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The Impressionistic Geography Charts

Presented by Michael Dorer, Ed.D.

Basic Outline

- Overview Geography: Static and Dynamic
- The Philosophy of the Charts
- The Role of the Impressionistic Charts

  The charts have a curricular focus upon Geography, and:

  Anthropology

  Astronomy

  Botany

  Chemistry

  Fundamental Needs of People

  Geology

  Historical Geology

  History

  Meteorology

  Oceanography

  Physics
- Striking the Imagination: Technical and Psychological Lessons

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- The Organization of the Charts

  Chapter 1: The Universe, Solar System, and the Earth (7 Charts)

  Chapter 2: Solar Energy and the Earth (10 Charts)

  Chapter 3: Movements of the Earth and Their Consequences (12 Charts)

  Chapter 4: The Atmosphere and its Phenomena (8 Charts)

  Chapter 5: The Work of the Wind (3 Charts)

  Chapter 6: The Hydrosphere and its Phenomena (20 Charts)

- The Experiments
- When to Present the Charts
- How to Present the Charts
- Examples
- Questions and Answers

Impressionistic Geography Charts

With the study of the Impressionistic Geography Charts, we begin Dynamic Geography that regards movements of the earth and phenomena that occurs on the earth. We use these Impressionistic Charts to capture the child's imagination, to give the child an impression of a particular reality. They help the child know the different phenomena in a simple way, near to their experience or level. Not all the charts are impressionistic, the maps and paths of marine currents are more scientific.

The charts are organized from a general to a detailed viewpoint. Humanity, or the child, is the center of the study; the earth is seen as humanity's home. The Human Being is the point of reference for our work.

The earth is studied in relation to the universe and to the solar system; then in relation to solar energy, movements of the earth and related consequences. Next are phenomena that modify the earth's crust and therefore conditions of life on earth; the atmosphere and phenomena related to it, the hydrosphere and phenomena related to it.

The geography charts might be considered part of traditional geography except they do an analysis of difficulty. We examine one difficulty at a time and then combined with another. For example, we consider the earth still, then the rotation, then its revolution, then both movements together.

The second essential point of difference is that they are meant to strike the imagination of the child. These charts are not only meant to convey information, they are meant to excite, inspire, and motivate students through their imaginations.

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The essentially of the knowledge is another differentiating feature of the charts. The aim is to show what is given to the child, how and with what concrete references. The teacher should know basic geography to satisfy a child's curiosity, he or she should be able to answer the children's questions. This material requires periodic updating and may need to be changed occasionally.

This work is done with children from 8-12 years.

The total of 60 charts are divided into 6 groups called chapters:

- *CHAPTER 1: THE UNIVERSE, SOLAR SYSTEM AND THE EARTH* (7 charts)
- *CHAPTER 2: SOLAR ENERGY AND THE EARTH* (10 charts)
- *CHAPTER 3: MOVEMENTS OF THE EARTH AND THEIR CONSEQUENCES* (12 charts)
- *CHAPTER 4: THE ATMOSPHERE AND ITS PHENOMENA* (8 charts)
- *CHAPTER 5: THE WORK OF THE WIND* (3 charts)
- *CHAPTER 6: THE HYDROSPHERE AND ITS PHENOMENA* (20 charts)

One common way to organize the Impressionistic Geography work is to offer the charts in the following order:

Elementary One

Chapter 1 The Universe, Solar System and the Earth (as History: with Great Lessons)

Fourth Year: (17 charts)

Chapter 1 The Universe, Solar System and the Earth

Chapter 2 Solar Energy and the Earth

Fifth Year: (20 charts)

Chapter 3 Movements of The Earth and their Consequences

Chapter 4: The Atmosphere and its Phenomena

Sixth Year: (23 charts)

Chapter 5: The Work of the Wind

Chapter 6: The Hydrosphere and its Phenomena

Although the charts are available in a variety of sizes, one should always choose to use a large format. This does not depend upon the size of the classroom or of the group, but is to give a greater impression and to aid in striking the imagination.

During lessons with the charts, there are certain experiments to be given. These are to be given before or within the lesson. Children are encouraged to participate; the experiments are scientific in nature.

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The commands for the experiments give: materials; teacher's instructions; conclusions to be made. The first lessons repeat some of the experiments done in history. When presenting the charts, consider simple sensorial parts, and then emphasize the scientific parts. At the end of each topic, research is given to the children or problems are suggested by the children, these are not compulsory, but a guide.

Presentation: General Introduction

Discuss with the children what their experience and knowledge of geography already is. It means a "study about the earth". We will be using some charts and experiments to help us on our study of the earth. We want to know how this world is made internally and externally, the laws that govern phenomena on our earth. We would like to know how our earth moves, about other heavenly bodies. Their imaginations will remember a time before the earth existed and the drama of its formation. Our earth study begins with the universe and the solar system.

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CHAPTER 1 THE UNIVERSE, SOLAR SYSTEM AND EARTH

Elementary II Presentations: First Semester 4th year

Number	Sensorial Title	Technical Title
1.	How Small the Earth Is!	A Comparison of the Size of the Earth to the Sun
2.	The Sun's Family	The Solar System
3.	The Cosmic Dance	The Beginning of the Cooling Process
4.	The Time of the Volcanoes	Volcanism and the Cooling Process
5.	The Sun's Beautiful Daughter	Cooling and Filling the Oceans
6.	What's Inside the Earth?	Geochemical Constitution of the Earth
7.	The Continents Drift!	The Evolution of the Continents

Chapter 1 Presentation:

To understand the earth better, we must see it as part of the universe. What is the universe? It is everything around us. It is so immense it is nearly impossible for us to imagine it. Besides us, there is the sun, which is a star, other stars, planets like the earth, satellites that move around the planets. Recall how the universe was formed in the Great Lesson of the Story of the Universe.

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Chapter 1 Topical Overview:

The Formation of the Earth
Force of Attraction
Force of Repulsion
Centripetal and Centrifugal Force
Inertia
Friction
Gravity
Chemical Reaction
Precipitation
Matter and Energy
Mixtures
Crystallization
States of Matter
Materials change state at different temperatures
The Sun and the Earth
The Solar System
The Beginning of the Cooling Process of the Earth
Hot Air Rises
Volcanism
Filling the Oceans
Erosion
Layers of the Earth
Liquid and Viscous
Elastic, Plastic, Rigid
Specific weight
Density.
Lithosphere
Stratification of Rocks
The Rock Cycle
Igneous rock
Sedimentary rock
Metamorphic rock
Continental drift

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Chapter 1 Experiments:

Experiment 1: Force of Attraction
Experiment 2: Centrifugal and Centripetal Force
Experiment 3A, 3B, 3C, and 3D: Force of Inertia
Experiment 4A, 4B: Force of Gravity
Experiment 5: Hot Air Rises
Experiment 6: Volcanism
Experiment 7: Erosion
Experiment 8A, 8B: Air Occupies Space
Experiment 9A, 9B: Specific Weight
Experiment 10: Stratification of Rocks
Experiment 11: Formation of the Mountain
Experiment 12: Fracture of the Earth's Crust
Experiment 13: Stratification of Rocks Observation of the Three Groups of Rocks

