Lesley University School of Education
Activity Plan: Weather and Climate

Overview

Brief Description of Group to be Taught:
This unit will be taught to a team of two 5th grade classes in Norwell, MA. Each class is made up of 20 students. This is a heterogeneous class of varying abilities. I was not privileged to students' IEPs. The two classes have limited exposure to inquiry based science and cooperative group learning.

Massachusetts Frameworks Strand and Learning Standard:
The Massachusetts Frameworks for Science set standards for grade 6-8 and 3-5. Since I taught a fifth grade class, I will be using the 3-5 standards for this unit and touching upon the 6-8 standards. I discussed this with the Science/Math teacher for the class I taught. They operate their team with a middle school philosophy but since the state administers a MCAS test for science in the fifth grade, the school system has set the fifth grade to master the concepts for the 3-5 standards. They also introduce a few topics for the 6-8 standards. The school system believes in touching upon a topic twice (introduced and mastered).

Unit Introduction: The purpose of this unit is to master their understanding of Weather and the Earth's Atmosphere. This unit is mostly based upon a Weather and Water unit developed by the FOSS (Full Option Science System) Middle School Project Staff. I have also added some information from the Climate and Weather unit created by Investigating Earth Systems. The class I taught has just finished a unit on the water cycle. The weather unit will build on some of the concepts learned from the water cycle unit.

Lesson 1- introduce the course, share weather reports- 2 session
Lesson 2- understand air pressure- 2 sessions
Lesson 3- seasons- 2 sessions
Lesson 4- heat- 2 sessions
Lesson 5- causes of weather: wind, temp, air pressure- 2 sessions
Lesson 6- Fronts and Global warming- 4 sessions
Rest of Unit- climate, class weather reporting on different parts of country- 2+ sessions

This was actually asked by a few fifth graders
Driving Question: If January 2005, has been the snowiest month on record, how can we say that there still is global warming?

Lesson 1

Relationship of this Lesson to the unit: This is the first lesson of this unit. **The class has just finished a unit on the weather cycle. They were introduced only to the first layer of the atmosphere. They will build on this knowledge in the entire unit to study weather.** This lesson will introduce the students to weather and to different weather instruments. They will also begin their three-week observation of the weather in their community.

Massachusetts Frameworks Strand and Learning Standard:
Strand: Earth and Space Science 3-5
Learning Standard 6- Explain how air temperature, moisture, wind speed and direction, and precipitation make up the weather in a particular place and time.
Earth and Space Science 6-8
Learning Standard 4-Explain the relationship among the energy provided by the sun, the global patterns of atmospheric movement, and the temperature differences among water, land and atmosphere.

Concepts:

- Day 1: Meteorology is the science of weather. Day 2: Weather is the condition of Earth's atmosphere at a given time in a given place.

Processes:
- Day 1: Communicating. Day 2: Observing weather in their community. Assessment will be a multi-day observation of the weather conditions in our community.

Science Habit of Mind:
- Day 1: Offering reasons for findings. Day 2: Keep records of observations.

Other Subject Area Objectives:
- Day 1: Language Arts: Writing weather report. They will see that this is a perfect example of informative form of writing. Later in the unit they will use the persuasive form of writing.

Session Length: two 50 minute classes. (Ongoing observations of weather conditions for 3 weeks)

Materials Needed: per class

- ❑ DAY 1: computers in class (total 5- one per group of 4 students)
- ❑ Weather journals (20 students each class)
- ❑ Weather map (one per class)
- ❑ White and colored paper in case groups ask for it
- ❑ DAY 2: per group of 4
- ❑ Thermometer
- ❑ Barometer
- ❑ Anemometer
- ❑ Weather Vane- or compass
- ❑ Hygrometer

Class Activities
Lesson 1 DAY 1

TIME	PROCEDURE	CONCEPT
Prep	Get yesterday's local weather report. Also tape the 11:00pm television broadcast or the early 5:00/6:00 morning broadcast of the weather. Have a map of the United States or New England states to plot weather data on board.	
15 min	Introduction: Tell students they are beginning a new unit on weather. Assign new roles and groups for unit (5 groups of 4). Each group is to create a concept map of the knowledge they already possess about weather. We have just finished the water cycle unit hopefully one class will include this connection. If not as you walk around the class ask them about the unit they finished. *Does it play any role in weather? Does weather differs for each season?* Walk around room to help with any technical issues using the software but try not to give many facilitating question as this is being used as a class pre-assessment. Students will use the available computers in the room and the software *Inspirations* to complete their concept maps. The class has created a concept map before as they complete one at the beginning and end of most units. At this time of the year it shouldn't take much time. Pass out journals and explain that work and notes for this unit will be kept in these journals.	Roles and groups. Community of learners
15 min (writing)	Ask each group to write a weather report about the current weather. Ask each group, how long you think the meteorologists have to report the weather? Tell groups that each group will they report their data. It is important inform all the aspects of weather in approximately a two minute report. Walk around the groups. Ask: *What types of information should be included in a weather report?* *What sources should be used for a weather report?* *What do you see happening outside?* *What do you feel happening outside?* *Try to remember what words the meteorologist use.* *What kind of props does a meteorologist use?* Students may use the map for their presentation. They may also use white and colored paper to help them present their report.	Language arts (informative writing) Offering reasons for findings.
20 min (reporting)	Have each group share their reports. They will only have about 1-2 minutes per group to report. On chart paper, have students come up with a class list of what they felt was important to report. Share the copy of yesterday's weather report with the class. Show the television broadcast that was taped. *What were some of the aspects of weather that were reported? What does each mean?* Add to list what the meteorologist felt	communicating

	was also important to report. *What are some other words or phrases that you usually hear during a weather report?* On chart paper, start a list of words that they heard in the reports or in others they heard in the past. Some student may not understand the vocabulary but we will build on this and explain in future investigation. Some concepts may include: temperature, air pressure, wind direction, wind speed, humidity, and precipitation. Write only those the students come up with. Others can be added later.	
	What is meteorology? Have students answer this question in their journals. Have students put journals away. Give students their homework: watch a television weather report and read the report in the newspaper. Ask student to write a paragraph on how the two differ. Tell students that tomorrow we will be using some instruments the meteorologists use to gather their data.	

LESSON 1, DAY 1 Assessment:

Method of assessing: The following will be assessed based on observation during group work and presentation and also their ability to answer the facilitating and formative questions written above in italics.

	Novice	**Competent**	**Expert**
Process Skill	Not interested in communicating with in group about important weather conditions. Not willing to be part of presentation.	Able to communicate with others in the group. Takes a smaller role in the presentation.	Takes a leadership role in the presentation of the group. Able to communicate with others in the group.
Habit of Mind	Not able to offer any reasons for the weather findings in the group.	Offers reasons for why they were reporting certain weather condition.	Thorough job of offering reasons for their findings. Incorporates these reasons in the weather report.
Concept	Not a complete understanding that meteorology is a science.	Understanding that meteorology is the science of weather.	Excellent understanding that meteorology is the science of weather and curious about other aspects of weather.

