Elementary Earth Science

Investigate the Possibilities

THE EARTH

Its Structure & Its Changes

Teacher's Guide and Student Journal

Tom DeRosa
Carolyn Reeves

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Unless otherwise noted, Scripture quotations are from the New International Version of the Bible.

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Introduction

The overall goal for each workbook is to include three components: good science, creation apologetics, and Bible references. This goal underlines the rationale for the design of the workbooks.

Science is a great area to teach, because children have a natural curiosity about the world. They want to know why and how things work, what things are made of, and where they came from. The trick is to tap into their curiosity so they want to find answers.

Many elementary-level science lessons begin with definitions and scientific explanations, followed by an activity. A more effective method is to reverse this order and begin with an activity whenever possible. The lessons found in these workbooks begin with an investigation, followed by scientific explanations and opportunities to apply the knowledge to other situations.

In addition to the investigations, there are sections on creation apologetics, written mostly in narrative forms; connections to Bible references; on-your-own challenges; pause and think questions; projects and contests; and historical stories about scientists and engineers. These sections encourage students to think more critically, to put scientific ideas into perspective, to learn more about how science works, to gain some expertise in a few areas, and to become more grounded in their faith in the Bible.

It is not expected that students will do everything suggested in the workbooks. The variety provides students with choices, both in selection of topics and in learning styles. Some students prefer hands-on activities and building things, while others prefer such things as writing, speaking, drama, or artistic expressions. Once some foundational ideas are in place, having choices is a highly motivating incentive for further learning.

Every effort has been made to provide a resource for good science that is accurate and engaging to young people. Most of the investigations were selected from lessons that have been tested and used in our Discovery classrooms. Careful consideration was given to the National Science Education Standards.

Format for Individual Lessons:

1. **Think about This:** The purpose of this section is to introduce something that will spark an interest in the upcoming investigation. Lesson beginnings are a good time to let students make observations on their own; for a demonstration by the teacher; or to include any other kind of engaging introduction that causes the students to want to get answers. Teachers should wait until after students have had an opportunity to do the investigation before answering too many questions. Ideally, lesson beginnings should stimulate the students' curiosity and make them want to know more. Lesson beginnings are also a good time for students to recall what they already know about the lesson topic. Making a connection to prior knowledge makes learning new ideas easier.
2. **The Investigative Problem:** This section brings a focus to the activity students are about to investigate and states the objectives of the lesson. Students should be encouraged throughout the investigation to ask questions about the things they want to know. It is the students' questions that connect with the students' natural curiosity and makes them want to learn more. Teachers should stress to students at the start of each lesson that the goal is to find possible solutions for the investigative problem.
3. **Gather These Materials:** All the supplies and materials that are needed for the investigation are listed. The teacher's book may contain additional information about substituting more inexpensive or easier to find materials.
4. **Procedures and Observations:** Instructions are given about how to do the investigation. The teacher's book may contain more specifics about the investigations. Students will write their observations as they perform the activity.
5. **The Science Stuff:** It is much easier for students to add new ideas to a topic in which they already have some knowledge or experience than it is to start from scratch on a topic they know nothing about. This section builds on the experience of the investigation.
6. **Making Connections:** Lessons learned become more permanent when they are related to other situations and ideas in the world. This section reminds students of concepts and ideas they likely already know. The scientific explanation for what the students observed should be more meaningful if it can be connected to other experiences and/or prior knowledge. The more connections that are made, the greater the students' level of understanding will become.
7. **Dig Deeper:** This section provides ideas for additional things to do or look up at home. Students will often want to learn more than what was in the lesson. This will give them some choices for further study. Students who show an interest in their own unanswered questions should be allowed to pursue their interests, provided the teacher approves of an alternative project. Students should aim to do at least one project per week from Dig Deeper or other project choices. The minimum requirements from this section should correspond to each student's grade level. Students may want to do more than one project from a lesson and none from other lessons. Remember, this is an opportunity for students to choose topics that they find interesting.
8. **What Did You Learn?** This section contains a brief assessment of the content of the lesson in the form of mostly short-answer questions.
9. **The Stumpers Corner:** The students may write two things they would like to learn more about or they may write two "stumper" questions (with answers) pertaining to the lesson. Stumper questions are short-answer questions to ask to family or classmates, but they should be hard enough to be a challenge.

Note to the Teacher

The books in this series are designed to be applicable mainly for grades 3–8. The National Science Education Standards for levels 5–8 were the basis for much of the content. Recommendations for K–4 were also considered, because basic content builds from one level to another.

We feel it is best to leave grading up to the discretion of the teacher. However, for those who are not sure what would be a fair way to assess student work, the following is a suggestion.

1. Completion of 20 activities with write-up of observations — 30%
2. Completion of What Did You Learn Questions + paper and pencil quizzes — 35%
3. Projects, Contests, and Dig Deeper — 35%

The teacher must set the standards for the amount of work to be completed. The basic lessons will provide a solid foundation for each unit, but additional research and activities are a part of the learning strategy. The number of required projects should depend on the age, maturity, and grade level of the students. All students should choose and complete at least one project each week or 20 per semester. Fifth and sixth graders should complete 25 projects per semester. A minimum guide for seventh and eighth graders would be 30 projects. The projects can be chosen from "Dig Deeper" ideas or from any of the other projects and features. Additional projects would give extra credits. By all means, allow students to pursue their own interests and design their own research projects, as long as you approve first. Encourage older students to do the more difficult projects.

