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The Science of Ghana

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Introduction

The purpose of this unit is to connect the science and social studies curriculum and encourage students to make connections between school subjects and real life. The students will simultaneously understand how the real life experiences of Ghanaians are influenced by science and meet the needs of the science curriculum standards through scientific inquiry, experiments, and observations. The students will learn about weather, how heat affects wind and water movement, and the effects of global wind cycles. They will learn how these concepts relate to the climate, and therefore the nutrition resources of Ghana. The integration of science with social studies and language arts will also activate the various learning styles and academic strengths of my students as we study Ghana.

This unit is designed for second grade at Davis Street Inter-District Magnet School, where every class participates in a school-wide initiative of International Study, by learning intensively about a particular country throughout the year. Our school and consequently, my classroom is comprised of about 90 percent African American students, with the remaining 10 percent made up of students from various ethnicities, including White, Latino, and Multiracial backgrounds. The school is a “Title 1” school with a majority of its student body comprised of families from low socioeconomic background. There is a great need to provide interesting lessons that engage the attention of the students while they are in school. It is especially important to teach science in an engaging way that will inspire them to think critically and prepare them for more advanced science in upper elementary and middle school, since they will need to be prepared for state mandated testing of science in their academic future.

At Davis Street Magnet School, we have many literacy incentives. There has been a great emphasis recently on reading and writing in order to address a need to improve scores on state-mandated tests. Much of our teaching time is spent working on literacy skills, especially writing responses to open-ended questions about stories the students have heard or read. The students are expected to become experts on relating to and responding to literature. Therefore, the social studies and even science activities have to be integrated with the literacy curriculum in a functional way in order to maximize the time provided to teach these subjects. Therefore, I have created reading material at my students’ shared reading level based on my own research on Ghana. This means that I’ve researched what I want the students to learn, and created a written text at a level they can read along with my support, as a guided whole group reading. I’ve created corresponding writing and

reading comprehension activities that fit the required literacy curriculum.

Since the majority of the math and literacy curriculum is prescribed by the district, teaching science and social studies requires excellent planning. It also provides an excellent opportunity to provide subject integration and teach creatively. Therefore, through this unit, the students will benefit from an interdisciplinary approach. They will learn through reading, written responses to the reading, journal writing, and research, as well as first hand experience via pen pal letters, guest speakers, and experiments.

This curriculum unit is designed for second grade students, but the content could easily be extended to teach students from second to fifth grade. In order to adapt the curriculum for older children, the reading selections might be supplemented with more challenging and longer texts. The students could delve much deeper into terminology and learn more about the scientific principals. They would be expected to write with much more depth, but the content would be very similar.

Since the unit is designed to complement a year-long study of Ghana and address New Haven Science Standards (as annotated in the Standards Appendix), it will consist of two main sections. The first section will allow students to learn the science behind the facts they will have learned about Ghana in the beginning of the year. They will understand how and why Ghana has a different climate and different seasons than those found here in the northern United States. This will provide multiple opportunities for scientific inquiry, and will address the science content and performance standards for inquiry A1-A7. The second part will allow them to understand how the climate and weather have created the different food sources that are popular in Ghana. This section will directly address the A23 and A24 science standards, which require students to learn about the sources of common foods and describe how people in different cultures use different food sources to meet their nutritional needs. (Another exciting extension would be to explore the scientific forces that created some of the topographic features of Ghana, such as the Kwahu plateau, the Volta River and Lake Volta. This extension would be linked to the standard addressing the properties of liquids and solids.) The majority of this unit will take place during the second and third marking periods of the year, with additional introductory work taking place in the first semester. The presentation of a science fair project in the fourth semester will be the culminating project. Therefore, the unit will essentially tie science and social studies together for the majority of the school year.

Section 1: The Science of Ghana

Climate and Weather

Climate is a word that means the type of weather a place gets most of the time. In Connecticut, we have a climate with four seasons and temperatures that change quite a bit from very cold, to very warm in summer. We get equal amounts of precipitation in every season. We expect cold weather in winter and hot weather in summer. We also know that the weather could change very quickly from day to day and of course, from season to season.

Ghana’s location close to the equator is one of the most important factors that determines the weather and creates a very warm climate. Temperatures are usually high at all times throughout the entire country. The average temperatures are between 26 degrees Celsius and 29 degrees Celsius. This is equivalent to 79 degrees to 84 degrees Fahrenheit. Especially in the northern part of the country, it tends to be very hot for

most of the year. (Library of Congress)

There are two main air masses that also significantly affect the weather in Ghana. The continental air mass and the maritime tropical air mass each move toward the equator with the trade winds and bring seasonal changes. The area where these two air masses approach the equator is called a convergence zone, which moves north and south seasonally. (Encyclopedia Brittanica, 2008) As the sun's rays move across the equator toward the north (which brings our spring and summer seasons) the humid maritime air mass, called the intertropical front, moves air from the south to the north into Ghana. This brings moisture and warmth from the Atlantic Ocean near the equator, which makes the air hot and humid. As the earth's tilt causes the sun's rays to hit the southern hemisphere again, (during our fall and winter) the harmattan winds come from the northeast across the Sahara desert, south into Ghana. (Library of Congress) The harmattan is the name of the continental air mass as it is known in Africa. The harmattan winds bring the dry, dusty air from the desert and create drier weather, especially in the northern part of Ghana. (Encyclopedia Brittanica, 2008) The causes of these seasonal changes will be discussed in section 2.

