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Integrating Mathematical Concepts in the Study of the Atmosphere and the Ocean

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Introduction.

The concern for the teaching of mathematics has been expressed by the National Council of teachers of mathematics. They have taken the lead in creating directions for reform and the implementation of reform in mathematics teaching.

These reforms are manifested not only in the curriculum standards that define what students should learn, but also in the way that mathematics should be taught to students.

As a result of the concern for mathematics in general, the revolution in the subject matter and the way it is taught has been on going. Various new topics have been introduced, new teaching methods have been explored and new evaluation techniques are being tried.

There are various assumptions that must be made if these changes are to be implemented. There must be changes in how teachers teach, what they teach, and how they evaluate students' performance. If these changes are to be effective then teachers must see themselves as the agents of change. The changes needed in the teaching and learning of mathematics cannot occur in a vacuum. Teachers cannot change without the availability of the critical support and resources needed for change. The kinds of changes demanded by the standards call for methods of teaching and the utilization of curriculum resources that are different from those that teachers have been exposed.

The purpose of the unit.

The development of the unit will be rooted in these objectives:

(a) to utilize the concepts gained from concepts in the seminar (Atmosphere and the Ocean) to generate links between mathematics and the content area.
(b) Provide students with activities related to the topic, so that they can be involved in the teaching learning environment.
(c) To provide concepts that are relevant to the students' experiences yet laced with ideas so that

meaningful concepts can be learned. d) To approach mathematical concepts from a more diverse and non traditional view point.

The Emphasis of the Unit:

The unit will use the major concepts covered in the seminar as the background from these topics the application to mathematics will be developed. Mathematical concepts such as: functions, set theory, ratio and proportion, Variation, the calculation of distance, the application of statistical graphs to make decision and prediction.

The Audience:

It has been my experience that it is difficult to find mathematical correlations to events that are common place in the lives of students especially students in the upper level courses. Students also find it difficult to communicate ideas across subject areas. This unit will be written with the aim of finding the concepts that will link mathematical ideas to students in advanced courses, however some attempts will be made to find connections with other mathematical levels.

The unit will consist of a narrative section that will provide the content needed to understand the mathematical problems posed. The second section will explain the mathematical ideas that emerge from the topics and show the connections that can be made. The third section will generate teaching ideas that could be used with students. The focus of the teaching application will be to utilize problem solving strategies that emphasis writing in mathematics, and strategies that have students make decisions and draw conclusions.

Conclusion:

The development of the unit will rely on the focus and the direction of the seminar. Mathematical connections will be made to topics such as climate, weather, radiation, the formation of clouds, the wind systems, and the effect of pollution on climate.

Climate and Weather.

The combined effects of the earth’s motions and energy from the sun and the planets formless and invisible envelope of air reacts by producing an infinite variety of weather which, in turn creates the basic pattern of global climates. There is much distinction between weather and climate.

Weather is constantly changing, sometimes from hour to hour and at other times from day to day. Weather is the term that denotes the state of the atmosphere at a given time and place. Even though these changes seem erotic, it is possible to arrive at a generalization of variations. The aggregate weather condition is called climate.

Climate is therefore defined simply as “average” weather, this includes the character of an area variation , patterns, and extremes of weather. Simply climate is the sum of all statistical weather information that describes a place or region.

The nature of climate and weather can be expressed in these terms.

1. The temperature of the air

2. The humidity of the air

3. The type and amount of cloudiness

4. The types and amount of precipatation

5. The pressure exerted by the air, and

6. The speed and direction of the wind .

These variables constitute the variables from which weather patterns and climate types are developed.

The Earth Sun Relationships : Its Effects on Climate / Weather.

The energy that the earth intercepts from the sun is only about two billionth of its total energy. Solar radiation (energy) represents more than 99.9 percent of the energy that heats the earth , but the solar energy is not distributed equally over the earth’s land sea surface. It is this unequal heating that accounts for the ocean’s currents and creates the wind, which transport heat from the tropics to the poles in an attempt to create a balance of energy. The temporal and spatial variations in the amount of solar energy reaching the earth is caused by the motions of the earth relative to the sun and by variations in the earth’s surface.