Class Activities
Lesson 1 DAY 2

TIME	PROCEDURE	CONCEPT

Prep	Gather all weather instruments.	
5 min	Ask students: *Can someone share what they learned last night after reading and watching weather reports? What are some important aspects discussed or reported in weather. How do you think these are measured?* Today we will be taking a mini field trip using some weather instruments. Explain what behavior is expected out of the students when they go outdoors. Do not tell them their names or what each instruments measure. But do go over and add to the class chart paper anything they learned that is important when reporting or predicting weather.	
20 min	Each group will receive five different weather instruments and observe each instrument's use. The class will take a mini-field trip out to the school yard. They will spend a few minutes with each instrument, record the observations and try to figure out what each instrument measures. In groups, students will discuss, take notes and write down any questions they may have about each instrument, its use and how it pertains to weather. Each group will also come up with a few "what we would like to know" questions about weather. (w from kwl, the k was done in the first concept map and the l will be done later) This will help me adjust the time frame of future lessons (expand, shrink or add lessons) according to students interest.	Recording observations measurement
20 min	Whole class discussion of ideas. Return to classroom and have a brief discussion of what we observed outside. Ask the reporters from each group to report their findings, observations and questions. On chart paper, write down what they thought each instrument did or measured. Write down questions on a separate paper as to what they want to learn. Ask them, *why does a meteorologist need to use all these instruments to predict weather*? Discuss the importance of controls. *Why did some of us come up with different readings? Is it fair to place a wind gauge next to a wall? Is it fair to place a thermometer in the shade? Is it fair to place a rain gauge under a tree?* As a class come up with the ideal location for each instrument to be used for gathering future data. *What are some other ways of observing the weather?* (precipitation, visibility, clouds).	Observations controls
5 min	*What is weather?* Have students answer this question in their journals. Students need to take their journals home tonight. From the two day introduction to weather each student will create a chart or way to display the data they will gather as a group each day for the next 3 weeks. We will share these at the beginning of the next class. This is important because they will receive a grade on their observation records. We will also use the data at the end of the unit to see if student can notice correlations or trends that may help them to predict weather. Tell students that in their next class they will discover how air pressure affects our weather.	

Sample Class Weather Chart

*This is an ongoing assessment. Students will be accumulating their data over the next 3-4 weeks. I'm leaving the columns blank. Students will choose what they will observe. As a class we will decide on the aspects of weather to observe. The class should come up with but is not limited to observing: Temperature, Air pressure, humidity, wind speed, wind direction, visibility. Last column is for other observations i.e. cloud cover or types, precipitation, rainfall. If I student doesn't need this chart they must show how they will organize their data.

								Other Observations
Monday Time_____								
Tuesday Time_____								
Wednesday Time_____								
Thursday Time_____								
Friday Time_____								

Lesson 1, Day 2 Assessment:

Method of assessing: The following will be assessed based their journal entries and also their ability to answer the facilitating and formative questions written above in italics.

	Novice	**Competent**	**Expert**
Process Skill	Some incorrect or careless observations	Careful observations and use of controls.	Excellent observations gives more than asked on the chart. Usually adds cloud type, visibility, precipitation etc.
Habit of Mind	Sloppy record keeping. Forget to write down all data for every day.	Careful record keeping. No missed data.	Excellent record keeping with details and drawings
Concept	Not a clear understanding that weather changes or that it differs in areas around the world and in ours from year to year.	Student has a clear understanding that weather happens at a given time in a given place.	Clear understanding of weather, conditions, and beginning to make connection with climate

Lesson 2

Relationship of this Lesson to the unit: This is the second lesson of this unit and will take two days. This lesson will introduce the students to air pressure and the atmospheric layers.

Massachusetts Frameworks Strand and Learning Standard:
Strand: Earth and Space Science 3-5
Learning Standard 6- Explain how air temperature, moisture, wind speed and direction, and precipitation make up the weather in a particular place and time.
Strand: Earth and Space Science 6-8
Learning Standard 4- Explain the relationship among the energy provided by the sun, the global patterns of atmospheric movement, and the temperature differences among water, land and atmosphere.
Strand: Physical Science 6-8
Learning Standard 2-Differentiate between volume and mass. Define density.

Concepts:
- Day 1: Air occupies space and can be compressed. Homework: Air has mass. Day 2: Weather happens in the first layer of the atmosphere (troposphere).

Processes:
- Inferring

Science Habit of Mind:
- Open minded, willing to listen and learn from others in groups

Other Subject Area Objectives:
- Math: relationship of cylinders and volume

Session Length: two- 50 minute classes

Materials Needed: (Per group of 4)

- ❑ 2- 30cc syringes
- ❑ 1- 2 inch piece of tubing to be used to connect syringes. (I am using the surgical tubing given from a medical supply store. It must fit over the nozzle of the syringe. I chose 2" because it was a little more elastic that one in the FOSS manual.)
- ❑ Homework kits for each student: large baggy including (2 balloons, 2 straws, 1 foot piece of string)
- ❑ Homework sheet for balloon experiment for each student.

Class Activities-
Lesson 2 Day 1

TIME	PROCEDURE	CONCEPT
Prep	Gather materials. Assemble homework kit. In each large baggy put 2 balloons, 2 drinking straws, 12" piece of string.	
10 min	Ask students to take out journals. Refresh what students did yesterday;	Cooperative

	they used a variety of weather tools. *What did each instruments measure?* Some of the answers will bring up air. *What did the meteorologist have on his weather map that had to do with air?* They should eventually bring up highs and lows but will not understand what they mean. *Why do you think high and lows are important to a meteorologist?* (Just looking for their answers, not the right one. They are not at this point yet) *Air* plays a very important role in weather. *Ask: Why do you think air plays an important role in weather?* Today we will discover some of the properties of air. Ask Getters to get the materials for their group. One Group is to go outside with weather instruments and gather ongoing weather data in location chosen by class.	learning: open minded willing to listen and learn from others
15 min	Group discussion: Each group is to play with the syringes first apart and then after a few minutes to connect them with the tube. Make observations. Each group is to question why certain things may be happening. As you walk around the room, ask *What ways can you make an observation? Can you feel anything? Can you hear anything? Why is the syringe making that noise? What do you think you are feeling?* When they say air is in there ask them how they know that. *Show me evidence? What would happen if you block one end with your thumb? Did any air escape? Is there the same amount of air?* Students are to record in their journals: *Observations* *Questions* *Drawing of what they saw* Purpose of this investigation is to discover first that air exists (it is made up of stuff and it takes up space) and then also the relationship of air pressure and volume. Visit each group to observe their progress. As you travel around the room, try to suggest to any group that isn't blocking the nozzle to try more things to see if they will try that. Make a mental note of which groups observe the volume of the two tubes when connected. Encourage the students to write down questions. As you walk around the room, when you see a group question something have them write it down. This will help with the whole group discussions.	Observing and inferring

20 min	Whole class discussion of ideas. Each reporter will explain what their group observed. Write this on chart paper. As a group, the students will discuss what happened to the air in the syringe when you pushed and pulled on the plunger. They will also discuss what air can do. Some of the observation will include the concept of compressing the air. Have a student come up and draw this on chart paper. When he/she draws the syringe with air and then compressed, ask the class if he/she should have the same amount of molecules or whatever they call them. *Did some escape? Did the molecules get smaller? Why did you draw the space between the molecules closer together?* This visual drawing will direct more of the questions to pressure and compression. They may not come up with the word pressure, but make sure the concept is there. (Note: in the two classes that I taught, at least one student brought up the word pressure.) If they use the word "squished" have them explain that more. They may come up with the word compressed. After the student draws the compression of air. *Ask: what did you feel when you did this? What do you mean it felt hard? Like a rock?* Keep on this until the group understands the relationship between pressure and volume of air. Bring up what might be familiar to them: Mile High Stadium, scuba diving or climbing Mount Everest. Relate this to the atmosphere. Students will understand that in Mile High Stadium that there is "thin air" or "less oxygen".	Inferring
10 min	*What happens when air is compressed?* Have students answer this question in their journals. Clean up. Getters return materials. Have student record today's weather data gathered earlier from one group and put away journals. Before they do this take a minute or so to ask how people are going to set up their data. Some will talk about their ideas for charting it. Emphasize that this will be for a grade on how detailed and accurately they record their observation. Pass out homework kits. The children are to design their own experiments. From today's lesson they assumed that air took up space and was made of something. They are to prove that air has weight. Ask them: *How we can tell if something has weight? How do we measure weight?* We have used scales and balances before. They should be instructed to be clear in their directions on how they performed their experiment. Remember the peanut butter and jelly direction experiment we did earlier.	

Lesson 2 Day 1 Assessment

Method of assessing: The following will be assessed based their journal entries, observations of cooperative learning, and also their ability to answer the facilitating and formative questions written above in italics.