Chapter 1 Research and Project Suggestions:

- Classify the stars according to light color and size.
- Graph the representative distances of the principle star from Earth.
- Gather information on the principle constellations.
- Make a visit to a planetarium if possible, slides, films on the universe are suggested.
- Gather information and pictures on the other planets (may divide the class into groups).
- Build the planets with clay or papier-mâché, with size proportional, arrange them using proportional positions, on a wall, floor, ceiling.
- Make a graph to show the distance of the planets from the sun
- Graph the planets in relation to the sun in proportional dimension
- Gather information and pictures regarding space exploration.
- Prepare charts and illustrations of the consistencies and proportions of the continental land masses through the ages, i.e. continental drift.
- Collect pictures and illustrations of volcanoes, especially presently active ones. Research principle volcanic eruptions in history.
- Look for practical examples showing how hot air rises.
- Find examples of gravity in daily life.
- Earthquakes-visit a seismic center.
- Locate the seismic zones of the world by means of maps.
- Graph the principle earthquakes.
- Collect photos of changes caused by earthquakes.
- Make a chart of specific weights of most common elements.
- Observation of the stratification of rocks in the environment, includes a drawing exercise.
- A collection of minerals and/or fossils and their classification.
- A visit to a museum of natural history.

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CHAPTER 2: SOLAR ENERGY AND THE EARTH

Elementary II Presentations: Second Semester 4th year

Number	Sensorial Title	Technical Title
8.	Solar Energy Absorbed by the Earth	Insolation
9.	Fire and Ice	If the Earth Did Not Rotate
10.	How the Rays of the Sun Reach the Earth	Perpendicular and Oblique Solar Rays
11.	What Are The Rays of The Sun Like When They Reach The Earth?	A Different Number of Rays Cover Equal Areas
12.	The Rays Work to Reach The Earth	The Work of the Rays of the Sun in Passing Through the Atmosphere
13.	The Rays Work to Reach the Earth	The Work of the Rays of the Sun in Passing Through the Atmosphere
14.	The Earth Stores Heat	The Atmosphere as a Poor Conductor of Heat
15.	The Earth Gives Back Heat	Radiation
16.	Like a Warm Bed	Radiation: Retaining Heat
17.	Like a Freezing Bed	Radiation: Dispersing Heat

The sun's glowing crown of rays gives life and light to the earth. The sun's warmth surrounds us. The earth uses this daily gift of heat and slowly gives some back, at night

We know the earth is made up of rocks and is very hot inside, but if the sun did not exist, life would not exist on the earth. The gift of light and heat is called "Insolation."

Chapter 2 Topical Overview:

Insolation or Solar Energy absorbed by the Earth

Rotation of the Earth

Revolution of the Earth

Illumination of the Earth

Perpendicular and Oblique Rays

The Illumination of the Equator compared to the Poles

Different dispersions of Solar Energy in crossing the Atmosphere

The Atmosphere as a Bad Conductor of Heat

The Radiation of stored heat from the Earth

Good and Bad Conductors of Heat

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Chapter 2 Experiments:

Experiment 14: Solar Energy

Experiment 15: Illumination of the Earth

Experiment 16: The Perpendicular and the Oblique Rays

Experiment 17: Illumination of the Equator and the Poles

Experiment 18A and 18B: Good and Poor Conductors of Heat

Chapter 2 Research and Project Suggestions:

- Research various parts of the earth and heat distribution in various seasons.
- Make a graph representing temperatures at different heights.
- Graph showing differences of temperature at sea level and on a mountain.
- Graph temperature throughout the day.
- Graph temperature throughout the year.
- Graph temperature in your home and another distant city or locale. Keep records.
- Distribution of heat in various parts of the Earth.
- Investigate the insolation of the planets.
- Investigate various energy sources. How are each related to the sun?
- Find out about alternative energy.

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CHAPTER 3 MOVEMENTS OF THE EARTH AND THEIR CONSEQUENCES

Elementary II Presentations: First Semester 5th year

Number	Sensorial Title	Technical Title
18.	Day and Night	Rotation and Its consequences
19.	What is the Hottest Time of Day	Variations in Temperature of the Earth's Surface with Respect to the Rotation of the Earth
20.	The Earth is Leaning	The inclination of the Axis of the Earth
21.	The Seasons	The Revolution of the Earth and the Seasons
22.	The Seasons on the Map	The First Day of Each Season
23.	The Zones of the Earth	Astronomic Zones
24.	Our Summer	The Northern Summer Solstice
25.	Our Winter	The Northern Winter Solstice
26.	Spring and Autumn	The Vernal and Autumnal Equinoxes
27.	Torrid Zone	The Equatorial Climatic Zone
28.	Temperate Zones	The North and South Temperate Climatic Zones
29.	Frigid Zones	The Artic and Antarctic Climatic Zones

On a train that goes fast, we feel like we are still and the scenery is moving. We have the same impression on earth. . It seems to us that our earth is still, and the sun, moon, and stars move. It seems that every morning the sun comes up in the east. As it gets later in the morning, the sun seems to rise higher in the sky. At noon, the sun is slightly towards the south. Then, in the evening we see that the sun sets at a point opposite to where n rose.

The earth is actually moving! The earth rotates in the direction west to east At the same time it is revolving in an orbit around the sun.

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Chapter 3 Topical Overview:

Rotation and its Consequences

Night, day, twilight, sunrise, sunset, noon, midnight

Variations of Temperature in during the day

Latitude, longitude, and Meridians

Time Zones

International Date Line

The Inclination of the Earth's Axis.

The Seasons

Climatic Zones of the Earth

Solstices and Equinoxes

Summer

Winter

Autumn

Spring

The Distribution of Heat on the Earth

The Climate and Cultures

Chapter 3 Experiments:

Experiment 19: Day and Night

Experiment 20: Inclination of the Polar Axis

Experiment 21: Marking off the Imaginary Parallels

Experiment 22: The Seasons

Chapter 3 Research and Project Suggestions:

- Locate the fundamental points (N-S-E-W) in relation to the sun.
- Show use of the compass.
- Orienteering and compass courses
- Orienteering without compass and/or at night.
- Construction of a sundial.
- Graph the length of day and night during the year, need calendar with sunrise and sunset noted.
- Graph temperatures of various houses throughout the day.
- Locate the principle cities of the world and note the time difference between these cities and your home.
- You can compare the times in different countries.
- Examine human life in different climatic zones.
- Examine animal life in different climatic zones.

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CHAPTER 4: THE ATMOSPHERE AND ITS PHENOMENA

Elementary II Presentations: Second Semester 5th year

Number	Sensorial Title	Technical Title
30.	How the Winds Form	The Formation of the Winds
31.	Wind Cycles	Winds: A scheme of Their Formation
32.	Regular Winds	
33.	A Sea Breeze	Local Winds: the Daytime Sea Breeze
34.	A Land Breeze	Local Winds: the Nighttime Land Breeze
		A lesson on "Winds and Their Direction at the Equinox" is given using Chart 26
35.	Summer Monsoon Winds	Winds and the Distribution of Precipitation During the Summer in the Southern Hemisphere
36.	Winter Dry Winds	Winds and the Distribution of Precipitation During the Summer in the Southern Hemisphere
37.		Winds and the Distribution of Precipitation-Working Chart

The atmosphere protects the earth. It follows the movements of the earth and its gravity. It permits life on earth. It is made up of gases, which we cannot see although they do exist. There is a weight upon the earth from the air, it is called air pressure.