The northern part of Ghana has somewhat different climate than the southern part. The two regions are separated by the Kwahu Plateau, which is at the northern edge of the forest. In the entire country, the seasons do not create vast differences in temperature, as do our summer and winter, but bring different amounts of rain and humidity. (Levy 1999, 10-11)

To the north of the plateau, there are two main seasons: the drier harmattan season, which lasts from about November to April, and the wet season, which lasts from April to October. To the south of the plateau, there are four seasons. Heavy rains fall from April to late June, followed by a short period of drier weather in August. Another rainy season begins in September and lasts until November. In November the harmattan season brings the driest weather until March or early April. The weather in Ghana is usually humid all year in the southern part of the country and during the rainy season in the north. This is especially true at night. (Library of Congress)

The Food Resources of Ghana

Food staples are what people use for the majority of their diet. In the western part of Ghana, food staples are wheat, potatoes, and rice. In the northern part, millet, yams, and corn are the most important staples. In the south and west, plantains, cassava and cocoyams are grown. In the southeast, corn and cassava are the staple foods. In the center of the country, wet rice and hill rice are staples as well, which are important because they last a long time in containers. (Levy 1999, 115-117)

The cocoyam grows wild in the moist forest areas, and is grown on purpose as well. It is harvested for the roots and the shoots are eaten also. Cassava is a very important plant, because it can grow in the dry climate of the north as well as the wet forest land. It is also convenient because the tubers (the part that is eaten like the part of potatoes and yams that are eaten) can stay fresh in the ground until they are needed. The tubers are eaten and it can also be turned into flour, but a lot of care must be taken to make the flour properly. Corn and millet are grains that are grown in the sun and can be planted in dry climate. These are both cooked to provide a filling part of a meal or they can be made into flour. One common base for meals is called kenkey ("ken-keh"). To make it, corn is ground up, soaked in water for two days and then formed into balls. The balls of kenkey are cooked in boiling water and wrapped in plantain leaves. This is eaten with fish or stew and sometimes for dinner. Kenkey can be made with other ingredients as well in different parts of the country. (Levy 1999, 116-118)

Three meals are eaten each day, and in the villages, a lot of work goes on during the day, so breakfast is a big meal and the midday meal might be more of a light snack. There are traditional rules about who eats the meat or fish first, and how it should be shared. Meat is considered a very special meal for most Ghanaians. Animals are mostly eaten by people who have more money and belongings, since they are seen as a symbol of wealth. Sometimes, animals are traded just like money and exchanged for needed items or given as gifts. Fish is much more common. Both fish and meat, when served, are often made into a stew. Since meat is a luxury item, most foods are made with starches and often contain nuts for protein. Groundnuts, which grow mostly in the north, and palm nuts are used in soups and stews. Vegetables include a form of spinach, okra, eggplants, onions, tomatoes, sweet potatoes, and many beans. The leaves of the cocoyam plant are another green vegetable people enjoy. They are called kontomire ("kon toh meer eh"). (Levy 1999, 117-119)

The most common evening meal is fufu, which is dough made of cassava and plantain or cocoyam. It is usually served with soup that contains a mixture of foods and cooked for one hour. The ingredients that might go into the soup are groundnuts, palm fruit, fish, beans, and vegetables. Soups made with nuts are grainy and thick, and the ones made with palm fruit have a yellow, oily broth. Other common soups are forowe, which is made with fish and tomatoes, nkita, which is made with eggs, fish, and beef. Another soup made in many parts of Ghana is pepper soup, made with hot chili peppers. For breakfast, one popular food is ampesi ("am-peh-si"), which is made with cassava, cocoyam, yam, and plantain. Surprisingly, not very many sweet foods are made from chocolate, even though chocolate is grown cheaply in the region and is very good quality. It is used mainly as a crop for income and starchy foods are made into sweets for snacking. (Levy 1999, 118-120)

Section 2: Forces of Nature that Influence the Climate, Weather, and Food Sources of Ghana