	Novice	**Competent**	**Expert**
Process Skill	Not able to infer much from the data	Able to infer the basic concepts about air compression and pressure	Shows a great ability to infer many different concepts from the data.
Habit of Mind	Doesn't always listen to other peers.	Will listen to other peers' opinions.	Willing to listen and formulate new ideas.
Concept	Understand that air is in the tube but no relation to pressure or compression. May think air escaped.	Understands that air is matter and can be compressed.	Understands air is matter and can be compressed. Makes connections between volume, pressure and density.

DAY 2

*__Note:__ This is a two day lesson. The students will share how they did their experiments with the balloons. We will discuss how we proved that air had weight and what variables should have been addressed. Only a few students will have balanced the two balloons before either popping or filling one. Maybe have them infer what would happen if we used 2 plastic bags. If time remains in the day have them try this. Why did the balloon react differently? We will also as a class create a poster of the 5 layers of the atmosphere. Bring up the Mile High Stadium or scuba diving again. What happens the further we go out in the atmosphere? They will infer from what they learned the first part of this lesson that that the troposphere will have dense air and the exosphere has thin air. It is like the blankets on a bed. Which blanket gets squished the most? We will also discuss other properties of the other layers, where the ozone layer is found, where weather occurs, and where we would find shooting stars, the space station and shuttle.

EXPLORING AIR WITH A SYRINGE

Observations:_____
_____
_____
_____
_____
_____
_____
_____

Questions:_____
_____
_____
_____
_____
_____
_____
_____

Draw what you see:

Name_____ Homework

AIR INVESTIGATION

1. What do you want to find out?
Does air have weight?

2. What materials will you use?

3. How will you do this? Describe and Draw.

4. What did you observe?

5. What did you find out?

Lesson 3

Relationship of this Lesson to the unit: This is the third lesson of this unit. This lesson will introduce the students to seasons and how seasons affect our weather.

Massachusetts Frameworks Strand and Learning Standard:
Strand: Earth and Space Science 3-5
Learning Standard 14- Recognize that the earth revolves around the sun in a year's time and that the earth rotates on its axis once approximately every 24 hours. Make connections between the rotation of the earth and day/night, and the apparent movement of the sun, moon, and stars across the sky.
Strand: Earth and Space Science 6-8
Learning Standard 11- Explain how the tilt of the earth and its revolution around the sun result in an uneven heating of the earth, which in turn causes the seasons.

Concepts:
- Day 1: The Earth's axis of rotation tilts at an angle of 23.5º. Day 2: The Sun strikes the surface of Earth at an angle. Homework: Beam spreading is the increase in an area covered by a beam of light as the solar angle increases.

Processes:
- Day 1- modeling Day 2- measuring

Science Habit of Mind:
- Be curious.

Other Subject Area Objectives:
- Day 1: Math: angles Homework: graphing Day 2: Social Studies- maps, latitude, longitude Math- measuring

Session Length: two- 50 minute classes

Materials Needed: for 1st day of this lesson
For entire class
- ❑ 4 globes
- ❑ One lamp with light bulb
- ❑ Colorful sticky dots
- ❑ Copies of sunrise/sunset times- one per student (see attached)
- ❑ Copies of graph paper- one per student (see attached)

Class Activities-
Lesson 3 Day 1

TIME	PROCEDURE	CONCEPT
Prep	Gather materials. Make 40 copies of homework graphing sunlight. May want to spread desks apart. The whole group activity needs space to move around the room.	
5 min	Ask students to take out journals. *What did we investigate in the last few*	

	days? We talked about air. Is the air temperature different in the summer and winter? Is the weather different during the different seasons? Why? Seasons play a very important role in weather. *Why do we have seasons?* Begin discussion about seasons and ask class *What ideas do you have to explain why daylight hours change over a year?* Some students will have more understanding of this but many will have misconceptions about this. One Group is to go outside with weather instruments and gather ongoing weather data.	observing
15 min	Whole Group: This time we will be starting with a whole group activity, because we will be using the entire room for our model. In the opening of class they said understood the sun played a part in the change of seasons. *Since we can bring the sun into our classroom what other forms of light can we use? What could we use for the earth?* Ask the student how we might set up a model of the Sun-Earth system. Have globe and lamp on hand. Set up model in center of the room. Keep a record on chart paper of the following vocabulary that the children will come up with as they explain what they know about the Sun-Earth system: revolve, rotation, axis, more difficult ideas may include North Star, equinox, solstices etc. They may not come up with all. That's OK! Address some of these questions: *How long does it take for Earth to make one revolution around the Sun? How do you know this?* *How long does it take for Earth to rotate on its axis? How do you know this?* *How do we know where it is day and where it is night on the globe?* *How much of the globe is in daylight at any given time?* If they bring up revolutions ask them to expand what they know about it. If they bring up rotations explain how that is different from revolutions.	modeling Cooperative learning
20 min	Investigate hours of daylight: Have the students use the model to investigate the question. *Why do hours of daylight differ depending on time of year and location on Earth? How do you think we could show this on our model?* Use colored sticker dots to mark our location on the globe. The student will figure out how they will do this. They could use multiple globes or travel around the room with one globe. Have students do the traveling and rotating. Have the students be in charge today of writing discoveries on the chart paper. It will keep as many students involved. Have them stop occasionally and address the following questions: *Which region of Earth is getting the greatest number of hours of daylight now? How do you know this?* *Which is experiencing the most hours of darkness? How do you know this?* *When Earth is at this point in its revolution, what season is it in the Northern Hemisphere? At this point what season is it in the Southern Hemisphere? Where in the room will be the next season? Which one do you think it will be?* ***At this point check the time. Figuring out seasons may take up the***	Modeling Cooperative learning

	entire time. If so do not start the rest and add another day to the lesson. This is just a plan and I have never done this activity. Investigate Equinox and Solstices: Have student take a second trip around the room. Use different colored stickers to find out where a person may experience more sunlight. Hopefully they will also take some of their own experiences to answer the questions. Ask: *Is there a part of Earth that experiences only daylight or only darkness? How could we figure this out?* *Is there ever a time when the day and night are equal everywhere on Earth? How do we know this? How many times does this happen during a revolution?* Try it. *Why?* *When is the longest day on the year in the Northern Hemisphere and which way is the North Pole tilted? How do we know this?* Pose a question to the class. *What would happen to our seasons if the Earth was not tilted on its axis? How do you know this?* Some students will need this done. Some students will want to know what will happen if the Earth was tilted more.	
10 min	Clean up. *Why do we have seasons on the Earth?* Have students answer this question in their journals. Have student record today's weather data gathered earlier from one group and put away journals. One the second trip we were asking about what the longest day of the year was. Sometime it is important to back our predictions up with more evidence. Pass out homework. The students will be graphing hours of sunlight.	Recording data Math

Lesson 3 Day 1 Assessment

Method of assessing: The following will be assessed based their journal entries, observation on participation in Sun/Earth group model, and also their ability to answer the facilitating and formative questions written above in italics.

	Novice	**Competent**	**Expert**
Process Skill	Not able to make connection between model and sun/earth	Able to make connection between model and sun/earth	Able to make connections between model and sun/earth, with seasons and tilt.
Habit of Mind	Not as curious. Usually being led by others.	Curious about this natural phenomena	Curious and showed interest in trying additional models

Concept	Not a firm grasp of concepts. Understands rotation and beginning understanding of others	Understand rotation, revolution, tilt and seasons.	Firm understanding of concepts of seasons, equinoxes, solar angle and differences of angles in the world.