Chapter 4 Topical Overview:

Air Pressure

The Formation of the Winds

Low and High Pressure

Regular Winds

Rapidity of Cooling Depends on the Nature of the Body

Sea Breeze

Land Breeze

Monsoon Winds

Summer dry winds

The layers of the atmosphere.

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Chapter 4 Experiments:

Experiments 23A, 23B, and 23C: Air Pressure

Experiment 24A: Rapidity of Cooling Depends on the Nature of the Body

Chapter 4 Research and Project Suggestions:

- Practical experiences to show the fact that air occupies space.
- Practical demonstration of the movements of the air.
- Observation of a barometer. Record the various pressures.
- The construction of a barometer.
- Construct a graph showing variation of pressure in the same place at different hours of the day.
- Construct an anemometer - an instrument to measure the velocity of the wind
- Construct an instrument to measure the direction of the wind.
- Research local winds. Why do they form? Which direction do they blow? What phenomena do they cause?
- Research the layers of the atmosphere.
- Research the component gasses in the atmosphere.
- Examine air pollution.
- Research the atmospheres on other planets.
- Experiment with growing plants in other gasses.

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CHAPTER 5: THE WORK OF THE WIND

Elementary II Presentations: First Semester 6th year

Number	Sensorial Title	Technical Title
38.	Marine Currents	Cold and Warm Marine Currents
39.	Names of Important Marine Currents	Nomenclature of Marine Currents
40.	Let's Destroy the Rock	Erosive Power of the Winds

The wind often brings rain, it also contributes to the erosion of rock, movement of soil deposits, causes waves and some marine currents, and brings about variation of climate. It also contributes to transporting pollen and distributing seeds in many plants.

Humans can harness wind as a power source.

One work of wind is marine currents-great masses of water which move like rivers from one place to another within the sea. Only a part of their cause is winds-variations in density and temperature cause them internally.

Chapter 5 Topical Overview:

Heating and Cooling of Water
Marine Currents
Heating and Cooling of Solids
Heating and Cooling of Salt Water
Origin of Marine Currents
Wind Erosion

Chapter 5 Experiments:

Experiment 24B: Heating and Cooling of Water

Experiment 24A: Heating and Cooling of a Body

Experiment 24C: Heating and Cooling of Salt Water

Experiment 25: Origin of Marine Currents

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Chapter 5 Research and Project Suggestions:

- Research marine currents;
- Find illustrations or photos of places touched by warm and cold marine currents. Compare yearly temperatures for these places.
- Find pictures of wind erosion. Find other phenomena produced by wind (dunes, etc.)
- Research of other actions of wind in nature.
- Examine wind power.
- Study windmills throughout the ages.
- Examine other human uses of wind (sailing, kites, etc.)
- Research thermals.
- Study destructive winds.

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CHAPTER 6: THE HYDROSPHERE AND ITS PHENOMENA

Elementary II Presentations: Second Semester 6th year

Number	Sensorial Title	Technical Title
41.	Rain and the Desert	The Influence of Mountains on Precipitation and the Development of Deserts
42.	Rain by the Sea or Local Rain	Local Rain: Rain by the Sea
43.	Warm Air Rises	Evaporation
44.	Vapor Condenses	Condensation
45.	Formation of Rivers	
46.	North America is Like a Sponge	Major Rivers of North America
47.	North America is Like a Great Sponge	The North American Part of the Hydrosphere
48.	The Earth is Like a Sponge	Major Rivers of the World
49.	Let's Carry Away the Rock and Soil	The Erosive Work of Water
50.	A Valley Dug By a River	The Alluvial Valley
51.	A Canyon	
52.	Pillars of the Earth	Erosion: a Special Case
53.	Frost- Like a Young Boy	The Winter Freeze
54.	Thaw- The Young Boy	The Spring Thaw
55.	A Glacial Valley	A Valley Excavated by a Glacier
56.	Glaciers and the Environment	Moraines
57.	When Glaciers Disappear	The Hanging Valley
58.	Cycles of Water	
59.	Games of Water	The Water Cycle
60.	Water and Plants	Types of Vegetation

Discuss the importance of water to humanity.

Plants and animals need water to live.

Life began in the water and remained there for eons. Beings then freed themselves of life in the water but not of the need for water. The surface of the earth is 3/4 water. Our bodies are mostly water.

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Chapter 6 Topical Overview:

Orographic rain and desertification

Rain at the Sea: Local Rain

Evaporation and Condensation

Rivers

River Cities/Civilizations

The Most Important Rivers of North America

The Rivers of North America

The Major Rivers of The World

The Erosive Work of Water

Stratification of Sediment

Strange, erosive phenomena

Age of Rivers

Development of a Valley

The Alluvial Valley

The Canyon

The Glacial Valley

Chemical Erosion

Expansion due to Freezing

Freezing and Thawing

Moraines

Hanging Valley

The Water Cycles

Vegetative Zones

Chapter 6 Experiments:

Experiment 26: Stratification of Rocks: The Wearing Away of Stratified Sediments

Experiment 27: Development of a Valley

Experiment 28: Destruction of the Rocks (Chemical Erosion)

Experiment 29: Expansion

Chapter 6 Research and Project Suggestions:

- Importance of water for life.
- River Cities and Civilizations
- Dams and Canals
- Rivers in transportation
- Examine water or hydro power.

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- Study hydraulics
- Study water mills throughout the ages.
- Study irrigation.
- Examine other human uses of water
- Rain, snow, hail, dew, fog-research these.
- Illustrate different phases in the life of a river.
- Changes caused by a river in our environment. Outings, if possible.
- Find information and illustrate mechanical and chemical actions of water.
- Glaciers-illustrate types, changes they make in environment
- Study Ice Ages and Glaciers, show distribution in geological ages.
- Study Oceanography
- Do a pond or stream study
- Types of vegetation and their distribution on the earth.
- Research water pollution. How can we help in diminishing pollution, which the civilization and technology have brought?
- Research erosion. Study agricultural practices that reduce erosion.
- Mechanical and chemical actions of the water.
- Research mineral water.
- Research springs, including thermal springs.
- Research bogs, swamps, and marshes.
- Research ground water and subterranean waters which erode caves and tunnels,
- Learn about stalagmites and stalactites.
- Research glaciers today. Examine what is happening to them.
- Research different kinds of vegetation and their distribution throughout the earth.
- Research of other actions of water in nature.

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CONCLUSION

Upper Elementary Geography is a dynamic subject. Always have in mind the Montessori principles: Strike the imagination, adapt each chapter to the children, and give what is fundamental, necessary, and sufficient.

We cannot give geography to children as we learned it in high school or college. It is better to give only a few ideas and give them clearly, rather than to give concepts, which children cannot understand. It is not wise to give too many ideas; it is best to give just a few ideas and spend the time to explain these ideas well. Avoid the clutter of excessive detail. We are more interested in a broad vision. Always, remember the value of a significant experience in or with nature.