Students should keep their work in the Student Journal. If additional space is needed, teachers can provide files or notebooks to organize their work. You may or may not wish to assign a grade for total points, but a fair evaluation would be three levels, such as: minimum points, more than required, and super work. Remember, the teacher sets the standards for evaluating the work.

Ideally, if students miss a lab, they should find time to make it up or do one of the alternative activities. When this is not practical, make sure they understand the questions at the end of the lesson and have them do one of the "Dig Deeper" projects or another project.

You should be able to complete most of the 20 activities in a semester. Suppose you are on an 18-week time frame with science labs held once a week for two or three hours. Most investigations can be completed in an hour or less. Some of the shorter activities can be done on the same day or you may choose to do a teacher demonstration of a couple of the investigations.

It is suggested that at least five hours a week be allotted to the investigations, contests, sharing of student projects, discussion of "What Have You Learned" questions, and research time. More time may be needed for some of the research and projects.

Most of the equipment for these investigations can be obtained from hardware stores, grocery stores, and other local stores. You may want to look over the needed materials list now and begin to collect these items. For example, there is no need to make more than one trip to the hardware store if you know what you will need for this unit.

Note that the scientists introduced in this book, along with their life span, are listed in the Introduction. A useful tool is to make is a time-line. Scientists from other books in this series should be part of this time-line. A long chart about 30 centimeters (12 inches) high and about 5 meters (16 feet) long works well. The chart should be divided into equal 100-year intervals beginning with 2000 B.C. This chart can be displayed as needed. As each new scientist is introduced, a colored block can be taped to the chart showing the life span of the scientist/technician with the name of the person written inside. It is extremely helpful to students to relate other historical people to this time-line. Science is not an isolated endeavor that occurs apart from other historical events and should be shown in the context of what is happening in the culture and the world.

INVESTIGATION #1

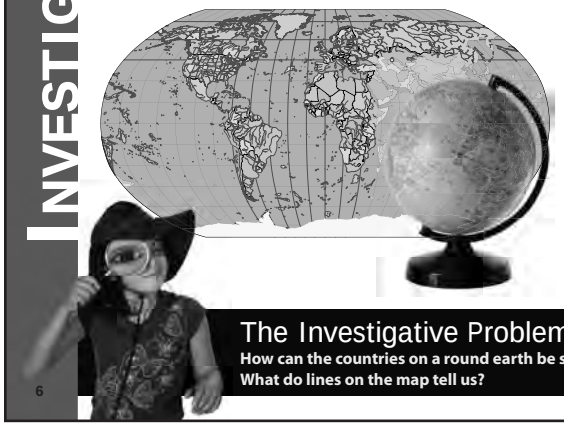
Orange You Going to Map the Earth?

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

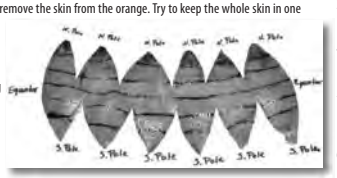
Part A

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?

Objectives

Students will learn how longitudinal and latitudinal lines divide the earth, and how they can be used to identify places on the earth. Some of the problems with flat maps will be illustrated.

Note

You can incorporate a little more math by pointing out that there are 360° in a circle. The earth's equator also makes a 360° circle. There are 24 hours in a day, so the earth can be divided into 24 time zones. Divide 360 by 24 to get 15° in each time zone. This will be more visual if you have the students draw a circle and then use a protractor to divide the circle into 24 sections.

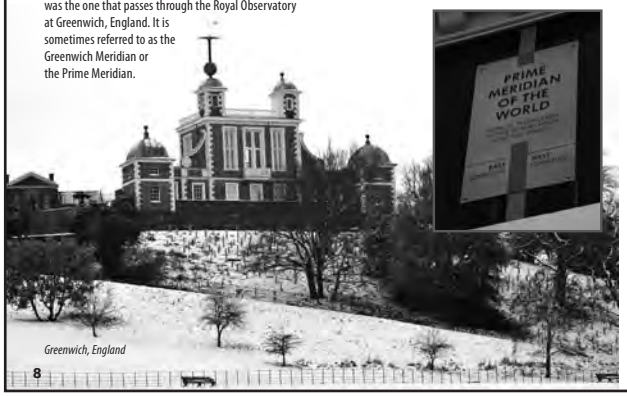
Permanent markers work best, but aren't essential.

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.



Greenwich, England

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.

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?

What Did You Learn?

1. Is the International Date Line a longitudinal line or a latitudinal line? *Longitudinal line*
2. What is the name of the starting longitudinal line that is designated as 0°? *The Greenwich Meridian or the Prime Meridian*
3. Which lines go from the North Pole to the South Pole? *Longitudinal lines*
4. Which lines circle the earth and are parallel to the equator? *Latitudinal lines*
5. What part of the earth doesn't have four seasons? *The part of the earth on or near the equator*
6. Into how many times zones is the earth divided? *24*
7. What is a GPS device? What can a GPS device in an automobile do? *It stands for Global Positioning System. It can tell you where you are on the earth. It is usually able to show you how to get to a specific address.*

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Activity 1

Investigation #1

Orange You Going to Map the Earth?

Thinking About

Date:

The Activity: Procedure and Observations

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.

Drawing Board:

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

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

_____

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

_____

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.

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

_____

_____

Dig Deeper

What Did You Learn ?

1. Is the International Date Line a longitudinal line or a latitudinal line?

   _____

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   _____

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   _____

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?

   _____

   _____

   _____

Stumper's Corner

1. _____

   _____

   _____

2. _____

   _____

   _____