Materials Needed: for 2nd day of this lesson

Each group of four

- ❑ flashlight
- ❑ meter sticks
- ❑ piece of paper

For entire class

- ❑ Overhead projector
- ❑ 9 x 13 cardboard with small 1- 1 ½ " circle cut out
- ❑ Globe
- ❑ Copies of Beam spreading worksheets- one per student (see attached)

Class Activities-
Lesson 3 Day 2

TIME	PROCEDURE	CONCEPT
Prep	Gather materials. **Use checklist to observe science skills.**	
5 min	Ask students to take out journals. *What did we discover yesterday?* They should refer to the chart paper. They made a model to observe the Earth's rotation= day and night, Tilt on axis= seasons and length of day. Ask, *What happens in the summer to produce more heat?* Write down their beginning ideas on chart paper of why this is so. Ask Getters to get the materials for their group. One Group is to go outside with weather instruments and gather ongoing weather data.	
20 min	Group work: *When we studied the water cycle, what form of energy made water evaporate?* The sun. Light is a form of energy. *Since we can't bring the sun into our classroom what other forms of light can we use?* Yesterday they came up with a few suggestions. *What form of light will look like a sun's ray?* Today we will be using flashlight as sun as our form of energy. *We want to shine the flashlight and compare the amounts of light on a piece of paper. Does anyone have any suggestions how we could do this? Does it matter how far we shine it?* Have two students come up and shine the flashlights from different distances. *Does anyone have a suggestion how we can make sure each group shines it from the same distance?* As group to attach meter stick to flashlight and shine the beam onto paper on the floor (trace shapes on paper). *What did we want to figure out?* From yesterday's class we talked about angles. *How do we show different angles?* The students should shine the flashlight straight	Cooperative learning math measuring

	down and at different angles but keeping the flashlight at the same distance from the floor. Stop class if noticing that they are not doing this and ask the groups that are, how they are using controls. *What did we talk about earlier when the two students came up to the room with flashlights? Why should we keep the flashlight at the same height?* Some may be able to connect this with the sun. The groups that didn't keep the height the same, we would like to see how their data is different. They should make careful observations or drawings of this experiment in their journals. They will need to use this for the homework tonight.	
20 min	Whole class discussion of ideas. *Does each shape that is traced have the same amount of energy?* Discuss that the amount of energy is the same. *Did the power of the flashlight change? What then is different about the shapes? S*ee if some students can come up with the concept that the amount of energy is spread out more area. They may not come up with that the density of the rays differs, but may have the concept. They should all understand that the area of the energy is different. Have them draw upon their knowledge of air density to discover this. (The classes that I taught did mention density of the air syringe experiment) Use transparency from the FOSS manual showing angles of rays 15º and 90º. As a whole class use overhead to project light through the hole in the cardboard, onto the globe as model of earth. Ask student to come up and show how the beams would shine on Earth at sunrise, sunset etc. *Where on the Earth is the beams most intense? Are the solar rays that are coming in at angles like the flashlight did?* See if the students can get this first if not ask some facilitating questions like: *If not what is creating the angles? If they think the rays are coming at an angle then ask, why they think this?* The surface of the Earth is at different angles. Again remind students to take careful notes in their journals. They will need this for their homework tonight.	Math- angles and area Social studies- globe, latitude
5 min	Clean up. Getters return materials. Have student record today's weather data gathered earlier from one group and put away journals. Assign beam spreading sheet as homework (see attached). Have student take home their science journals with notes from this investigation.	

Lesson 3 Day 2 Assessment

Method of assessing: The following will be assessed based observations during the group activity this is being done by a check list, their responses to the beam spreading homework sheet, and also their ability to answer the facilitating and formative questions written above in italics.

	Novice	**Competent**	**Expert**
Process Skill	Measures with help from other students	Makes careful measurements	Uses controls in measurement of angles.
Habit of Mind	Not curious. Led by others.	Shows curiosity	Shows curiosity and desire to try additional ideas.
Concept	Difficulty making connections between area of light and angle of the beam.	Understands beam spreading, that area increases as the angle increases.	Makes connections with the density of light.

After day 1 of lesson

Homework
Name_____

Sunrise/Sunset times for 2005 in Norwell, MA

Date	Sunrise (a.m.)	Sunset (p.m.)
January 21	7:05	4:44
February 21	6:30	5:24
March 21	5:44	5:57
April 21	5:53	7:32
May 21	5:16	8:04
June 21	5:07	8:23
July 21	5:25	8:13
August 21	5:57	7:35
September 21	6:29	6:42
October 21	7:03	5:52
November 21	6:42	4:17
December 21	7:09	4:15

Sunrise/Sunset Graph

Use on day 2

Homework
Name _____

Beam Spreading

1. How do you explain the different shapes of the light spots?

2. When is the area of the spot largest?

3. Which spot delivers the greatest amount of energy to the floor?

4. If you put a penny in each light spot, explain which one will receive the most energy.

5. What influence does solar angle have on the heating of Earth?

Lesson 4

Relationship of this Lesson to the unit: This is the fourth lesson of this unit. We have just talked about the sun. This lesson will build upon their knowledge of solar heating to understand heat transfer.

Massachusetts Frameworks Strand and Learning Standard:
Strand: Earth and Space Science 3-5
Learning Standard 9- Differentiate between weather and climate.
Strand: Earth and Space Science 6-8
Learning Standard 4- Explain the relationship among the energy provided by the sun, the global patterns of atmospheric movement, and the temperature differences among water, land, and atmosphere.

Concepts:
- Day 1: The Sun is the major source of energy that heats the atmosphere. Thermometers measure temperature of materials (This concept is a review concept. They used thermometers in a prior benchmark lesson). Day 2: Energy moves from one material to another by radiation and conduction.

Processes:
- Day 1: Measuring Day 2: interpreting data

Science Habit of Mind:
- Keep records of their investigations and observations.

Other Subject Area Objectives:
- Day 1 homework- Language art: Writing thoughtful paragraph Day 2- Math: graphing

Session Length: two- 50 minute classes

Materials Needed: (Per group of 4) for first part of lesson

- ❑ 4 Containers (about ¼ liter)
- ❑ 4 thermometers
- ❑ Sheet of newspaper
- ❑ Watch or stopwatch
- ❑ Sand- in a shallow basin
- ❑ Soil- in a shallow basin
- ❑ Water pitcher
- ❑ 100 ml beaker
- ❑ Heating lamp with clamp
- ❑ Each student is to receive a chart to record data

- **A temperature probe could be used in this investigation. Please note that if you did use a temperature probe the process skills and science habit of mind would have to be changed. In this lesson I was interested in having the student keep careful records during each time interval and gain experience using a thermometer**.

Class Activities-
Lesson 4 Day 1

TIME	PROCEDURE	CONCEPT
Prep	Gather materials. If soil is not dry, spread it out on newspaper and let it dry for a day or two. **Use check list for investigation to observe science skills.**	
12 min	Ask students to take out journals. *Can anyone refresh what we learned about the sun in the last few days? Why do you think the sun affects our weather? What does sun make?* Heat is an element of weather. *When is the warmest and coolest part of the day? What happens when you walk barefoot at the beach in the summer? What about on a black top? What do you do when your feet get hot? Does anybody jump to the white lines like I do? Why? What can you say about the different materials? Do any of them get more energy than the other? or Do they all get the same?* Remember the last lesson. *Do you think that this can affect weather?* The student are going to come up with a way to investigate what happens to different earth materials (water, soil, rock, air) when the Sun shines on them. Have them to decide what kinds of materials they would like to investigate (some classes might think that they would like to investigate metal etc but ask what material would best affect weather. *What kind of heat source could we use for the sun?* Have lamps ready. We have discussed controls before. *What kind of controls do we need so that we can compare data?* Write their suggestions on chart paper. Ask Getters to get the materials for their group. One Group is to go outside with weather instruments and gather ongoing weather data.	Cooperative learning controls
35 min	Group work: Students will put different earth materials in containers. Each material will be heated by the lamp. Remind them of the controls discussed (hopefully they will choose same amount of material, same amount of heat i.e. distance). When traveling around the room, see if they are using controls. Hopefully one student will want the each group to use the same amount of material, hold lamp at the same height etc. We want to heat up the materials for 15 minutes and then turn the light off and let them cool for 15 minutes. This is the only information I'll give so that we can fit it in our class time slot. *Do you think we should only get a beginning reading and an ending reading? Then how often should we take readings?* Let each group decide at what intervals they will measure their materials. Have them observe as a group what is happening with the data. Circle the room to see that they are reading the thermometers correctly and that they are all actively participating, maybe each person is responsible for the temperature readings for a particular material.	Measuring Time/space Record keeping
3 min	Clean up quickly. Getters return materials. Have student record today's weather data gathered earlier from one group and put away journals. Homework: Have students write what they observed in today's investigation and answer: *What is the importance of the Sun in this*	Language Arts (paragraph form writing intro,

	experiment? This is to be done in a thoughtful paragraph. This will get them thinking for tomorrow's discussion.	facts, closing)

Lesson 4 Day 1 Assessment

Method of assessing: The following will be assessed based their journal entries/record keeping, checklist observations on measurement, their response to the homework and also their ability to answer the facilitating and formative questions written above in italics.