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Geography Experiments which Accompany the Impressionistic Charts

Experiment 1: Forces of Attraction

Materials: A basin, construction paper (or black pepper), a jug of water.

Procedure: Now, let us see if the paper or pepper behaves as the gas and dust particles did in forming stars. Pour the water slowly into the basin. Wait for it to be absolutely still. Sprinkle the pepper or paper onto the surface of the water. Put the sprinkles away from the sides of the bowl or it will attract them.

NOTE: if using the paper, be sure to tear it in about twenty pieces, using your hands and not the scissors; the pieces of card should not be too large and almost square. Arrange them lightly on the surface of the water, away from the edge of the basin and in such a way that they do not touch each other.

Conclusion: What do you observe?

Statement: The grains of pepper or pieces of thin card have been attracted by a force. This helps you to understand how particles were attracted to each other in space to form celestial bodies. The force of attraction between the sprinkles of pepper is called cohesion.

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Experiment 2: Centrifugal and Centripetal Force

Materials: A small plastic bucket, water, a string.

Procedure: Take the small bucket, fill it about 3/4 full with water, attach the string to its handle and swing the bucket over your head.

Conclusion: What do you observe?

Repeat the experiment slowing down the movement. What do you observe?

Repeat the experiment with the bucket empty, let it go. What do you observe?

Statement: If we put something in circular motion, two forces result: one that attracts the thing towards the center, and the other that pulls it outwards. The former is called the *Centripetal force and* the latter *Centrifugal force*. If equilibrium is maintained between the two forces, the body does not fall.

Experiment 3A: Force of Inertia

Materials: A cylindrical glass or beaker with a flat base, a quarter, post card or file card.

Procedure:

1. Turn the glass up side down; put the card on top of it; and on top of the card put the money.
2. Take the post card away with a sharp movement.

Conclusion What do you observe?

Statement: The coin remains in its position through the "law of inertia." Because the card is no longer in position, the coin sits on the glass. A body in a state of rest remains at rest.

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Experiment 3B: Force of Inertia

Material: A cylindrical glass, with a flat base, water in a small pitcher, sheet of strong paper or card stock.

Procedure:

1. Fill the glass a little more than half full of water.
2. Put the glass on the sheet of paper.
3. Finally, give the paper a sharp pull.

Conclusion: What do you observe?

Statement: The glass remains in its position through the "law of inertia." Because the card is no longer in position, the glass sits on the tabletop. A body in a state of rest remains at rest.

Experiment 3C: Force of Inertia

Material: The lid of a box (rather large as that used for the test tube division box); a glass marble, pencil.

Procedure:

1. Place the cover with the rim up, in the center of the table. Put the marble in the middle and against the short side nearest you. Place the pencil horizontally on the table at the same position as the short side of the box.
2. Now, with a rapid movement, draw the cover towards you, making it drag on the table, but stopping it suddenly.

Observe and answer:

1. Compare the position of the marble with the rim of the box, from which if left. What has happened to the marble?
2. Compare the position of the marble with that of the pencil. What has happened to the marble?
3. Look up the word "inertia" in the dictionary.

Statement:

1. A body in the state of rest, that is immobile (the glass marble) maintains its state, that is, it remains still. The glass sphere remains still, in its position through the *force of inertia*.
2. The force of inertia is the characteristic of bodies to remain in the state in which they are found, that is, not to begin moving when they are still, or to continue to move, if they are already in motion.

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Experiment 3D: Force of Inertia

Material: Solid rubber ball, a blanket.

Procedure:

1. Place the blanket on a smooth pavement. Then throw the ball on the blanket.
2. Repeat the throwing, doing it so that the ball falls on the pavement.

Note: The way you throw must always have the same force.

Conclusion: What do you observe?

Statement: Every body persists in its own state of rest or of uniform motion in a straight line, as long as there is no intervention by an external cause to modify this state.

Experiment 4A: Force of Gravity

Materials: Piece of iron, sheet of paper, piece of cork, a feather, a plumb line, Newton's tube.

Procedure:

1. Hold in the same hand the first 4 materials listed. Hold the plumb line in the other hand. Get up on a chair and let the articles fall, all at once.
2. Take the Newton's tube, keeping it vertical, and then turn it over rapidly.

Conclusion: What do you observe?

Using the plumb line, answer: In which direction did the objects fall?

Statement:

1. *Gravity* is the force that attracts all bodies towards the Earth. The *force of gravity* is equal for all bodies. The direction of gravity is that indicated by the plumb line.
2. Weight is the result of the action of gravity on the molecules that *constitute* a body.

It may be said that:

- The force of gravity increases gradually as the bodies draw near the center of the Earth and therefore diminishes when the body goes away from it.
- Since weight and gravity are linked together, the weight of a body diminishes gradually as it goes away from the Earth and increases as it comes closer to

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the Earth.

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Experiment 4B: Force of Gravity

Material: Two equal sheets of paper.

Procedure:

1. Crumple one of the sheets of paper into a hard ball.
2. Get up on a chair, then holding the first sheet of paper and the ball of paper - drop both at the same time.

Conclusion: What do you observe?

Statement: The weight of the two bodies (the sheets of paper) is equal. The sheet crumpled into a ball fell more rapidly, because it has a smaller surface than the flat sheet; that is, a lesser quantity of air exerted pressure on it. The resistance met by the sheet of crumpled up paper is less than that met by the flat sheet of paper.

Experiment 5A: Hot Air Rises

Material: Votive candle, cardboard tube with opening cut on bottom large enough to slide candle in and out, clay, tin plate, incense and matches, aluminum cup to cover top opening of tube.

Procedure: Take the tube; fix its base with a little bit of clay on the plate. Light the incense. Hold the incense near the lower hole and note the direction of the smoke. Now light the candle and place it inside the tube covering the tube with the cup. After about five minutes take away the cup on the top of the tube and hold the lighted incense once again near the lower hole. Note the direction of the smoke this time.

Conclusion: What do you observe?

Statement: Hot air rises, and the empty space left is occupied by cold air.

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Experiment 5B: Hot Air Rises

Materials: A spiral, a knitting needle, a piece of clay, some little candles, some matches.

Procedure: Fix the spiral on the top of a knitting needle. Insert the knitting needle in the clay so that it stands up. Insert one or more candles beside it and light them up.

Conclusion: What do you observe?

Statement: Hot air rises.

Experiment 6A: Volcanism

Materials: A volcano model, Ammonia dichromate crystals, some sulfur, some matches.

Procedure:

1. Make a model of a volcano out of papier maché. It must have a small metal cup at the summit, acting as a crater. Pour some ammonia dichromate crystals and a small pinch of sulfur into the crater. Put a lighted match on the crystals until some of them catch fire.

Conclusion: What do you observe?

Statement: Inside the earth there are some substances that tend to come out. If they do not find their way, they will create it, thus forming, among other things, volcanoes.

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Experiment 6B: Volcanism

Materials: In clay: volcanic cone with "pipe"; plastic funnel, threaded into a rubber tube; rubber stopper, pierced by a long glass tube, flask or decanter (or a glass vase, with a large belly and a long straight neck); spirit lamp or Bunsen burner, wire grid, matches, metal stand, properly set-up sand of various grains and colors, powdered marble, earth, powdered wood-carbon (charcoal), water - houses, plants, shrubs, moss, stones powder and piece of pumice, landscape scenery: for the reconstruction of natural and geographical environment - wood support or platform with a central hole - large flat metal basin.