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The sun radiates hundreds of thousands times more energy than the earth and provides energy to the earth in the form of heat and light through mostly visible wavelengths. About 30 percent of the sun's rays are reflected back into space, and the remaining energy is distributed to the Earth's surface. However, the sun's energy is not distributed evenly across the entire planet. The equator and the low latitude areas of the tropics receive most of the sun's heat, which is pushed toward the poles due to global atmospheric convection. Beginning approximately at the tropics of Cancer and Capricorn, between 32 and 35 degrees latitude, the Earth begins to lose more heat than it gains at the surface. Heat loss increases at higher latitudes, moving toward the poles. (Abbott 2004, 19-22)

Convection is created when air is heated, causing it to become less dense and therefore lighter. Heated air rises, and pulls air off the ground and pulls air from nearby as well. Therefore, it creates low pressure near the ground. As the hot air rises, it expands, loses its heat, and becomes denser once again. If the air is moist, the cooling causes moisture to condense into cloud droplets and then eventually rainfall. After the air cools and becomes denser, it sinks back down, hits the ground and creates a high pressure zone as the air pushes against the ground and forces the surrounding air away from it. (Encyclopedia Britannica, 2008.)

The differences in heat between the tropical latitudes and the polar latitudes create important ocean currents and winds that bring heat from the tropics toward the poles. Meanwhile, the high pressure of the cold air at the poles creates movement of air away from the poles. (Abbott 2004, 22)

However, the air does not flow in a straight line over the Earth. This is because of the Coriolis Effect, which states that the air moves at much higher speeds at the equator than at the poles, since the globe is widest at the equator. Since the Earth rotates to the east, the air is also moving east. It moves fastest at the equator, slower at the tropics, and barely moves at the poles. This creates a large scale movement of air that is pushed off course as cooler air from higher latitude moves into the faster moving air near the equator, which effectively moves the warm air west as it collides. In the northern hemisphere, this creates movement south and toward the right of its original path as it gets closer to the equator, as in Figure 1. Likewise, moving masses of air and water from the south pole head north toward the equator and are pushed to the left of their original paths. (Abbott 2004, 274-277)

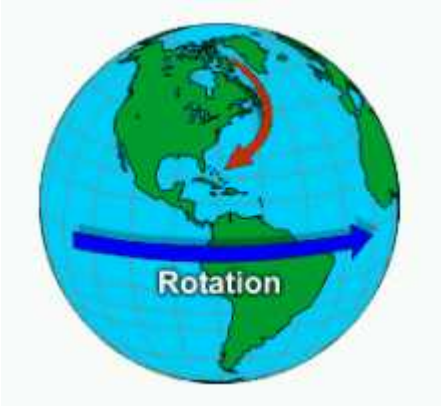

Figure 1: This shows how air moving south from the north pole toward the equator is deflected to the right of its path due to the rotation of the earth. (Source: National Weather Service, 2007)

This can easily be demonstrated in the classroom with a chalk, a globe, and two people with steady hands. One person should be instructed to turn the globe in the direction of the earth's rotation, (counter clockwise if you're looking at it from above the north pole). A second person should be instructed to use chalk to draw a straight line down from the north pole to the equator at a steady speed. The line will not be straight, but will curve to the right of its path downward, or southwest on the globe. This is because the spot directly beneath the starting point, which the chalk would have touched if the globe were standing still, will have moved by the time the chalk line reached the equator. This can also be demonstrated with a turntable and a ruler, as in figure 2. (Robinson: National Weather Service)

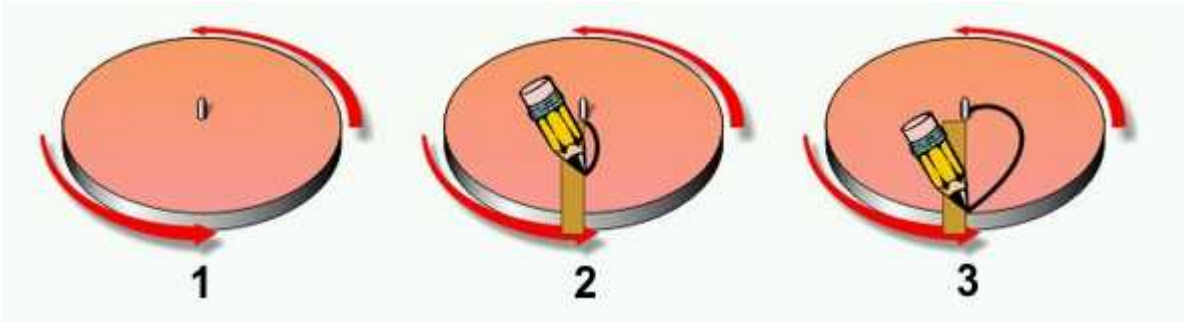

Figure 2: This shows the effect of using a ruler to make a straight line on a moving circle. (Source: National Weather Service, 2007)

Meanwhile, heated air located between the equator and about 30 degrees latitude north and south, rises (as it moves east with the earth's rotation), away from the equator toward the poles. Moist, warm air expands and

rises within this band of the earth as it moves away from the equator. As it rises and moves towards the tropics, the air begins to lose heat and the moisture in the air condenses and drops as rain. It cools and creates the tropical high pressure zone. The cooler, drier air then sinks back toward the equator. As it moves back toward the equator, the Coriolis Effect causes the air to be pushed back toward the west. The movement of the air east and away from the equator, then toward the equator and west causes a circular movement of air called a Hadley cell. (Abbott 2004, 275-277) The circular movement of air within the Hadley cells is pictured here.