	Novice	**Competent**	**Expert**
Process Skill	Not able to read thermometer. No use of controls in measuring materials.	Careful measurement of temperature and materials.	Careful with measuring of materials, height of light and temperature readings. Use of controls.
Habit of Mind	Not all data recorded, missed temperature readings.	All data recorded at intervals.	Organized chart with data clearly presented.
Concept	Not making the connections between the experiment and the sun/earth materials	Sun heats up the earth material that can be measured with a thermometer.	Understanding that different materials heat at different rates.

***Note: This is a two day lesson. The next day does not have any activity it will be spent analyzing the data and graphing. We may need a third day if the students need to redo their experiment for better controls before we analyze the data.**

Materials Needed: Per student

- ❑ Copies of graph paper.
- ❑ Copies of Earth Material Temperature Questions

Class Activities-
Lesson 4 Day 2

TIME	PROCEDURE	CONCEPT
Prep	40 copies graph paper. 40 copies of Earth Materials Temperature Questions.	

15 min	Ask students to take out journals. *What are some observations you noted about how each material reacted to the sun/heat*? Each reporter will explain what their group observed. The students will discuss what happened to the temperature for each of the materials as they warmed and cooled. This was part of the homework last night. This is where we will know if an additional day will be needed to redo the experiment. If data is inconsistent we then need to discuss why that happened. *What variables may have come into play during the experiment? Did we all use the same amount of materials? Did all materials receive the same amount of energy? Where did we all place our thermometers? Did we all know how to read the thermometers?* We observed that different earth materials heated up and cooled differently. *What is a good way to analyze data? Ask what they have been learning in math class?* Have student get data from yesterday and pass out questions and graph paper. One Group is to go outside with weather instruments and gather ongoing weather data. Whole class discussion: Go over how we can enter data. *Why did I have a column temperature change Why would we want to find out temperature change not actual temperature? You have learned about many different graphing techniques, what would be the best for this investigation?* Have students decide how to set up the graph. We use graphs to help interpret data. *Why do we use graphs?* It helps people visualize the data better. A benchmark lesson on graphing has already been done in math class and science class. They should know about setting up the x and y coordinates but I have left them blank for them to figure out. They should know understand that pie charts or bar graphs may not be the best solution. A line graph works best. *After they have work through other suggests ask, why a line graph works best?*	Math-graphing
20 min	Group work. Before you send the class to group work. Make sure they understand temperature change is from the starting temperature each time. In groups have students work on the temperature change chart and graphing their group's results. In addition have the group answer the Earth Material Temperature Questions (see attached). Circle the room. Ask students: *Why am I having you use temperature change not actual temperature?* *Why do you think that the water took longer to heat up?* *Do you think that the water will ever get to the temperature of the air?* *What are some of you reasons for why you materials heated up as they did?* *Did this confirm what you thought would happen or did you discover something new?* *What properties of air and water do you think explains why they reacted this way?*	Cooperative learning

10 min	Whole class discussion of ideas. Compare graphs. Discuss questions. Students will probably have a number of ideas to explain the last question. The students should have noticed that the temperature of the water increased the least and went down the slowest. Water has an important property. It takes more heat energy to raise an amount of water one degree than it takes to raise the temperature of an equal amount of sand or soil. *How do ocean temperatures affect our weather?* Water also affects our climate. This will be expanded on in a later lesson. See what kind of definition the students will come up with for climate. If they don't have any ideas then don't go any further. *What evidence do you know that water affects our climate? How is weather different from climate?* This is a great way to introduce the difference between climate and weather. Also have the class discuss what they know about how the climate of certain areas of our earth.	Interpreting data
5 min	Clean up. Have student record today's weather data gathered earlier from one group and put away journals. Students will finish answering any questions not covered in class. In journals have students respond to: *Reflect on what you could have done differently in this experiment to get better results on your data and graphs?* This is to be done in a thoughtful paragraph. Students may use text or internet to gather information.	

Lesson 4 Day 2 Assessment

Method of assessing: The following will be assessed based their final graphs, their response to the homework reflection in journal, answers to Earth Material Questions and also their ability to answer the facilitating and formative questions written above in italics.

	Novice	**Competent**	**Expert**
Process Skill	Able to plot some data. Not able to interpret which materials absorb most energy.	Able to interpret from data and graphs which materials absorb most energy.	In addition able to interpret rate of how quickly/slowly materials lost heat.
Habit of Mind	No understanding that good recordkeeping leads to good results	Understanding that good recordkeeping leads to good results.	In addition that clear and organized data can be understood by all.
Concept	No clear understanding that transfer of heat to earth materials	Understanding that different materials absorb heat at different rates.	Understanding that materials absorb heat affects climate

Earth-Material Temperature Chart

Time 3 min intervals	Sand Temperature	Sand Temp change	Soil Temperature	Soil Temp change	Water Temperature	Water Temp change	Air Temperature	Air Temp change

Earth-Material Temperature Graph

Earth-Material Temperature Questions

1. Which material heated up the most in 15 minutes?

2. Which material heated up the least in 15 minutes?

3. Which material cooled off the fastest?

4. Which material cooled off the slowest?

5. Did all four materials receive the same amount of solar energy? Support your answer.

6. Which properties of the earth materials do you think may have caused the temperature differences?

Lesson 5

Relationship of this Lesson to the unit: This is the fifth lesson of this unit. This lesson will investigate wind and air pressure. The students already have investigated the relationship between air pressure and volume in a prior lesson. They have been taking weather observations on wind. This will begin to pull the picture together.

Massachusetts Frameworks Strand and Learning Standard:
Strand: Earth and Space Science 3-5
Learning Standard 8- Describe how global patterns such as the jet stream and water currents influence local weather in measurable terms such as temperature, wind direction and speed, and precipitation.
Earth and Space Science 6-8
Learning Standard 4-Explain the relationship among the energy provided by the sun, the global patterns of atmospheric movement, and the temperature differences among water, land and atmosphere.

Concepts:
- Day 1: Differential heating of Earth's surface by the Sun can create high and low pressure areas.
- Homework and Day 2: Wind is a movement of air from an area of high pressure to and area of low pressure.

Processes:
- observing

Science Habit of Mind:
- open-minded

Other Subject Area Objectives:
- social studies- geography

Session Length: Two- 50 minute classes.

Materials Needed: for class (distribute to 3 station see directions below)
- ❑ water
- ❑ 8 thermometers
- ❑ muslin
- ❑ rubber bands
- ❑ 10 large balloons
- ❑ Flexible measuring tape, if not string and meter stick
- ❑ Ice in a large container
- ❑ Four clear plastic bottles with medium sized necks
- ❑ two piece of poster board 10cm x 10cm
- ❑ Supply of hot and cold water
- ❑ Food coloring: red and blue
- ❑ Instructions for each station- see below
- ❑ Station investigation observation sheet 20 (one for each student) per station
- ❑ Copies of homework sheet- one per student (see attached)