Procedure:

1. After having placed the metal basin on the table, put in the wood platform. On the platform, place the volcanic cone.
2. Thread the rubber tube through the cone, and arrange it so that the funnel adheres to the crater.
3. Place the planned objects for the reconstruction of the natural environment, completing the work with the landscape scenery.
4. On the floor, mount the metal stand, affix the flask and under it, the burner and the grid.
5. In the flask, pour sand, powdered wood-carbon, earth, and water. Plug the flask with the rubber stopper.

Attention: Be sure that the glass tube draws deeply in the water. Finally, light the burner. Keep away and do not go near the cone, until the experiment is finished.

Observe and answer:

1. The various substances listed above, contained in the flask, represent the "magma". Look in the dictionary for the definition of "magma".
2. Why have the materials been pushed out, together with the boiling water?
3. Draw the section of the volcanic apparatus, by using the proper classified nomenclature.
4. Mark, on a world map, the position of active volcanoes.
5. Draw a map of any area of interest, and then locate the active volcanoes, designating them in red, and "extinct" volcanoes in black.

Statement: The *volcano* is a vent in the earth's crust, from which materials of very high temperature erupt. One part of the material, by solidifying, accumulates around the opening itself, forming a volcanic neck. We have said that the volcano released much gases and ashes. We do not know

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how it happened, but eventually this cloud of gases and ashes released rain onto the earth.

Experiment 7: Erosion

Materials: Clay, water, watering can.

Procedure: Build a little mountain using hard clay for the very center and soft clay on top, and then pour some water on top of the mountain with a watering can.

Conclusion: What do you observe?

Statement: Where the earth is bare or has little vegetation, the *erosion* is very great. Soils of various types erode at different rates.

Experiment 8A: Air Occupies Space (1st experience)

Materials: A glass bowl, a small bottle, a stopper, and water.

Procedure: Take the small bottle and cork it. Fill the bowl with water. Dip the bottle under the water' and slowly take off the stopper.

Conclusion: What do you see? Write down your observations.

Statement: Air occupies space and air rises. When the small bottle is tilted upward underwater and uncorked, the air bubbles rise to the water surface.

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Experiment 8B: Air Occupies Space (2nd experience)

Materials: A funnel, water in a pitcher, rubber stopper with an opening, bottle.

Procedure:

1. Thread the funnel through the stopper and with it, plug the bottle. Then pour the water into the funnel. **Attention**: the funnel must always remain full of water.

   What do you observe?

2. Hold the stopper lifting it slightly, and pour the water again.

Conclusion: What do you observe now?

Statement: Air occupies the space inside the bottle preventing the water from entering the bottle.

Experiment 9A: Specific Weight (1st experience)

Materials: Cubes, with an edge of 1 cm; of the following substances: poplar wood, iron, lead, cork, hollow cube, in steel, with an edge of 1 cm; liquid substances: distilled water, oil, pure alcohol, precise scale pan balance.

Procedure:

1. Weigh each of the six solid cubes, taking note of their weight.
2. Calculate the weight of the hollow cube.
3. Then, using the same hollow cube, weigh one cm^3 of each of the named liquid substances making note of their weights.

Attention: We must obtain the "net" weight.

Conclusion: What do you observe?

Statement: The *specific weight* is the ratio between the relative weight of a body and the weight of an equal quantity of distilled water.

The *density* of a body is the ratio between the mass of the body and its volume.

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Experiment 9B: Specific Weight (2nd experience)

Material: Graduated cylinder (measuring tube) (100 cm3), water in a pitcher- various pieces of material: iron, marble, brass, wood, lead, mercury- precise scale pan.

Procedure:

1. Weigh each piece of material and note the weight, expressed in grams.
2. Pour the water filling exactly half the graduated tube. Then, one at a time, place each piece of material in the tube removing each before putting in the next. Each time, note the displacement in the water level.
3. Finally, divide the weight of each piece by the volume of water displaced be each of them: you will obtain the specific weight of the different materials examined.

Conclusion: What do you observe?

Statement: The specific weight is related to the ratio of the weight and volume: D = MN

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Experiment 10: Stratification of Rocks (parallel to Experiment 13)

Materials: A small somewhat flat soup plate, rolling pin, about 2 kg. of grey clay or plasticene and four or more colors (yellow, black, white, green) of plasticene, about 0.5 kg. of each.

A circular cardboard disc with a diameter of about 30 cm., a small plate, some wax paper, a knife, rolling pin, a centimeter ruler and pencil, a scissors.

Procedure:

1. Roll a circle from the grey clay to fit the plate. Form an edge of clay and fit it around the plate, connecting it to the clay circle.
2. Of the same grey plasticine, prepare a circular sheet, as big as the plate. Cover the bottom of the same plate with the wax paper and then with the clay circle.
3. Invert this construction to form a basin. Roll each color of dough and layer it successively inside the basin, trimming the edges after each layer so only the edges of the lower layers are showing.

Conclusion: What do you observe?

Statement: The first layer that forms the basin is at the bottom. The last layer that forms the basin is at the top. The youngest layers are along the outside edge; the oldest are at the bottom.

Research to Follow Experiment 10:

1. Which color of material is placed first, and which was placed last? List the strata in the order in which they were placed by the teacher on the bottom of the basin.
2. Among the concentric rings that constitute the sedimentary basin, which are the oldest: which are in the center and which are on the periphery?
3. Using the same colors as in the experience, draw the section of the sedimentary basin and write your observations.
4. What is the difference of position of the concentric ring between a sedimentary basin and a plateau?
5. Compare the drawing of Exercise no. 3 with that corresponding to the relative command illustrating the wearing away of sedimentary stratifications on a mountain. Write your observations basing them on the position of the strata of the same color.
6. With a black pencil, draw on a sheet of paper a large S (capital manuscript letter). From the same point trace with a different color, another S, parallel to the first. Now turn the paper, so that you see the S horizontally. On the left, you will notice a sedimentary basin and a mountain on the right. Fold and cut the paper into two parts, exactly where the basin and the mountain are joined. Write your observations basing them

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on the colors. In the process of the formation of mountains as illustrated here, the strata rise unevenly.

Experiment 11: Formation of Mountains by Folding

Materials: Six strips of thick felt, rather firm, of different colors; for example: grey, yellow, black, white, green, pink. The width of the strip of material must be about 30 cm and the length not less than 70 cm.

Procedure:

1. On a table, lay on top of each other the strips of material. Attention: the laying out of the material must be done with care, because the strata that result must be visible.
2. Press your hands on the two ends of the strata of cloth, push from both sides towards the center.
3. Another time, with your left hand, hold the strips firm and with your right hand, push the strips toward the center.

Conclusion: What do you observe with each type of pressure?

Statement: One way mountains have been formed is by folding. *Strata* rise unevenly The formation of the mountain (called *orogeny*) has also been caused by:

a. *lateral pressure* (horizontally) and

b. pressure from top to bottom and vice versa supporting pressures of the continental mass, in determined periods of the history of the Earth.