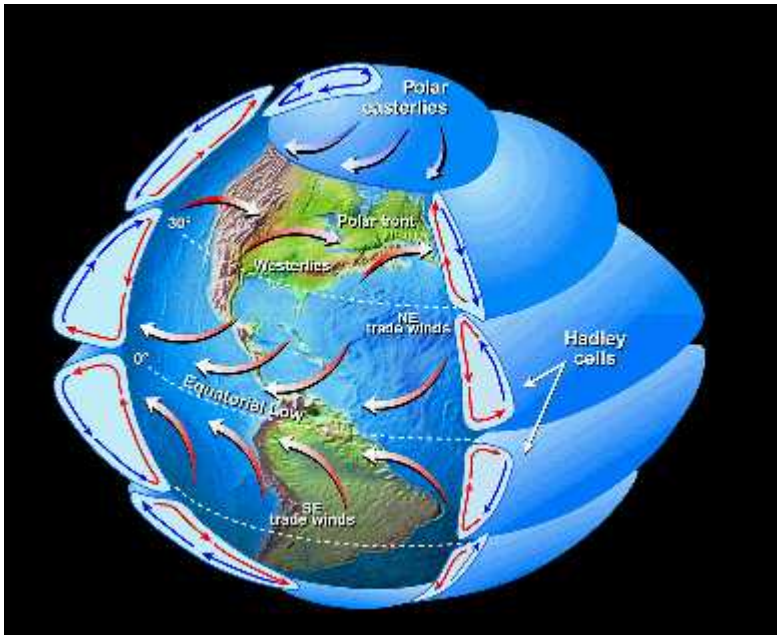

Figure 3: This illustrates the movement of winds created by global convection as it is affected by the rotation of the earth. (Source: www.nasa.gov)

This creates strong winds between the tropics and the equator called the trade winds. The trade winds control the weather of the land located within these latitudes, such as Ghana. Since the air cooled at the tropics has lost most of its moisture, the air is relatively dry, which creates the dry weather typical of regions at this latitude, between 20 and 30 degrees, such as the Sahara desert. The Trade Winds carry hot, moist air that has yet to release the moisture, creating the warm, humid climate that is typical of locations close to the equator. Since the air remains within the warmest part of the Earth, the seasons do not create great variations in temperature, but remain warm all year. (Abbott 2004, 275-277)

The movement of the humid tropical air mass and the dry harmattan air mass by the trade winds is easier to understand when considering the effect of Ghana's proximity to the Atlantic Ocean. As the sun's most intense rays move north of the equator, the effect is similar to a sea breeze. A sea breeze is wind caused by a difference in air pressure created by the heating and cooling properties of the land and sea. (National Weather Service, 2008)

During the day, the sun heats the land more than the water, because of the water's depth and transparency. The warm air over the land rises due to convection. This creates a warm low pressure area at the surface of the land due to air being drawn into an upwelling like a vacuum cleaner. The upwelling air reaches a height where it begins to move off to the side, over the ocean, and cools. It eventually sinks, where it hits the ocean surface where it is a high pressure zone and the moist ocean air is pushed back toward the warm upwelling low pressure zone over the land. The circular movement of the air can be seen in Figure 4.

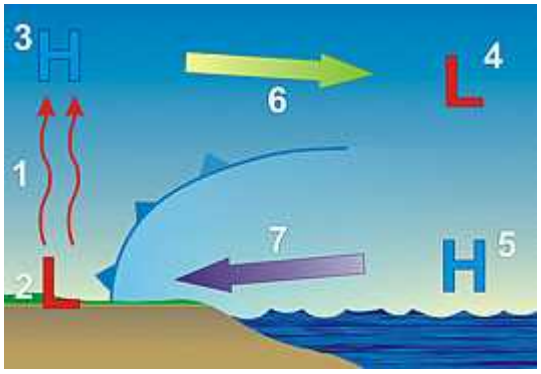

Figure 4: This illustrates the rapid heating of the land, creating movement of air. (Source: National Weather Service, 2008)

This process is reversed at night because of the more rapid cooling of the land compared to the water, (which is a result of the water having heated to a much more significant depth). At night, the warm air over the ocean begins to rise and creates low pressure over the ocean. Air moves from the land toward the sea and is called a land breeze. (National Weather Service)