Class Activities
Lesson 5 Day 1

TIME	PROCEDURE	CONCEPT
Prep	Gather all materials. Set up stations around the room for each experiment. Since there are five groups set up two of each station. Station 1: water, 2 thermometers, muslin, rubber bands. Station 2: balloons, measuring tape, ice in container, 2 thermometers. Station 3: two clear plastic bottles, poster board, hot and cold water, food coloring.	
10 min	Ask students to take out journals. *What are some of the aspects of weather that we are measuring each week?* Write list on the chart paper. *We did an air pressure experiment earlier in the unit. Can anyone tell me what we learned?* They can refer to the chart paper. *What do you think would happen if the air inside the syringe was cooled? How do you think we could do this experiment?* *What else do we know about cold air? How about warm air? Do you think the same things would happen to warm and cold water?* Maybe they will refer to swimming in the ocean. *How do you think we could set up an experiment to show what happens when hot and cold air/water merge?* Talk about getting wet on a breezy summer day. What do we feel? Today we will be visiting three stations to observe wind, temperature and air pressure. One Group is to go outside with weather instruments and gather ongoing weather data. All other groups will start at one station and make careful observations about what they are seeing. As in first investigation they will also write down any question (see attached investigation sheets)	observing
35 min	Station1: Instructions: First wet one hand with water and then blow air one the hand. Make observations as to how it feels. Decide how you will use the materials to see if wind has an effect on energy transfer and temperature. We investigated evaporation in our water cycle unit. They are to create some kind of wind on one thermometer. *Ask students why they are setting their experiment up that way? How did you hand feel? Why do you think it felt cooler? Was it because the water was cooler? Did the wind play any part in it?* Ideally they will record the temperatures of both thermometers and then attach a piece of muslin to each thermometer end. They are to dampen one thermometer. They will have to figure out how to increase the evaporation (blowing or waving). Take turns waving. After a few minutes take final temperature. Record observations. Some groups will do it differently Station 2: Instructions: With the materials on table, design an experiment to see if temperature has an effect on pressure and volume. *Ask groups why did you decide to set up their experiment that way? What*	Cooperative learning observing Measuring

	are your predictions? Thinking back on the syringe is their anything you can say about temperature and size/volume of the balloon? Not all students may then be able to make the connection to pressure and temperature. Ideally they will blow up two balloon the same size and tie them shut. Measure the circumference around the balloon. Use controls as to where each balloon was measured. Put one balloon in ice container with a thermometer; keep the other at room temperature. After a certain time period, re-measure both balloons. Record observations. Some groups will do it differently Station 3: Instructions: With material given, design an experiment to see what happens to the hot and cold water when layered. *What happens to the heat in your house? How do you think you should set this experiment up? What are you seeing when the colors mix? Why did you choose that water temperature as the one on top?* Ideally they will fill one 500ml bottle with cold water add blue food coloring, stir water. Fill the other bottle with hot water and add red food coloring, stir water. Place a piece of poster board on top of the cold water bottle. Hold the bottle over the sink or large pan. Hold the card tightly to the neck of the bottle and quickly invert it over the hot water bottle. Put bottle together at necks and make sure they match exactly. While holding the bottles together, have someone in the group quickly pull the poster board card out. Record observations. Some groups may reverse the water with hot on top. *What do you think you are seeing when the two colors merge?* Leave a note to empty water for next group.	Open-minded
5 min	Clean up. Have student record today's weather data gathered earlier from one group and put away journals. Pass out homework: they will be making a model of wind. Student will need to read from text to address some of these questions.	Modeling

Lesson 5 Day 1 Assessment

Method of assessing: The following will be assessed based their observation made on worksheets for all 3 stations, understanding in their wind model and also their ability to answer the facilitating and formative questions written above in italics.

	Novice	**Competent**	**Expert**
Process Skill	Missing some key observations in some or all of stations.	Accurate observations made in all 3 stations	Careful, detailed, organized observations made. Group thought of some nice questions
Habit of Mind	Not willing to accept	Willing to accept new	Willing to listen, accept new

	new ideas.	ideas.	ideas and formulate new hypothesis.
Concept	Beginning to understand pressure and temperature. Couldn't connect all 3 experiments	Understanding of high/low pressure and temperature. Make connections to all 3 experiments	In addition: Able to make connection that barrier in experiment 3 is like a front. Connection with experiment 2 and syringe experiment done earlier

Day 2

***NOTE:** This is a two day lesson. Day 2 of this lesson does not have an activity. *If groups need more time to get to the stations then we can hold off the whole group discussion and continue to work at the stations. Time is built into this.

Whole group discussion: Have reporters from each group share what they observed, questioned or learned from each station. Write these observations on chart paper. Have each reporter compare and explain their group's procedure. Record on the chart paper students' thoughts why we observed temperature change in station 1. We learned that evaporation requires energy. It took energy away and lowered the temperature. Remember when we talked about sunlight. When we had less sunlight the temperature was cooler. Record on chart paper the students' thoughts about the relationship they learned from station 2. We learned that as temperature decreases the volume decreases. Some students may then connect what they learned in air syringe experiment that as temperature decreases the pressure increases. They should understand the reverse of each relationship. Record on chart paper the students' thoughts about the flow of warm and cold water they learned from station 3. They should they connect the flow of water with the flow of warm and cold air.

From the reading last night, the movement of air masses creates wind. They will understand air masses in the next lesson. The students will share their wind models.

We will then read about and discuss local winds. As a group we will complete a sheet about Sea breezes, Land breezes, Valley breezes, and Mountain breezes found in the FOSS manual. If time remains they can build an anemometer using a protractor and ping pong ball or assign for this for homework.

Station Investigations

(Please use one for each station)

How did your group conduct the experiment:_____

_____

_____

_____

_____

_____

_____

_____

Observations:_____

_____

_____

_____

_____

_____

Questions:_____

_____

_____

_____

_____

Draw what you did and saw:

Name_____ Homework

For homework you are to create a wind model/drawing. The model should demonstrate

1. How wind starts.
2. How the Sun is involved.
3. Energy transfer.
4. Differential heating
5. air pressure and density
6. How wind moves across Earth's surface.

Lesson 6

Relationship of this Lesson to the unit: This is the sixth lesson of this unit. It will take at least four days to complete. We will be building on the knowledge of air pressure, wind and heat from the prior lessons. The first day we will investigate air masses and fronts. During the second and third days we will introduce global warming. Each student will decide whether they feel that global warming is real and is affecting our climate and weather or not. The class in two groups will research global warming and on the third day we will conduct an in class debate. Any extra time we will begin our discussion on climate to link with the rest of the unit.

Massachusetts Frameworks Strand and Learning Standard:
Strand: Earth and Space Science 3-5
Learning Standard 9- Differentiate between weather and climate.
Learning Standard 8- Describe how global patterns such as the jet stream and water currents influence local weather in measurable terms such as temperature, wind direction and speed, and precipitation.
Strand: Earth and Space Science 6-8
Learning Standard 4- Explain the relationship among the energy provided by the sun, the global patterns of atmospheric movement, and the temperature differences among water, land and atmosphere.

Concepts:

- Day 1: Air masses are large bodies of air that are uniform in temperature and humidity. Extra Day 1: The boundary between two air masses that meet is called a front. Weather conditions change as a front passes by. Day 2 & 3: Global warming may have an effect on Earth's weather. (Climate is a beginning concept and will be elaborated on in a later lesson some may link climate with global warming)

Processes:

- Day 1+: inferring Days 2 &3: communicating

Science Habit of Mind:

- Day 1+: cooperative learning. Day 2 & 3: Open-minded is needed for debating

Other Subject Area Objectives:

- Social Studies: geography, debate structure Language Arts: debating

Session Length: at least four- 50 minute classes

Materials Needed: for class

- ❑ Day 1: solar hot-air balloon (or inexpensive black trash bags & glue)
- ❑ Fishing line
- ❑ 2 thermometers
- ❑ Transparency on Fronts
- ❑ Days 3 & 4: 40 handouts on informal debate structure
- ❑ Stop watch

Class Activities-
Lesson 6 Day 1

- **Note *: a Sunny day is need for this activity. Have a filler day ready just in case.**