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Experiment 12: Fracture of the Earth's Crust

Materials: Rectangular parallelepiped having a square base: one of the bases is subdivided into strips of equal width, but of different colors - a parallelepiped equal to the above, but composed of 3 prisms, obtained by dividing the base by means of segments joining the midpoint of a side with the vertices of the opposite side.

Procedure:

1. Place the whole parallelepiped on the table, in such a way that the two square bases are perpendicular to the surface of the table and the colored strips are horizontally in front of you. This parallelepiped represents a series of stratifications of sedimentary rocks, in their original position (horizontal), generally rigid.

Attention: The stratum marked by the red color is that which was most recently deposited.

2. Then, near-by, place the divided parallelepiped, in such a way that the disposition of the strata corresponds to the strata of the whole parallelepiped. This new parallelepiped represents the example of two fractures caused by deforming pressures. *(Horsand graben fault)*

3. With both parts, by using different hand pressure push laterally, from one side toward the top and from the other side toward the bottom, in such a way as to cause the displacement and the upsetting of the two masses of lateral rocks. This fracture, accompanied by displacement of the rocks along a level is called a *fault*.

4. Finally, compare the position of the strata of the two *faults* with the strata of the whole parallelepiped.

Conclusion: What do you observe? Draw the various phases of the experience.

Statement: Because of the fracture of rigid rocks, the *fault level* can assume a horizontal, oblique or vertical direction.

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Experiment 13: Stratification of Rocks: the wearing away of stratified sediments

Materials: Grey oil-based clay: about 2 kg., brick colored oil-based clay: about 1 kg, wax for modeling. Four colors of play-dough or plasticine, a circular disc of cardboard with a diameter of about 8 inches, wax paper, a serrated knife, a rolling pin, a ruler, a pencil, and scissors

Procedure:

1. Construct the model of a common mountain with the grey clay. Give the base a diameter of 8 inches, and make the altitude about 6 inches. Cut a circle of wax paper the same diameter as the disc, and place it on the disc. Then place the mountain on top of the paper.
2. The successive phases of the construction of the mountain represent the stratifications, that is, the successive deposits of sediments: Roll softened play-dough into a circular sheet with a diameter of about 12 inches and thickness a little more than 1 /4 inch. Place the center of a sheet exactly at the top of the mountain. Pressing and removing excess, make the sheet adhere to the sides of the mountain. The sides of the mountain have, in this way, changed color.
3. Repeat the process, working successively with dough of different colors, finishing the work with a stratum of brick-colored clay.
4. Slice the top (decapitate) of the mountain, giving the origin to a special plateau from a folded mountain.

Conclusion: What do you observe?

Statement: The principle of the *supposition of stratification* states that in any sequence of strata, not later disturbed, the order in which they were deposited is from bottom to top. The first layer that forms the mountain is at the center. The outer layer of the mountain is the most recent. The center of a plateau from a folded mountain is the oldest layer; the outer layer is the most recent layer.

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Observe and answer:

1. Which color of material is placed first and which is placed last? List the strata, in the order in which they have been placed by the teacher in constructing the mountain.
2. Are the oldest terrains (that is, that which the teacher, in the course of her work, placed first) on the periphery or in the center of the plateau?
3. Using the same colors as in the experience, draw the section of a mountain and write your observations.
4. After having worked with command no.10 answer: What is the difference of position of the concentric strata between a plateau and a sedimentary basin?
5. Which color of material is placed first and which is placed last? List the strata, in the order in which they have been placed by the teacher in constructing the mountain.
6. Are the oldest terrains (that is, that which the teacher, in the course of her work, placed first) on the periphery or in the center of the plateau?
7. Using the same colors as in the experience, draw the section of a mountain and write your observations.
8. After having worked with command no.10 answer: What is the difference of position of the concentric strata between a plateau and a sedimentary basin?

Experiment 14: Solar Energy

Materials: A lamp with a stand, a tiny green ball, or green bead.

Procedure: Take a lamp, switch it on and place it in the middle of a table in such a way that the rays fall in all directions. A short distance away, place a tiny ball (since it represents the earth, the ball should be very small).

Conclusion: Note now, what part of the total rays the ball receives.

Statement: The earth receives a very small part of the solar energy.

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Experiment 15: Illumination Of the Earth

Materials: A flashlight, a tube, the blue and tan globe (Globe 2).

Procedure: Take the flashlight and throw the light horizontally on the earth.

Conclusion: What do you observe?

Statement: The sun can illuminate only half of the earth at a time, the other half remains in the darkness and this causes the day and the night.

Experiment 16: The Perpendicular and the Oblique Rays

Materials: A flashlight, black paper, and chalk.

Procedure: Take the flashlight and throw the light on the black paper, first perpendicularly. Trace the area of illumination. Direct the light obliquely onto the paper. Trace the area of illumination.

Conclusion: What do you observe?

Statement: The rays that fall perpendicularly, concentrate on a very small space. The area lit is small and intense. When the angle is oblique, the lit area is large and less intense than when the angle is perpendicular.

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Experiment 17: Illumination of the Equator and the Poles

Materials: A light bulb, a tube, (or a flashlight) the blue and tan globe (Globe 2), a string to measure.

Procedure: Take the light bulb inside a tube (or the flashlight) representing the sun, and direct the light horizontally on the globe; then measure the distance of the light from the equator and from the light to the poles.

Conclusion: What do you observe?

Statement: The distance of the sun from the equator is less than the distance between the sun and the poles. This difference in distance makes very little (0.001%) difference in their temperatures.

Experiment 18A: Good and Poor Conductors of Heat

Materials: A knitting needle, a hotplate, a glass rod, a cylindrical stick of wood.

Procedure: Take the three sticks holding one end of them in your hand. Attach the other ends to the flame.

Conclusion: What do you observe?

Statement: Heat spreads inside the bodies but not at the same speed for all of them. The bodies in which heat spreads easily are called *good conductors of heat*, those in which it spreads slowly are called *bad conductors of heat*. Generally speaking, metals are good conductors of heat, while glass, paper and wood are bad conductors.

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Experiment 18B: Good and Poor Conductors of Heat

Materials: A heat source, a box of Ingenhousz*, wax or paraffin, water in a saucepan.

Procedure: Melt the wax on the hotplate and dip in it the sticks of the several materials attached to the box and they will be covered by a thin layer of wax. Boil the water, pour it into the box, and put the box on the flame.

Conclusion: What do you observe?

Statement: From the Ingenhousz box, we see also that not all metals are good conductors in the same way. Among the bodies which are bad conductors, such as paper and wood, others moderately bad conductors, such as soil and stones.

Experiment 19: Day and Night

Materials: A lamp without a shade (or a flashlight), the blue and tan globe. (Globe 2)

Procedure: Place the globe in front of the lamp or flashlight representing the sun and make the globe turn on its own axis and around the sun. What do you see? Does it correspond to the earth's position?

Conclusion: What do you observe? You can also write the consequences of this movement.