The earth’s two principal motions, rotation and revolution affects the weather on the earth. Rotation is the spinning of the earth about it’s axis. This rotation one every 24 hours produces the daily cycle of daylight and darkness. On the other hand the revolution is the movement of the earth in its orbit around the sun. This movement affects the seasons enjoyed by the earth. The variations in temperature are also connected with the distance of the earth and the sun. because the earth’s orbit is not perfectly circular, the distance varies slightly during the course of a year.

The shortest distance 147 million kilometer from the sun occurs, on or about the 3rd of January. This position is called perihelion. On July 4 th the earth is farther away from the sun the aphelion with a distance of 152 million kilometers.

This combination of revolution and the distance from the sun causes the seasons. The seasonal variation in the altitude of the sun affects the amount of energy received at the earth’s surface in two ways. First, when

the sun is directly overhead (at a 90 degree angle). The solar ray are most concentrated. The lower the angle the more spread out and less intense is the solar radiation that reaches the surface. The second, the angle of the sun determines the amount of atmosphere that the rays must travel through.

If the sun is directly overhead, its rays pass through a thickness of only 1 atmosphere, where as rays entering at a 30 degree angle travel through twice the amount and 5 degree rays travel a thickness roughly equal to 11 atmosphere. The longer the path, the greater is the chance for absorption, reflection and the scattering by the atmosphere, which reduces the intensity at the surface. This same effect explains the difference between the heat of the midday sun and the beauty of the setting sun, and position north or south of this location, the

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readings will be applicable. These readings are intended to provide or force a link between mathematical ideas, and theory from climate and the ocean.

Each lesson plan can be considered a mini lesson and can be used for the duration of one or two lessons. The main focus is to provide background information to mathematical problems that are pertinent to the topic climate and weather. Each lesson plan will be independent of each other and will cover ideas as diverse as sun - earth radiation, to weather prediction. In some cases sufficient information will be found in the body of the unit, in some cases suggestion will be made for students to do research.

By using a section of the unit over time the students will experience various concepts from climate and weather thus assisting them in making the connections between mathematics and the content.

Mathematical Connections.

Functions: Mathematically the concept of function relate to the mapping of the elements in set A to a unique element in set B.

Many every day phenomena that pertain to the climate or the weather involve two or more quantities that related to each other by some rule of correspondence. Not all correspondences have simple mathematical relationships, but in most cases there is some rule of correspondence that matches each item from one set with an item from another set. This rule of correspondence is called a function.

Examples of function can be drawn from the following that affects the weather or climate.

a) The amount of solar radiation is dependent on the latitude of the city and the position of the earth in its orbit in relationship to the sun.
b) The seasonal variation in the altitude of the sun affects the amount of energy received by the earth’s surface.
c) The temperature readings depend on the hour of the day.
d) The climate of a region is dependent on the latitude, the altitude, and it’s position with respect to a continent or an island.
e) Climate and weather with respect to the humidity
f) The type of precipitin with respect to the type of clouds, ocean current, or the wind direction.

g) Pressure with respect to the air flow.
h) The wind direction with respect to the earth’s rotation.

Representing functions by sets of ordered pairs is a common practice in discrete mathematics. Example 1

Rule : Distance radiation must travel through the atmosphere.

Set A:(Altitude of the sun). Set B (number of atmosphere)
(figure available in print form)

example 2 Length of daylight. set A set B latitude summer solstice.

It is sometimes necessary to represent a function by an equation. For example the relationship between pressure and density and pressure and altitude. The relationship between air pressure, temperature can be described as:

Pressure = density x temperature x constant mathematically this can be expressed as P (x) = mx + b (where x is the variable)

Graphs: Most functions can be expressed geometrically. The Graph of a function ther