TIME	PROCEDURE	CONCEPT
Prep	If you don't have a solar hot-air balloon you need to make one. Cut and glue two thin, inexpensive black trash bags together. A solar hot-air balloon is about 9' long. Another possible option is to make a control bag out of white or clear plastic.	
5 min	Ask students to take out journals. *Why do we get rain? Do you think it has anything to do with the temperature of air? Has anybody seen this symbol on a weather map?* Show a front. *What does it mean?* Refresh what the students have learned in the past few weeks about weather. Cold air is denser and warm air is less dense. We learned how different earth materials absorb energy. *What do we know about areas of air or fronts (only if they come up with this)?* The vocabulary they may use can include air mass, stagnant air, warm fronts and cold fronts. Write these on the board, we can add to or correct them at a later time. *Why do you think areas of hot or cold air occur?* One Group is to go outside with weather instruments and gather ongoing weather data. This group will stay outside today. We will meet them out there.	Inferring
15 min	Whole class: Explain behavior expected of students when we go outside. Ask a few volunteers to make observations about the bag. They will note it is black and maybe its size or thickness. *Why will we be using a black bag? What happens when you walk on the blacktop in a parking lot?* Hopefully they will connect this with the investigation on earth's materials with the black soil. *What other experiment did we do that used a black material?* The class may want to use a different color bag too. See if they infer what will happen in the sun; heat the air inside a bag. *We did another experiment with hot and cold water, recalling that, what do you think will happen to the bag?* Have them design this experiment. They should use thermometers have them ready but they may not ask for them and just assume that it heats up. If this happens at the end of the lesson ask why they assumed it heated up. *Where is the evidence?* They should want to put the bag in sunlight and then in shade. *Where do we need to put the bag?* What should happen is that the bag should begin to float as the air inside the balloon warms. *How do we know it has heated up? Now where should we move the bag?* After it cools ask, *How do we know it has cooled down?* They may also wish to observe what happens to air in a clear of white bag. Have this ready just in case but don't bring it out if they don't inquire about it.	Cooperative learning observing controls

25 min + *there is a lot to discuss in this section. It will probably take two days to finish a good discussion.	Back inside the classroom have students discuss that there could be cold and warm air masses. *What can we say about the air in the black bag?* See if they can come up with the term on air mass. An air mass is a body of air with the same temperature and humidity. *Do air masses stay in one place forever? What moves the air mass?* Remember the lesson on winds, the difference in air pressure moves the mass. Discuss the meeting of two air masses: fronts. *Did anyone do the hot and cold water experiment with the hot on top? What did we see? What do the meteorologists talk about during the weather reports when approaching storms are coming?* See if you can get the students to come up with front. Show the symbol for a front again. The boundary we saw in the colors is a model of a front. **Show the transparency of Fronts from FOSS manual.** **Show weather map from FOSS manual.** *** See "extended day 1 note" at end of this lesson. With an extra day we can incorporate a software simulation into the lesson.** Pose questions: *When a cold air mass overtakes a warm air mass, what do you think happens to the warm air?* *What kind of front is formed?* *Suppose the warm air mass formed over the Gulf of Mexico. What kind of air mass would it be?* *If the cold air mass formed over Canada, what kind of air mass would it be?* For the last two questions think about the weather map. What kind of temperature air masses would come from these places? *Which air mass do you think would have the highest humidity?* *What might happen to the water vapor in the warm air mass as it is lifted over the cold air mass?* *What happens to warm air as it rises?* *What happens when the air temperature and dew point are the same?* *What type of weather can result from condensation?* Have them take out their weather observations for their community for the last few weeks. Ask them if they observed any patterns in temperature or air pressure and the weather they observed.	Inferring Cooperative learning
5 min	Clean up. *What is an air mass?* Have students answer this question in their journals as homework. Have student record today's weather data gathered earlier from one group and put away journals. Additional homework will include assigned reading on air masses and fronts and also to complete attached homework sheet.	

Extended Day 1:

- ***Because there is a lot to discuss and absorb in this discussion. An additional day will most likely be needed. Continue discussions. Use transparencies of Fronts and Weather Map from FOSS Manual. If we do make a second day then use the extra time to have students work on the computers on a weather map simulation from*** www.explorelearning.com. ***This is a simulation that allows students to manipulate fronts.***

Lesson 6 Day 1 and Extended Day 1 Assessment

Method of assessing: The following will be assessed based observation of their behavior outdoors, journal entries/record keeping, journal responses and also their ability to answer the facilitating and formative questions written above in italics.

	Novice	**Competent**	**Expert**
Process Skill	Not able to infer what will happen to the warming air.	Able to infer from outdoor experience that warm air rises and the balloon acts like a front.	Able to connect from prior lessons and infer what will happen with a warm air mass. Understands needs for controls and white balloon.
Habit of Mind	Poor outdoor behavior	Able to work well in group. Meets expected outdoor behavior	Shows ability to lead and follow. Helps others as needed. Meets expected behavior outdoors.
Concept	Makes no connections between air mass and solar balloon.	Show an understanding of what an air mass is.	Able to connect knowledge of warm and cold air masses, solar balloons and understanding of weather fronts.

Name_____ HOMEWORK

One of your class mates asked at the end of the water cycle unit. *If January 2005 is the snowiest month on record, how can we say we have global warming?* The class decided that one of the effects of global warming was that as the Earth's temperature increases the glaciers would begin to melt and the level of the oceans would rise causing flooding.

You are to simulate this at home for your homework. Please put as many ice cubes as you would like in a bowl. Fill the bowl with water up to the top. Observe the level of the water as the ice cubes melt. Make conclusions about this investigation. Why do you think this happened? Does the amount of ice cubes matter?

Class Activities-
Lesson 6 Days 2 and 3

TIME	PROCEDURE	CONCEPT
Prep	Make 40 copies of *An Informal Debate Structure.* Gather books, statistics, and other resources about global warming. Move desks; position half the desks or tables on one side of the room and half on the other side. This will be kept this way for two days.	
5 min	Ask students to take out journals *Have any of you ever seen or been involved in a debate?* (Hopefully a few may have seen a Presidential debate or have participated in one during another class) Have student brainstorm in general what happens during a debate. Write this on a chart paper. One Group is to go outside with weather instruments and gather ongoing weather data.	Social studies-debate
15 min	Whole Group: *How do fronts create a snowstorm? How about a thunderstorm?* A couple of students inquired about global warming. They asked, if January 2005 was the snowiest month on record, do we still have global warming? Discuss last night homework. *What did they learn from their misconception of global warming?* They should have discovered that the water level didn't rise. *Why do you think this happened?* . Ask: *What have we heard that causes global warming and what are some of the effects? Ask the students how they feel about global warming being a real issue.* Divide class up according to their beliefs. This is a great time to use the ideas in the Feb. 2005, Science Scope article that I reviewed. Go over handout *An Informal Debate Structure.* At this point, have student record today's weather data gathered earlier from one group. Homework will be to work on their arguments for the debate.	Open minded research
30 min	For the rest of the class students will research on internet, use any resource books in class and evaluate statistics on global warming. Students will prepare their roles for the debate and work on arguments. If you see the students only working on their arguments, ask them: *How do you do well in a debate? Do you have to understand the opponent's point of view? Will you have to anticipate what their arguments will be? Do you think you will need to research their side too? What are some of the aspects of global warming do your opponents see as important?* **During the last five minutes of class if you feel that students need another day preparing for debate allow the time for it.	communicating

DAY 3 50 min	Have students take their seats. Have students follow procedure for the debate. See attached sheet. Homework: Have them make reflections about how they thought the debate went and if their position changed after they acquired more knowledge on the subject.	Social studies Language arts communicating

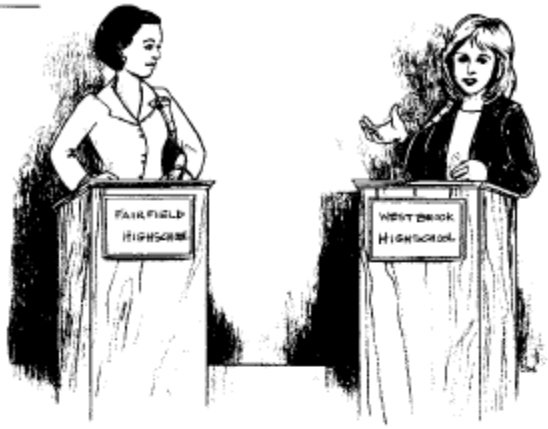
Lesson 6 Days 2&3 Assessment

Method of assessing: The following will be assessed based performance, behavior and input during debate, self assessment of debate as homework, and also their ability to answer the facilitating and formative questions written above in italics.