Similarly, the movement of the sun's rays north over the land and then south over the ocean create a similar effect on a seasonal scale. In the spring and summer, the sun's rays heat the earth more intensely than the water. This creates a low pressure zone above the land, which draws the warm, moist air from the ocean toward the land. This is similar to the sea breeze effects during the day. Furthermore, the low pressure zone causes the air to expand and cool, allowing moisture to condense in the form of rainfall over the land. In the fall and winter, the sun's rays heat the water more than the land, creating an effect similar to the land breeze. When the water is heated, a low pressure zone of especially warm air is created over the ocean. The low pressure zone draws relatively cool air from the continent toward the low pressure zone over the ocean, and brings the hot, dry harmattan air mass south through Ghana towards the ocean. Furthermore, during this season, the precipitation in the low pressure zone is over the ocean rather than the land, causing dry weather on the land. (Abbott 2004, 273-281)

Section 3: Teaching Methods/ Lessons

Climate and Weather

For the first section of this unit, the students will read, study and discuss information about Ghana's climate and weather. After the information has been discussed, reading comprehension questions will be modeled, discussed and answered in writing. The reading will be teacher-created, as will the written response questions. The reading material will be created at a level the students can read together with teacher and/or pee r support. The written response questions will match the literacy curriculum focus with the content on Ghana. A sample may be found in Appendix 2.

Secondly, the students will compare and contrast the weather and climate of Ghana with their own Connecticut weather through discussions and journal writing. They will learn why the climate is different through hands on demonstrations and experiments. This section will address the science performance

standards for scientific inquiry numbers 1-7.

In order to understand how the sun's heat is transferred around the Earth, the students must first understand global rotation, revolution, and conceptualize the Sun's radiation of the Earth. Therefore, the students will observe a demonstration of the earth's rotation and revolution around the sun using a globe and a yellow ball. Then, the students will draw and write about this in their science journals, and finally act out the movement of the earth as it moves around the sun. The students will observe as a dot is placed on the globe and the globe is moved around the sun while rotating on a tilted axis. They will observe how the sun's rays reach each hemisphere at different times of the year, but the majority of the sun's energy remains within the tropical area all year long.

Once the students understand how the sun's energy heats the regions of the earth, they will be ready to begin a series of four science experiments which are designed to help them understand convection and how it affects Ghana's weather.

First, the students will have an opportunity to share what they think they know about warm air and cold air and how it moves. They will read and research to learn that warm air has less density than cold air. Then they will have opportunities to make predictions and experiment with objects of varying densities to see what happens to them when placed on a balance scale. This first experiment will allow them to create an accurate hypothesis for the second experiment.

The second experiment will allow the students to observe convection in water, which will be conducted as a science fair project. The students should have enough knowledge about density to hypothesize that hot water is lighter than cold water, and therefore should move upward within colder water. Then, they will observe as food coloring is used to show the warm water currents rising and falling within a large container of colder water. They will measure the temperature of the water in the large jar and the small jar and repeat the experiment with water at several temperatures. They will use their science journals to record predictions, pictures and written observations, and conclusions. The students will then read teacher created text (at shared reading level) which will explain how convection within the ocean creates patterns that are important to global weather. The students will write and draw to show what they've learned. See attached lesson plan.

Convection Experiment (adapted from 2008 Home Training Tools)

Objectives: Develop prediction and observation skills, learn that hot water is less dense and therefore lighter than cold water, so it rises above cold water. Observe convection currents within water and record the results. Students will use their understanding of the results to visualize how convection affects the ocean water.

Materials : large clear container, a small clear container with a flat bottom, plastic wrap, knife, food coloring, thermometer, cm ruler, rubber band

Procedure :

1. First, fill a large bucket with cold tap water and a small jar with cold tap water.
2. Measure the temperature of the cold water in the bucket and the small jar.
3. Then, color the water in the small jar so it may be observed.
4. Cover the small jar of water with plastic wrap and secure it with a rubber band.
5. Create a hypothesis about what will happen when the small jar of water is opened and the

water is allowed to escape.
6. Carefully lower the small jar into the large bucket of water and cut a hole in the plastic wrap to allow the colored water to come out into the clear water.
7. Use a ruler and a timer to measure the amount of water that has risen within 10 second intervals.
8. After the colored water appears to stop rising, measure how many centimeters the colored water has lowered within the small container.
9. Record observations with pictures and words in the science journal.
10. Repeat several times, filling the small jar with water at different, warmer temperatures. Record the temperature each time.
11. Follow science fair guidelines by creating a graph for the information.

A third experiment will allow the students to observe how air movement is affected by warmth and cold as well. They will see how warm air moves straight up in a draft free setting, and then creates a high pressure zone and low pressure zone. The teacher will heat a baking tin full of sand and place the heated tray next to a tray of ice. Students will watch as smoke from a lighted match moves from the high pressure zone above the ice, to the low pressure zone above the heated sand. This will allow the students to see how wind is created. The students will then continue to learn how air pressure creates wind, as well as other types of weather. See attached lesson plan.