Statement: Since the movement is continuous during each moment of the day, there is one part of the earth where the sun is rising: at that point it is sunrise. In the mean time, on the opposite point the nights are beginning: it is sunset. It is night is on the portion of the globe that faces away from the light; it is day on the portion of the globe that faces toward the light. Both night and day are happening at the same time somewhere on the globe. Man has created the *time zones* to designate time changes due to the earth's rotation.

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Experiment 20: Inclination of the Polar Axis

Materials: An orange or an apple, a knitting needle, a lamp supported by an object.

Procedure: Take the needle and stick it into the orange, passing through the center of the fruit. Incline the axis of the orange 23½° from vertical. It remains in this position as it rotates. Put then the orange in front of the lamp representing the sun and make turn on itself and round the sun.

Conclusion: What do you see? Does it correspond to the earth's position?

Statement: With the light, we see that half of the earth is lighted, but the circle of illumination does not go through the poles in some of the positions of the earth: in one position, the North Pole is in darkness, while the South Pole is illuminated. In another position, the darkness and light is reversed. In other positions, the circle of illumination is through the poles.

On the chart, we see that the inclination of the earth's axis with respect to the sun is 23½° from the vertical. The left side of the chart shows the position of the earth in relationship to the sun's rays on June 21st. The part of the earth which receives the sun's rays perpendicularly is in the northern hemisphere. The North Pole is illuminated. The right side of the chart shows the position of the earth on December 21st. The southern hemisphere receives the sun's rays perpendicularly. The South Pole is illuminated, while the North Pole is not.

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Experiment 21: Marking off the Imaginary Parallels

Materials: A stick on a stand with three strings attached to it: one red and two blue; a chalk pencil or piece of chalk; the blue and tan globe (Globe 2).

Procedure:

1. Take the stick, place it in such a way that the central string is at the height of the equator and the other two are at the level of the tropics.
2. With the topmost blue string and a chalk pencil pointing on the summer solstice, trace a line on the globe; this corresponds to the Tropic of Cancer: (*Tropic* is from the Greek word *tropicus* meaning *to change* or *where the sun changes*.) It is the last point on which the solar rays fall perpendicularly.
3. With the red string, trace the equator.
4. With the lower blue string, trace the Tropic of Capricorn.
5. Bring the globe back to the summer *solstice*; find the point of tangency with the Earth using the upper blue string. Trace the latitude that marks the Arctic Circle. (*Arctic* comes from the Latin word *articus* meaning bear.)
6. Bring back the globe to the winter solstice; find the point of tangency with the Earth, using the lower blue string. Trace the latitude which marks the Antarctic circle. (Antarctic means opposite to the bear.)

Conclusion: What do you observe?

Statement: From the sun's position, the imaginary lines of the Equator, the two tropic lines, and Arctic and Antarctic lines are determined.

Do a Three Period Lesson on the names and locations of the parallels.

Comments: Regarding the experiment to show the equator, Tropics of Cancer and Capricorn, and the Arctic and Antarctic circles, the world in which we live is a complex reality made up of a myriad of smaller realities. When we study these many smaller realities, we isolate the characteristics and then, after this study, we synthesize our knowledge of smaller characteristics into knowledge of the whole. For example, we ask, what would happen if the world stood still? Moreover, we have Chart 9 where the earth is pictured with ice on one half and fire on the other half. This is not a picture of what actually exists in reality, but rather, it gives a concept of what would happen if the earth did not rotate on its own axis. After examining this concept, with regard to day and night as well as cold and heat, we go on to explore the fact that the earth also revolves around the sun. Then we go on to the fact that the earth's axis is tilted.

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With regard to the instrument to show the equator and the tropics, we cannot expect this instrument to do more than that for which it was designed.

NOTE 1: The distance between the strings must be relative to the distance between the equator and the tropics on the globe being used.

NOTE 2: It is necessary to keep the globe and the instrument stationary during the experiment.

Experiment 22: The Seasons

Materials: A lamp with a stand, the blue and tan globe, (Globe 2)

Procedure: Place the bulb representing the sun on a stand in such a way that its light strikes the equator; *rotate* the globe on its own axis and around the lamp, with its axis inclining 23-1 /2 degrees from the vertical. Have its axis pointing always towards the north.

Conclusion: What do you observe?

Statement: The *inclination of the axis* of the Earth is the cause of the seasons.

Experiment 23A: Air Pressure

Materials: Two test tubes (one should fit inside the other); water.

Procedure: Take the two test tubes, fill the bigger one half full with water, immerse the smaller test-tube in it until it is just below the water level. Tilt the test tubes and hold them in a slanting position.

Conclusion: What do you observe?

Statement: The water in the bigger test tube tends to come out, and the pressure of the atmosphere pushes the smaller test tube upwards.

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Experiment 23B: Air Pressure

Materials: A glass, water, a piece of paper.

Procedure: Fill a glass with water (up to the very brim) and cover it with a piece of paper. Turn the glass over quickly.

Conclusion: What do you observe?

Statement: The pressure of the air is stronger than that of the water inside the glass and it prevents the water from coming out.

Experiment 23C: Air Pressure

Materials: A beaker or flask that just fits a hardboiled egg, a peeled hard-boiled egg, matches and newspaper

Procedure: Place the lighted paper in the beaker. Place the egg on top of the beaker.

Conclusion: What do you observe?

Statement: Inside the beaker a vacuum is created. The pressure of the air outside forces the enter the beaker.

Comment: The three experiments show that the air has weight and that the air exerts a pressure upon the earth. This pressure is not always the same. If the pressure is measured at different points of the earth, we find that it differs, and this difference is related to the distance above sea level and temperature. (Air pressure is measured with a barometer.) There are movements of air caused by the differences in pressure; these are called winds. The atmosphere is very important because without it life is not possible. Wind is important, because it brings an exchange of air: cool air to warm areas and warm air to cold areas, etc.

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Experiment 24A: The Rapidity of Cooling Depends on the Nature of the Body

Materials: Two equal burners, two pans of the same size, water, sand, and two heat resistant thermometers.

Procedure: Place some sand into one of the pans, and into the other pan, an equal quantity of water. Put the pans on two burners and heat. Use two thermometers to measure the temperatures.

Which of the two will heat more quickly? Why?

Which of the two will cool first? Why?

Conclusion: What do you observe?

Statement: The water is slower in heating up but it retains the heat longer; the earth (on the other hand) heats up more quickly but also looses the heat quickly.

Comment: With the experiment, we have verified that the land is heated more quickly than the water and the heat of the water is lower with respect to the land. However, we have also seen that the water retains its heat longer. We have verified this fact: warm air is lighter than cold air, and in nature, no space can remain empty. During the day, the land is heated more quickly than water. The air over the land heats and rises. The "empty space" created is filled by the air over the water which moves in over the land. This is why there is sea breeze during the day. During night, the opposite phenomenon happens. The water heats more slowly but retains heat longer, while the land gets colder more quickly. As the water is warm, the air over it is heated and rises, creating a "space" into which the air over the land comes. This is why there is land breeze at night

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Experiment 24B: Heating and Cooling of Water

Materials: A glass pan, sawdust, and a burner are needed.

Procedure: Put a thin layer of sawdust on the bottom of the glass pan. Fill the pan with water. After the sawdust has settled to the bottom, put the pan on the burner.

