeled and represent the axis of the earth's spin. The earth also has a Magnetic North Pole and a Magnetic South Pole that are located in different places. You probably won't find the magnetic poles on a regular map. Find where both magnetic poles are located, and show this on a map. Explain what is meant by declination when using a compass.
- There are several Internet sites that can tell you what time it is in other places around the world. Find the time in your hometown. Then find what time it is right now in ten other cities around the world. Record the cities and the times. Now look for a pattern about how the time changes as you go from east to west.

What Did You Learn?

1. Is the International Date Line a longitudinal line or a latitudinal line?
2. What is the name of the starting longitudinal line that is designated as 0°?
3. Which lines go from the North Pole to the South Pole?
4. Which lines circle the earth and are parallel to the equator?
5. What part of the earth doesn't have four seasons?
6. Into how many times zones is the earth divided?
7. What is a GPS device? What can a GPS device in an automobile do?