Observing Air Movement (Adapted from 2008 Home Training Tools)

Objectives: Students will develop prediction and observation skills, learn that hot air is less dense and therefore lighter than cold air, so it creates less air pressure than cold air. Students will observe as a small high pressure zone is created with cold air that will move into the lighter, low-pressure warm air, thereby creating a tiny wind current.

Materials: two large baking tins, sand, ice, small candle, lighter, oven, oven mitt, draft free table.

Procedure :

1. First, create a draft-free display space with a 3-walled study carrel desk or cut cardboard box.
2. Pour sand into one of the baking tins and heat in the oven for about ten minutes.

3. Set the hot tin on an oven mitt on the draft free table.
4. Hold a candle over the hot sand in what is now a low pressure warm air zone. Have students predict what the air will do over this hot sand. They should predict that warm air moves up, since it is light.
5. Light the candle and blow it out so that the smoke will show the movement of the warm air.
6. Next, fill the second tin with ice cubes and set it next to the hot sand. Ask the students to predict what will happen to the air between the two tins.
7. Light a candle right between the two tins, touching the edge of the ice tin. Blow it out so that the students may observe the movement of the air through the smoke.
8. Ask students to deduce why the smoke flows away from the ice and toward the heated sand.
9. Have students draw and write about this in their journals. Then have them draw the earth and predict what happens when the warm air from the tropics meets the colder air of the polar regions. Which way will the wind blow?

Finally, the students will experiment with movement to see how the Coriolis Effect creates movement of Earth's air east and west as it moves vertically. The students will venture into the yard in groups of 4 or 5 students and create circular movement with their bodies. They will measure the distance traveled by the center and the outer edge of the circle to observe that the person on the outer circle moves farther in the same amount of time, or faster than the person in the center. See attached lesson plan.

The Coriolis Game

Objectives: Students will create, observe and measure the Coriolis Effect, allowing them to understand the eastward and westward movement of the earths prevailing winds. They will make observations verbally and in writing and drawings.

Materials : Students, 2 yard sticks per group, measuring tape, timer, chalk or something to mark the ground with.

Procedure:

1. One student will stand on a designated, marked spot on the ground, holding a yard stick in on hand by his side.
2. A second student should hold the other end of the yard stick with the opposite hand held at his side and a second yardstick in the other hand.
3. A third student should hold the opposite end of the second stick in one hand and a soft ball in

the other.
4. A fourth student or a team of two students should mark the spot where the second and third child stand and set the timer.
5. The three students holding the stick should begin moving counterclockwise as the timer begins. They should be careful to stay in a straight line by holding the yardsticks steady.
6. After 10 seconds, the measuring team should measure the distance traveled by the first, second and third child.
7. Students will discuss and record their observations, then look at the globe to relate the concept to the air on the surface of the earth at various latitudes.

Follow up: Two students could repeat this movement on pavement, and draw a straight line with sidewalk chalk along the yard stick as they move around in a circle. When they stand up, they will see that their "straight line" has become a curve.

After participating in all four experiments, the students will read, write about and draw information about how global wind patterns affect Ghana's climate as a result of its location within the tropics. The students will look at pictures of wind patterns across the globe and relate these patterns to what they learned about convection. The students will learn how tropical winds create rainy and dry seasons near the equator, rather than the drastic differences in temperature between seasons that we experience farther from the equator. They will understand how the winds move northeast bringing wet air during the wet season and southwest during the harmattan season.

The students will also have a chance do several more hands on activities to bring the subject more to life for them. They will each plant two seedling plants and observe what happens when very little water is available by watering some plants every day and some only once a week. The students will observe and write about their plants in their science journals. Furthermore, they will keep charts, recording the weather in Connecticut and the weather in Ghana, especially the temperature and rainfall. They will write comparisons and make graphs to show the patterns of the weather in each location. The students will create wind catchers and act out the movement of the wind across the equator. They will also draw wind patterns on maps of the world. They will demonstrate their learning by creating speeches or written papers explaining how and why the seasons are different in Ghana compared to the northeast United States. At this point, the students will write letters to invite students and parents of our school community who are from Ghana to speak to them about the weather and climate of Ghana. They will prepare questions for our guests and write journal entries afterwards, as well as thank you letters.

In addition to completing science experiments that will help the students understand how and *why* the climate and seasons are different, the students will also write pen pal letters describing the weather and seasons they've experienced. The class will be paired with students from Ghana who are studying the United States, through a web service called Epals. They will tell their new friends what they have learned about Ghana so far.

They will ask their new friends to elaborate on how their experience has been similar or different from what they've learned in our classroom. The students will then ask questions to find out more about the students' experiences in Ghana.

