INVESTIGATING

PROCESSES OF CHANGE

AREA TIME EMPHASIS	TOPIC	TITLE	TIME
10 DAYS	I	Observation and Measurement of the Environment	5 days
	II	The Changing Environment	5 days

TOPIC I - OBSERVATION AND MEASUREMENT OF THE ENVIRONMENT

How Can the Environment Be Investigated?

TOPIC ABSTRACT

Time Emphasis: 5 days

MAJOR BEHAVIORAL OBJECTIVES

At the completion of this topic, the student should be able to:

A. Describe and classify his own observations of the local environment.
B. Measure some of the properties of his environment at a level of performance described in the "Process of Inquiry Objectives."

Approach

Treatment of topic I should be brief. The amount of time spent will depend upon previous student experience with observation and measurement. The student should be made aware that casual observations must be standardized and classified in order to form a basis for scientific investigation. He should also become aware of the problems which accompany any type of scientific measurement.

An important aspect of the study of density should be to provide the vehicle for an examination of the skills of scientific measurement.

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TOPIC OUTLINE	MAJOR UNDERSTANDINGS	INFORMATION TO TEACHERS
A. The local environment		
A-1 Observation	**A-1** *How can the local environment be observed?*	**I-A-1**
A-1.1 Sensory perception	A-1.11 Observations involve the interaction of the senses with the environment.	CCO-10
A-1.2 Sensory limitations	A-1.21 Powers of observation are limited by the senses.	CCO-11
	A-1.22 Powers of observation can be extended by the use of instruments.	PIO-1; CCO-11
A-1.3 Inferences	A-1.31 Inferences are interpretations based upon observations.	CCO-12
A-2 Classification	**A-2** *How can observations of the environment be classified ?*	**I-A-2**
A-2.1 A system of classification	A-2.11 A classification system is based on observable properties.	PIO-5; CCO-10, 12
A-2.2 Purpose	A-2.21 A classification system enables an investigator to organize observations in a meaningful way.	PIO-3

TOPIC OUTLINE	MAJOR UNDERSTANDINGS	INFORMATION TO TEACHERS
B. Properties of the environment		
B-1 Measurement	**B-1** *How can properties of the environment be measured?*	**I-B-1**
B-1.1 Dimensional quantities	B-1.11 All measurements contain at least one basic dimensional quantity (time, length, or mass).	PIO-1
	B-1.12 Some properties of matter are described by the mathematical combination of the basic dimensional quantities (e.g., density, pressure, volume, or acceleration).	PIO-1
B-1.2 Comparison	B-1.21 Measurements of some properties of matter are made by a direct comparison with standards (e.g., length, mass, volume).	PIO-1, 2
B-1.3 Error	B-1.31 Any measurement is an approximation of an absolute value and must be considered to contain some error.	PIO-1, 2, 3
B-2 Density		
B-2.1 Variations	B-2.11 The density of a uniform material is independent of the size and shape of the material.	PIO-1, 2, 4, 5; CCO-10, 11
	B-2.12 The density of a gas varies with pressure and temperature.	CCO-10, 11
	B-2.13 The maximum density of most materials occurs in the solid phase.	PIO-1, 2, 5; CCO-7, 10, 11
	B-2.14 The maximum density of water occurs in the liquid phase.	PIO-1, 2, 5; CCO-7, 10, 11

How Changeable Is Our Environment?

Time Emphasis: 5 days

TOPIC ABSTRACT

Major Behavioral Objectives

At the completion of this topic, the student should be able to:

A. Describe the nature of changes occurring in his environment from observations of the environment.
B. Draw inferences about the relationship of energy to change from direct observations.
C. Draw inferences about man's ability to modify his environment from direct observations.

Approach

Throughout this topic the student's attention should be focused on changes in his environment. The student should develop an awareness that the phenomenon of change is the prevailing condition in nature.

In this topic it is desirable to start some long-term investigations of the "watch" type which will be concluded and summarized at various points in later topics. Specific suggestions for these investigations are included in the supplementary materials.

Long-term watches should be initiated with enthusiasm and students should be frequently encouraged so that they will feel the necessity for continuing their work. Specific end points for these investigations should be determined in advance, and plans should be established for the incorporation of the accumulated data into the appropriate topics.

The relationship between energy and change should be introduced in this topic. Further development will occur in topic V.

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TOPIC OUTLINE	MAJOR UNDERSTANDINGS	INFORMATION TO TEACHERS
A. The nature of change		
A-1 Characteristics of change	**A-1 How can changes be described?**	**II-A-1**
A-1.1 Occurrence of events	A-1.11 Change can be described as the occurrence of an event.	CCO-1, 2, 4, 6, 7
	A-1.12 An event occurs if the properties of matter are altered.	PIO-4, 5; CCO-1, 2, 4, 6, 7
	A-1.13 An event occurs if the properties of a system are altered.	PIO-4, 5; CCO-1, 2, 4, 6, 7
A-1.2 Frames of reference	A-1.21 Time and space are frames of reference through which change can be described.	PIO-3, 4, 5; CCO-1, 2, 10, 11, 12
A-1.3 Rate of change	A-1.31 A change can be described by measuring the rate at which it occurs.	PIO-2, 4; CCO-1, 2, 6, 7
	A-1.32 The rates of change of some earth processes are difficult to measure.	PIO-2; CCO-10, 11

TOPIC OUTLINE	MAJOR UNDERSTANDINGS	INFORMATION TO TEACHERS
A-1.4 Cycles-noncycles	A-1.41 Cyclic change is an orderly manner of events in time and space which repeats.	CCO-6
	A-1.42 Most changes in the environment are cyclic.	CCO-5
A-1.5 Predictability of change	A-1.51 The scope and direction of change is often predictable when evidence of the nature of the change is available.	CCO-1, 2, 4, 5, 6, 7, 10, 12
A-1.6 Occurrence of change	A-1.61 Change is a natural state of the environment.	
B. Energy and change		
B-1 Relationship between energy and change	***B-1 What is the relationship of energy to change?***	**II-B-1**
B-1.1 Energy flow and exchange	B-1.11 Change occurs simultaneously in the part of the environment which loses energy and in the part of the environment which gains energy.	CCO-1, 4
	B-1.12 The exchange of energy in processes of change occurs at the interface between parts of the environment.	CCO-1, 2, 4
C. Environmental Change		
C-1 Man's influence on the environment	***C-1 How does man modify the environment?***	**II-C-1**
C-1.1 Environmental balance	C-1.11 The environment is in a state of equilibrium which can be altered easily on a small scale.	CCO-4
	C-1.12 Man's technology has enabled him to disrupt the equilibrium of large portions of his environment.	CCO-6
C-1.2 Environmental pollution	C-1.21 The environment is considered to be polluted when the concentration of any substance or form of energy reaches a proportion that adversely affects man, his property, or the plant and animal life on which he depends.	PIO-2, 5; CCO-8, 9
	C-1.22 Environmental pollutants include such diverse materials as solids, liquids, gases, biologic organisms, and forms of energy such as heat, sound, and nuclear radiation.	CCO-7
	C-1.23 Pollutants are being added to the environment by natural processes, the activities of individuals, communities, and industrial processes.	CCO-1
	C-1.24 The addition of some pollutants to the environment varies with such factors as the seasons or the time of day.	PIO-2; CCO-1, 2, 4, 5