Teacher's Guide For

Core Meteorology: Atmosphere

For grade 7 - College

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MATERIALS IN THE PROGRAM

Teacher's Guide -This Teacher's Guide has been prepared to aid the teacher in utilizing materials contained within this program. In addition to this introductory material, the guide contains the following:

- Suggested Instructional Notes
- Student Learning Goals
- Test Questions on Blackline Masters 1A, 2A and 3A for duplication and handout to students.

INSTRUCTIONAL NOTES

It is suggested that you preview the program and read the related Student Goals and Teacher Points. By doing so, you will become familiar with the materials and be better prepared to adapt the program to the needs of your class. You will probably find it best to follow the program in the order in which they are presented in this Teacher's Guide, but this is not necessary. The program can be divided into chapters accessed through the DVD's Menu Screen under Chapter Selects. It is also suggested that the program presentation take place before the entire class and under your direction. As you review the instructional program outlined in the Teacher's Guide, you may find it necessary to make some changes, deletions, or additions to fit the specific needs of your students. After viewing the program you may wish to copy the Test Questions on Blackline Master 1A and distribute to your class to measure their comprehension of the events.

INTRODUCTION AND SUMMARY OF PROGRAM

Core Meteorology: Atmosphere is a unique approach to presenting in a logical way the scientific study of the atmosphere. All of the Earth's weather happens in a six to ten mile thick bottom layer of the atmosphere called the troposphere. Meteorology is the study of the changes in temperature, air pressure, moisture, and wind direction in the troposphere. Presented in an effective format designed to promote successful student learning, *Core Meteorology: Atmosphere* examines the key concepts and principles in the interdisciplinary science of meteorology, beginning with the solar system and an in depth look at the dynamic nature of the earth's atmosphere and how its different cycles, such as the hydrological and carbon cycles, make weather possible on the Earth.

Below is a list of the program and its chapters. Using this program, teachers can create a lesson plan to cover the specific concepts and themes discussed.

Core Meteorology: Atmosphere

- Atmospheres in the Solar System
- Composition of the Earth's Atmosphere
- The Structure of Earth's Atmosphere

- Atmosphere and Solar Radiation
- Atmospheric Conduction and Convection
- Atmospheric Balancing
- Hydrological Cycle
- The Carbon Cycle
- The Atmosphere and Climate Change

LINKS TO CURRICULUM STANDARDS

The design for this program includes the following curriculum correlations: National Science Educations Standards, Content Standard Grades (6-12) California State Board of Education Content Standards for Earth Sciences (Grades 6-12) and the State of New Jersey Department of Education Core Curriculum Content Standards for 5.8 Earth Science, section B, (Grades 7 – 12); and 5.10, Environmental Studies, Sections A and B, (Grades 7 – 12). The content of this program presents the foundational discoveries and principles of core meteorology, atmosphere in an easy to follow, step-by-step format.

SUMMARY OF PROGRAM

Core Meteorology: Atmosphere

This program on *Core Meteorology: Atmosphere* presents the key concepts of atmospheric dynamics: 1] the balance of gases and sunlight that makes it possible for life on Earth; 2] the unique composition and structure of the atmosphere; and 3] the effects of uncontrolled burning of fossil fuels that are changing atmospheric dynamics.

Chapter one introduces listeners to the solar system's planets and their atmospheres. The techniques used to study other planets atmospheres are also used to study Earth's atmosphere.

Chapter two discusses the chemical composition of earth's atmosphere, which includes the lower atmosphere's unique concentration of nitrogen, oxygen and other gases.

Chapter three shows the layered structure of the Earth's atmosphere is made up of the troposphere, stratosphere, mesosphere and thermosphere.

How the different kinds of solar radiation interact with the Earth's different atmospheric layers is delineated in chapter four.

Chapter five shows how atmospheric conduction and convection moves heat around in the troposphere.

Chapter six explains how the Earth's atmosphere is a self-regulating system that produces the conditions that are favorable to life in the troposphere.

The complexity of the hydrological cycle in the formation of weather is talked about in chapter seven.

Chapter eight examines the all-important carbon cycle and how it makes it possible for life on Earth to exist.

Chapter nine discusses how man-made carbon dioxide emissions are changing the composition and structure of the atmosphere and could possibly lead to catastrophic consequences.

Chapter 1 Core Meteorology: Atmosphere - Atmospheres in the Solar System

Student Goals - In this *Core Meteorology: Atmosphere* chapter the students will learn:

- An atmosphere is an envelope of gases and tiny particles that surrounds a planet
    - An atmosphere is the most important thing for life on a planet
    - In our solar system the earth's atmosphere is unique
- The atmospheres of the other planets in our solar system are different than the Earth's
    - The moon and Mercury have no atmospheres at all
    - The atmosphere on Venus is composed almost entirely of carbon dioxide
    - The outer planets – Jupiter, Saturn, Uranus and Neptune – are gas giants
    - The sun also has an atmosphere, although quite different than our own

Chapter 2 Core Meteorology: Composition of the Earth's Atmosphere

Student Goals - In this *Core Meteorology: Atmosphere* chapter the students will learn:

- Originally Astronomers learned about planets using telescopes and a process called spectroscopic analysis
- The Earth's atmosphere is 21% oxygen and 78% nitrogen
- The remaining 1% is argon, carbon dioxide and water vapor and other gases

Chapter 3 Core Meteorology: Atmosphere - Structure of Earth's Atmosphere

Student Goals - In this *Core Meteorology: Atmosphere* chapter the students will learn:

- The Earth's atmosphere is in a delicate dynamic balance that is absolutely critical for all life on the planet
- People live in the lower densest part of the atmosphere called the troposphere
    - The troposphere extends above the Earth's surface five miles at the poles and nine miles at the equator
    - All weather takes place in the troposphere
- The next layer is the stratosphere
    - It is home to a band of powerful winds known as the jet stream
    - It is also home to the ozone layer, which protects life on the planet from lethal, ultraviolet radiation from the sun
- The mesosphere starts where the stratosphere ends, extending from 31 to 55 miles
- Above the mesosphere is the largest section of the atmosphere: the thermosphere, where the Northern lights, or the aurora borealis, occur

Chapter 4 Core Meteorology: Atmosphere - Atmosphere and Solar Radiation

Student Goals - In this *Core Meteorology: Atmosphere* chapter the students will learn:

- Life on earth is all about sunlight
    - Radiation from the sun arrives in the atmosphere as electromagnetic waves
    - This radiant energy from the sun is virtually the only source of energy available to heat and maintain temperatures in the lower troposphere so that life on Earth is possible
    - The interaction between the earth's atmosphere and solar radiation is in delicate balance that makes it never too hot nor too cold for us
- The atmosphere is like a giant protective filter ... It absorbs . . . Scatters . . . And reflects solar radiation, making it possible for life on Earth
    - Heat is the result of what happens when solar radiation is absorbed by gases, liquids or solids
    - Light, that part of solar radiation that we see, passes through the atmosphere – no absorption but it does get scattered, causing blue skies and red sunsets
    - Another thing that might happen to solar radiation is that it gets reflected, pretty much back where it came from, that is, out of the earth's atmosphere

Chapter 5 Core Meteorology: Atmosphere – Atmospheric Conduction and Convection

Student Goals - In this *Core Meteorology: Atmosphere* chapter the students will learn:

- Conduction and convection are two other ways that move heat around on the planet
- An example of conduction is what happens when the heat from the burner is transferred to a pan
    - The pan does not move
    - While the pan is in contact with the burner, the heat moves from the hotter to the colder object
- When the heat is transferred to the water in a pan, the water starts moving, and when the heat is transferred to the air above the pan the air begins moving
    - This kind of movement of heat is called convection

Chapter 6 Core Meteorology: Atmosphere - Atmospheric Balancing

Student Goals - In this *Core Meteorology: Atmosphere* chapter the students will learn:

- What atmospheric scientists have found is that all three kinds of energy transfer – absorption, conduction and convection - are always going on in the earth/atmosphere/ ocean system
    - Somehow a heat balance keeps the relative temperatures in the lower reaches of the troposphere fairly constant and conducive to life

    - In many ways it is a self regulating system like the way the human body maintains a constant temperature of 98.6 degrees Fahrenheit
- The atmosphere regulates our atmospheric temperature by moving heat around
- Remarkably, the most important part of this story for us is that the troposphere is heated from the bottom to the top
- The atmosphere also participates in a number of Bio/Geo/Chemical cycles that involve life itself and industrial human activity

Chapter 7 Core Meteorology: Atmosphere – Hydrological Cycle

Student Goals - In this *Core Meteorology: Atmosphere* chapter the students will learn:

- The best known Bio/Geo/Chemical cycle is the hydrological cycle
    - Water leaves the earth as a gas through evaporation and returns as a liquid in the form of rain or a solid in the form of snow or hail
    - The water on our planet forms a closed system, which means a finite number of molecules have been here almost forever
    - 99% of all water is in oceans, lakes and streams; locked up in glaciers; or held in underground aquifers
    - Only 1% of water is in the atmosphere
    - Powered by solar energy, water is constantly circulating from one storage area to another through the hydrological cycle
- Other Bio/Geo/Chemical cycles that the atmosphere supports are the sulfur cycle, the nitrogen cycle, methane cycle and the aerosol, or particulate matter such as dust, cycle

Chapter 8 Core Meteorology: Atmosphere – The Carbon Cycle

Student Goals - In this *Core Meteorology: Atmosphere* chapter the students will learn:

- The Bio/Geo/Chemical cycle that has become of most importance to us today is the carbon cycle
    - All the carbon atoms that exist now are the same carbon atoms that have always been
    - They show up in pure forms as diamonds, graphite and most commonly coal
    - Carbon is also found as fossil fuels in the ground … Dissolved in oceans … In the atmosphere as carbon dioxide … And in all living things
    - Life itself drives part of the carbon cycle
    - The smallest reservoir of carbon is in the atmosphere in the form of CO_2
    - Without CO_2, the earth would be a frozen planet
    - Or, if there were a lot more the currently found in the troposphere, our world would be like Venus - too hot for life

Chapter 9 Core Meteorology: Atmosphere - The Atmosphere and Climate Change

Student Goals - In this *Core Meteorology: Atmosphere* chapter the students will learn:

- $CO_2$is an odorless, tasteless, invisible gas
    - It has a long, long life span in the atmosphere
    - At the end of the last ice age, CO_2 in the atmosphere was at a level close to 280 ppm
    - Currently the concentration of CO_2 is slightly over 380, so human emissions have increased it by slightly over 100 ppm
- The Earth's atmosphere has a distinct chemical composition that regulates solar radiation from the sun so that life is possible
    - The smallest reservoir of carbon is in the atmosphere in the form of CO_2
    - Without it, the earth would be a frozen planet
- Industrial output can interact with the atmosphere through the Bio/Geo/Chemical cycles, and as a result, can change the way the atmosphere regulates the heat coming from solar radiation

Answers to Blackline Master 1A Quiz

1-a; 2-a & c; 3-d; 4-b; 5-a; 6-c; 7-a, b & c; 8-b; 9-d; 10-a, b & c; 8-b; 9-d; 10-a