The Food Resources of Ghana

For the second section of the unit, the students will learn how the wind patterns and seasons affect the nutritional resources of people in Ghana. This will address the New Haven Science Curriculum Standard A24: "Describe how people in different cultures use different food sources to meet their nutritional needs." The students will learn about the natural resources of the area and how they are affected by the climate and seasons. During this section of the unit, students will compare and contrast foods they eat with those eaten in Ghana and sort the foods according to the food pyramid. They will also participate in taste tests of some of the vegetables grown in Ghana

First, the students will conduct research in the library to find out what the food staples are in the United States. They will then research and write about the climate and weather conditions necessary to grow these resources. They will then compare the food staples of the United States with those of Ghana. They will be able to explain how the climate of Ghana supports the staple foods grown there.

Secondly, the students will use the internet to find pictures of the foods found in the United States and those found in Ghana. They will cut out the pictures, label them, and create a display showing the foods of the United States and of Ghana. They will explain the similarities and differences within a speech to the class and/or in writing.

The students will continue their research, as necessary, in order to classify the foods of Ghana into the categories of the food pyramid. Students will create giant posters with the food pyramid and glue pictures of different meals onto the poster. They will present food pyramids for both the United States and Ghana. As a follow up, students will create Jeopardy questions about the foods of Ghana and challenge their classmates.

As a culminating project, students will create presentations on the foods of Ghana and their nutritional content. They may choose to present cooking demonstrations, taste tests, posters, or dioramas *along with* a written report.

Conclusion

At the end of the unit, I hope that my students will understand the scientific principles of convection, air flow and climate, and the effect of the environment on nutritional resources. I hope the students will understand these concepts fully as a result of the connection to the real world and the way that they influence life in Ghana. I hope the students will understand what life is like in Ghana more fully as well, as a result of exploring the science explanations for the differences they observe between Connecticut and what they have learned about Ghana.

Resources

References

Abbot, Patrick. *Natural Disasters* . New York: McGraw Hill, 2004. This book explains air masses, global wind patterns, and natural disasters such as drought and floods.

Encyclopædia Britannica. “Ghana”. Encyclopædia Britannica Online, 2008. http://original.britannica.com/eb/article-55173 (accessed July 24, 2008). Provides in depth discussion of the various regions of Ghana and the weather and vegetation in each.

2008 Home Training Tools. “Home Science Tools: The Gateway to Discovery.” Home Training Tools, Ltd, 2008. http://hometrainingtools.com/articles/weather-experiments-projects (accessed April 6, 2008). This website has several weather related experiments that make the science interesting and easier to understand. The experiments can be conducted with reasonably accessible materials.

Levy, Patricia. *Cultures of the World: Ghana.* Tarrytown, New York: Marshall Cavendish Corporation, 1999. This book was created for older children and has detailed information on the culture, food and economy of Ghanaians. It would be used as a read aloud or for research with adult assistance.

Library of Congress. “Ghana.” Library of Congress Country Studies, 1994. http://lcweb2.loc.gov/cgi-bin/query/r?frd/cstdy:field(DOCID+gh0040) (accessed March 19, 2008). This website has detailed information about the geography of Ghana and the climate. It is particularly useful because it explains the climate differences among the geographic regions.

Robinson, Henry W. “Activities in Meteorology: Coriolis Effect.” National Weather Service, 2008. http://www.nws.noaa.gov/om/educ/activit/coriolis.htm (accessed on July 29, 2008) This web page describes two possible ways of demonstrating the Coriolis Effect in a classroom.

New Haven Public Schools. “New Haven Public Schools Draft Science Standards.” New Haven Public Schools, 2007. http://www.newhavenscience.org/2curroverview.htm (accessed April 6, 2008). This is the full listing of New Haven science standards.

Teacher’s Additional Resources/ Reading List

Emiliani, Cesare. *The Scientific Companion:Exploring the Physical World with Facts, Figures, and Formulas* . New York: John Wiley & Sons, 1995. Chapter 11 provides valuable background knowledge for the teacher on atmosphere, wind patterns, air masses, and weather patterns.

Owusu-Ansah, David, B.A., M.A., Ph.D. “ Ghana.” Microsoft® Encarta® Online Encyclopedia 2008. Microsoft Corporation, 2008. http://encarta.msn.com/text_761570799__0/Ghana.htm (accessed April 8, 2008).This site is useful because it gives detailed information on the agriculture and resources of Ghana.

Scholastic . *Scholastic Atlas of Weather.* New York: Scholastic, 2004. This book would be used as a read aloud to provide background knowledge of weather forces or for research with adult assistance.

Stern, David. “(S-1B) Global Climate, Global Wind Flow.” Stern, David. http://phy6.org/stargaze/Sweather2.htm (accessed April 6, 2008) This website has advance descriptions of how wind flows in different regions of the earth, and explains the differences

between weather patterns of different latitude zones.

Wikipedia, " Library of Congress Country Studies: Ghana."Wikipedia, 2008. http://en.wikipedia.org/wiki/Geography_of_Ghana (accessed March 19, 2008). This is a collection from the Library of Congress Country Study and has the same information, but it is easier to browse than the Library of Congress site.