Conclusion: What happens to the sawdust as the water heats up? What happens to the sawdust after the pan is removed from the burner? Record your observations.

Statement: The sawdust shows that the water moves. The sawdust will be at the bottom at first. When the water gets warm, it rises with the sawdust and the cool water goes down. This happens in the ocean as well. Marine currents are caused by temperature differences.

Comment: Marine Currents Internal Causes: External Causes: changes in density and temperature winds and earth's rotation.

Experiment 24C: Heating and Cooling of Salt Water

Materials: A pan, salt water, and a hotplate.

Procedure: Fill the pan with salt water. Put the pan on the burner and let the water boil until it has evaporated.

Conclusion: What is left in the pan? Record your observation.

Statement: The sawdust shows that the water moves. The sawdust will be at the bottom at first. When the water gets warm, it rises with the sawdust and the cool water goes down. This happens in the ocean as well. Marine currents are caused by temperature differences.

Comment: The evaporation of water leaves a deposit of salts.

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Experiment 25: Origin of Marine Currents

Materials: Large transparent dish or aquarium (capacity about 5 liters) water, a pan, a heat source, Ice cubes, an eye-dropper, a spoon, red and green food coloring.

Procedure:

1. Bring to a boil about 3 liters of water and pour it into the large dish. Leave it for 3 minutes.
2. Add very slowly, along the edge of the dish, about 2 liters of cold water, in such a way as there is formed in the bottom of the dish a cold layer of water.
3. Then using the eyedropper, put a little red color into the water.

Conclusion: How does the color move when it reaches the area where the two strata of water mix? Write if you wish, your observations.

4. Now, using the spoon, put some cubes of ice into the water. Pour into the cubes some drops of green ink.

Conclusion: What do you observe?

Statement: The surface of the sea has currents; some of which are hot, others cold according to whether they come from the equator or the poles. The marine currents have their origin thus from masses of water of different temperature.

Comment: Notice, when the red color meets the points where the hot and cold water meet, it will sink more. Ice cubes will melt and sink. This can be clearly seen because of the green ink.

This experiment is used to give the child an impression of how the marine currents are formed. Actually, what happens in reality is contrary to what we see happen in the experiment because marine currents are affected by more than temperature. During the day, the sun heats the water (surface) causing some water to evaporate. (Evaporation is a cooling process.) The density or salinity of the water at the surface increases, causing this water to sink. The colder and saltier the water, the denser and heavier it is. Cold, dense water sinks and flows under warmer, lighter water, creating a current.

The experiment shows a special kind of current called a vertical current. There are two types of currents: vertical and horizontal. Vertical currents are formed by surface water and deep water. Horizontal or surface currents are caused by winds or the rotation of the earth. The earth spins west to east, causing clockwise surface currents in the Northern Hemisphere and counterclockwise surface currents in the Southern Hemisphere. The

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vertical currents can occur at the surface or deep in the oceans. We can compare this phenomenon to that of air currents.

In the water, many circles or currents are formed. These currents exchange water with cold countries and vice versa, thus affecting climates.

Experiment 26: Stratification of Rocks: The Wearing Away of Stratified Sediments

Materials: Little containers containing respectively: sand, soil, powdered brick, powdered chalk and gravel; a straw, a tray, a large spoon, some small shells and pieces of plant.

Procedure:

1. Sprinkle the various samples over the tray, uniformly distributing the samples over the whole surface of the tray. You have laid in flat layers the "terrain" of various types, that is, of different colors. Add shell or plant pieces to represent animals and plants that have become fossils.
2. First, without using the tube and then by using it, blow very, very gently obliquely on the strata to simulate the work of the water.

Conclusion:

1. List the strata, in the order in which they have been deposited. Which, among them, is the oldest, that is that which had been placed first? Which of the strata is the most recent?
2. The "wind" that produced the blowing wore away the stratified sediments. Which strata appeared first? Which strata appeared last?

Statement: The oldest terrains appear on the surface last. The wearing away of the most recent terrains will expose older formations and strata.

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Experiment 27: Development of a Valley

Materials: A large pan, pebbles, sand, and a hose with spray or large watering can.

Procedure: In the pan, build a "V" shape. Put large pebbles on the sides and bottom. Fill in the empty space with sand. (Do this before the children seeing the experiment.) With the hose, spray the sand so that the water runs along the sand horizontally. First, the water will make a channel over the sand. Then the channel will become wider and deeper until only the rocks remain.

Conclusion: What do you observe?

Statement: The force of water moves lighter and looser soil, forming grooves in the earth's surface. This is how rivers form canyons and valleys. The valleys formed by the rivers are usually v-shaped because the erosion occurs at the bottom of the river more than at the sides.

Comment: Charts 38 and 39 show in a schematic way the superficial movements of the oceans. Blue arrows are cold currents. Red arrows are warm currents. These charts show how the currents change course when they encounter the land and how they then follow the coastlines.

As we have said, the currents affect climates of the earth, are cooled, and return to warm areas, bringing cold water. (We may also compare marine currents to the circulation of our blood. The blood is purified in the lungs, and then travels to all parts of the body and returns to the lungs. It is a closed cycle which benefits the whole body.)

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Experiment 28: Destruction of the Rocks (Chemical Erosion)

Materials: A piece of calcite, a plate, 5% hydrochloric acid, and an eyedropper are needed.

Procedure: Put the piece of calcite in the plate; then pour a little bet of hydrochloric acid over it.

Conclusion: What do you observe?

Statement: The hydrochloric acid dissolved in the water, destroys the rocks.

Note: Be very careful with the acid. Wear gloves and protective eyeglasses. Do not let the children use this material.

Comment: Water also works underground, forming caves. Erosive work: chemical as well as mechanical.

Water with CO^2 has power to corrode rock. CO^2 combines with water to form carbonic acid.

The carbonic acid then reacts with limestone (calcite) to form calcium bicarbonate, which dissolves in water. Very often, the caves excavated underground are very beautiful because of the formation of stalactites and stalagmites. Stalactites (ceiling) and stalagmites (ground) are formed from dripping water containing calcium bicarbonate. The dissolved CO^2 escapes from the droplets and calcite precipitates. If the underground waters run through areas rich in minerals, they become mineral waters. If they run through areas of hot rock, they become thermal waters.

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Experiment 29: Expansion

Materials: A small bottle with the stopper, water, plastic wrap.

Procedure: Take the bottle, fill it completely with water, close it tightly, and wrap it tightly with plastic wrap. If it is winter, and it is very cold, put the bottle outside the window leaving overnight. Otherwise, put the bottle in the freezer compartment of the refrigerator and take it out after twelve hours.

Conclusion: What do you observe? If you like, you can write down your observations.

Statement: Water is the only common material that when solidifying increases in volume instead of decreasing.

Molecules of water, because of their chemical structure, will increase in volume when in a solid form (ice). This causes many difficulties. However, it also causes pond tops to expand when freezing, protecting the fish beneath.

Comment: Here we are not merely considering water as rain, but as ice. Now, we will consider water in its solid state: snow and ice. In cold regions, water falls as snow. If this snow does not melt, it accumulates in basins and valleys. Because of the weight, it forms blocks of ice. The chemical structure of ice water actually takes up more space than liquid water and, therefore, ice "expands.'

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