Annotated Children's Reading List

BBC Homepage. "BBC Bitesize Geography: Weather and Climate." BBC, 2008. http://www.bbc.co.uk/schools/geobitesize/geography/weather (accessed April 6, 2008). This site for students and teachers has lots of information on weather, global weather patterns, weather measurement tools, descriptions of various climate types and other geography related weather information.

Davies, Lucile. *Countries of the World: Ghana.* Mankato, Minnesota: Bridgestone Books, 1999. This book contains a detailed summary of the people, culture and geography of Ghana, with captivating photographs throughout.

Levy, Patricia. *Cultures of the World: Ghana.* Tarrytown, New York: Marshall Cavendish Corporation, 1999. This book was created for older children and has detailed information on the culture, food and economy of Ghanaians. It would be used as a read aloud or for research with adult assistance.

Scholastic . *Scholastic Atlas of Weather.* New York: Scholastic, 2004. This book would be used as a read aloud to provide background knowledge of weather forces or for research with adult assistance.

List of Required Materials:

- computer
- paper, pencils, crayons
- Globe and maps of the world
- flashlight
- ice cubes
- 2 baking tins
- sand, oven mitt, and access to an oven,
- cardboard cubicle or other means of creating a draft proof area
- small candle and matches
- measuring tape and timer
- large, clear container
- a small clear container with a flat bottom
- plastic wrap, rubber bands
- knife
- food coloring
- thermometer
- cm ruler

Appendix 1: Implementing District Standards *:*

Grades PreK-2 Core Scientific Inquiry, Literacy and Numeracy

A INQ.1 Make observations and ask questions about objects, organisms and the environment.

· Students will predict, discuss and observe during science experiments and projects.
A INQ.2 Use senses and simple measuring tools to collect data.
· Students will observe with the senses and measure with thermometers and measuring tools.
INQ.3 A Make predictions based on observed patterns.
· For each project, students will make predictions and test their predictions.
A INQ.4 Read, write, listen and speak about observations of the natural world.
· Students will work in groups, discuss in class, and write in science journals throughout the unit.
A INQ.5 Seek information in books, magazines and pictures.
· Students will complete research with library books, internet use, and pictures.
A INQ.6 Present information in words and drawings.
· Students will have to present findings in speeches, drawings, and in writing.
A INQ.7 Use standard tools to measure and describe physical properties such as weight, length and temperature.
· Students will use thermometers, rulers, and measuring tape as part of record keeping and science experiments.

Grade 2 Content Standards

Properties of Matter -- How does the structure of matter affect the properties and uses of materials? (PHY *)*

2.1 - Materials can be classified as solid, liquid or gas based on their observable properties.
A18 Describe differences in the physical properties of solids and liquids.
· Students will learn that liquids and gasses have the ability to move readily, and therefore retain and spread heat throughout the globe by their movements.

The Changing Earth -- How do materials cycle through the Earth's systems? (EARTH)

2.4 - Human beings, like all other living things, have special nutritional needs for survival.
The essential components of balanced nutrition can be obtained from plant and animal sources.
People eat different foods in order to satisfy nutritional needs for carbohydrates, proteins and fats.
A23 Identify the sources of common foods and classify them by their basic food groups.
A24 Describe how people in different cultures use different food sources to meet their nutritional needs.

· Students will learn the sources of common foods in the United States and in Ghana. They will classify them by food groups and compare and contrast the two countries.

Appendix 2: Sample Shared Reading Excerpt and Written Response Questions

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Teacher Created Shared Reading Text

Climate

Climate is a word that means the type of weather a place gets most of the time. In Connecticut, we have a climate with four seasons and temperatures that change quite a bit from very cold in winter, to very warm in summer. We get equal amounts of precipitation in every season. That means we get about the same amount of rain (or snow) in every season. We expect cold weather in winter and hot weather in summer and we know that the weather could change very quickly from day to day and of course, from season to season.

As you probably guessed, Ghana's location close to the equator means that it has a warm climate. Temperatures are usually high at all times throughout the entire country. The average temperatures are between 26 degrees Celsius and 29 degrees Celsius. In America, we use Fahrenheit temperatures, so we would say 79 degrees to 84 degrees Fahrenheit. This is about what it feels like to us in June or July. In the northern part of the country, it can be very hot.…

Written Response Question Worksheets

Ghana: The Climate

Written Response

Focus Question: What important facts did you learn from this selection. Give details from the text to show why these facts are important.

Remember to back up whatever you write in your topic sentence with details from the text that prove your point.

_____
_____
_____
_____
_____

Ghana: The Climate

Connecting

Focus Question: Would you want to live in an area close to the equator? Explain why or why not using details you learned from the **text** and information from **your life**.

Remember to back up whatever you write in your topic sentence with details from the text and your life.

_____
_____
_____