	Novice	**Competent**	**Expert**
Process Skill	Unable to communicate knowledge of global warming during debate.	Able to communicate important facts of their side of the global warming issue.	Communicates excellent knowledge detailed and accurate.
Habit of Mind	Not willing to listed to others viewpoints	Listens to both view points	Listens to all view points and willing to change according to facts.
Concept	Does not possess a full understanding of global warming	Understood most important issues of global warming.	Understood the concepts of global warming and its causes. Shows desire to change environment.

(Data Sheet 23-2)

Name _____



AN INFORMAL DEBATE STRUCTURE

A debate involves taking sides on an issue, and then presenting your arguments for or against that issue. A statement of that issue is called a *Proposition.*

The people who support the proposition are called the *Affirmative Team.* They agree with the statement. Those who disagree with it are called the *Negative Team.*

While formal debates follow a strict format, informal debates have various structures. Following is an example of a format for an informal debate. Each statement is usually given by a different team member.

Opening Statement by Affirmative Team—3 minutes.
Opening Statement by Negative Team—3 minutes.

(3 minutes allotted for teams to prepare rebuttals.)

Rebuttal by Affirmative Team—2 minutes.
Rebuttal by Negative Team—2 minutes.

Second Affirmative Statement—3 minutes.
Second Negative Statement—3 minutes.

(3 minutes allotted for teams to prepare rebuttals and closing statements.)

Rebuttal and Closing by Affirmative Team—2 minutes.
Rebuttal and Closing by Negative Team—2 minutes.

Note: An *opening statement* introduces a team's position and offers important evidence.
A *rebuttal* is a team's response to its opponent's arguments.
A *second statement* is a team's chance to expand upon their ideas and evidence.

REST OF THE UNIT

Time frame: At least another week

The students will understand that climate is the average weather conditions over a long period of time in a region. Students will view video from FOSS kit *Wonders of Weather* a class. Discuss the differences between weather and climate. Discuss possible climates around the world. Display climate map. Assign each group to one area, and then have them research weather and climate factors for their region. They might want to check what severe weather impacts this climate region. Finally, have each group share with the whole class their findings. *** If time allows use the weather map simulation or greenhouse simulation from *www.explorelearning.com*.**

We will go over all the weather data collected for the past 3 weeks and make comparisons between some of the observations. Some students will discover correlations between precipitation and cloud cover. They will understand that in science, weather in not predictable and this may not have happened in the 3-4 weeks the weather was observed. This is where the students will understand the need for their accurate, detailed and organize data.

The students will in groups create a weather report for a location of their choice. They have to take their knowledge of that area's climate and weather patterns to give an accurate report. Each group will present their project. If more days are needed in creating project, the schedule will allow for extra days. Students will have extra time to use the website simulations. The students will also make their final concept map. I will hand them back the original after they are finished to discover the knowledge they gained.

REFLECTION ON THE DAYS I TAUGHT

After contacting a fifth grade teacher in Norwell, I learned that the class was beginning their unit on weather. We went over some possibilities of lessons with hands on experiments that could fit in to her unit. I was able to teach the first day of Lesson 2 to two science classes. Unfortunately this fell before February vacation and a drug awareness week. A few weeks later, I was able to get in again and teach the first day of Lesson 4 on Friday and follow up on with day 2 the next Monday. Neither fifth grade classes had much exposure to hands on experiments or inquiry learning. They embraced the opportunity to learn each concept with eagerness and excitement. I was not able to tape myself. I would have needed to give them advanced notice for permission to videotape.

Lesson 2:

This lesson introduced air pressure using syringes. The students had already been introduced to the layers of the atmosphere by their teacher. They knew that weather happens in the atmosphere. I divided the class up in groups and gave them brief instructions to manipulate the object (the syringe) and make observations. Both classes worked very well in groups and kept on task. I learned the most during the whole group discussion that followed. I was surprised to find that in fifth grade they were very

comfortable in sharing their ideas. By the end of class they were using science terms to describe what happened instead of words like “thing”. Both classes didn’t seem to have any problems understanding the relationship between volume and pressure. They were able to draw what they thought was happening in the syringe and both classes even brought up the density of the air. Even when I asked the student what he meant by "density", he was able to give the class a pretty good fifth grade answer.

The first class took the ideas of air pressure and started relating it to their experiences in scuba diving or riding on a plane. They wanted to talk about air pressure in your ears and why they pop. They discussed what happens when Alvin explores the Titanic in the deep of the ocean. I then brought up a familiar topic of Mile High Stadium. The first class took a little while to understand that the air was thinner but could finally relate to a hike up Mount Everest.

During the second class, some students immediately started talking about Mt. Everest, where this took 15 minutes of kids questioning each other to get to this in the first class. This class never made any connections to the air pressure in the ocean. This class was exceptional at bouncing their ideas off each other and adding to them. At one point I felt that I wasn’t needed. The teacher commented how well the ideas and conversation was going.

The most important lesson I took away from this was timing. I had planned so much more in the time period. Because of the scheduling we even had an extra 10 minutes per class.

For homework I handed out two balloon, two straws and string. The children were to prove that air had weight. During the class they drew their assumption of what air was made up of. They knew that air was made up of something and took up space. I didn’t realize how excited 5th graders would get over balloons. I was better at giving instructions to the second group, that they should put away the balloons immediately and refrain from playing with them. Unfortunately the second group was a little too eager to get their homework assignment because they had seen the first group packing it up. I learned that I should have had the first group put away their homework kits before the next class came in. Both classes did a great job on how they set up their experiments for homework. I heard comments on how much they all enjoyed their class.

The lesson went so well that the science teacher from the other team borrowed my supplies and handouts so that she could do it for her class.

Lesson 4:
Again I was able to teach both classes. To start the class, I brought up what it was like to go to the beach. What did they feel? They talked about the sand being hot and water colder. They compared the air to the temperature of the water. After asking about walking barefoot on the parking lot, both classes compared the temperature of blacktop verses the white lines. I then introduce that today we were going to pick some of earth’s materials and investigate what happens when the sun shines on them. Both classes wanted to compare soil, sand or rocks, and water. Even thought they brought up air first in the discussion of the beach, I had to prod them to include air.

The experiment didn’t go as I had planned, but the students and their teacher learned a lot from the experience. Both the teacher and I were shocked to see that some of the groups had difficulty in reading a thermometer. About half the first class was reading each line as a degree instead of two. It was nice to know that even if the data didn’t come out as planned the children still gained experience in reading a

thermometer (a valuable science skill). The teacher was thrilled to discover this. A benchmark lesson on reading thermometers is needed before this lesson. The second class was not careful with controls. One group I caught turning the lamp off to make their readings. One boy in another group thought the air was getting too hot and decided to cool the thermometer off in the water. He then realized he made a mistake and started heating up all the earth's materials again. Both classes had spills. Their science classes ran about 60 minutes (because we were using their math timeslot so I could teach back to back) and we had enough time to introduce the experiment and then complete it.

The next day was spent going over the data and discussing what they had learned. The fifth graders didn't have much experience in deciding what the best graph would be. They were used to graphing in their math classes and setting up the data how they were told to do it. I let them decide what the best way to graph the data was. They eliminated the bar graph and other ideas. It took a while to have the children understand how to come up with the temperature change; the difference from each temperature reading to the starting reading not to each other. I had them explain to me why we were using temperature change and not actual temperature.

The discussions for both groups went well. Both groups understood that the air absorbed the energy the fastest and the water was the slowest. An older age group could understand slope of the graphs but this would have been beyond these fifth graders. They don't discuss slope until 7th grade math. Some of their ideas were interesting as to why this was so. I didn't let them know if they were right or wrong. We also compared the data of the groups, that some groups had the soil and sand reacting differently. The groups worked on the discussion questions and graphed their results. A couple of children had to finish graphing for homework. During the whole group discussion that followed, we talked about the properties of water and how water affects out weather and climate. The teacher was interested in this experiment because she was taking the unit study to climate. This lesson can move nicely into climate.

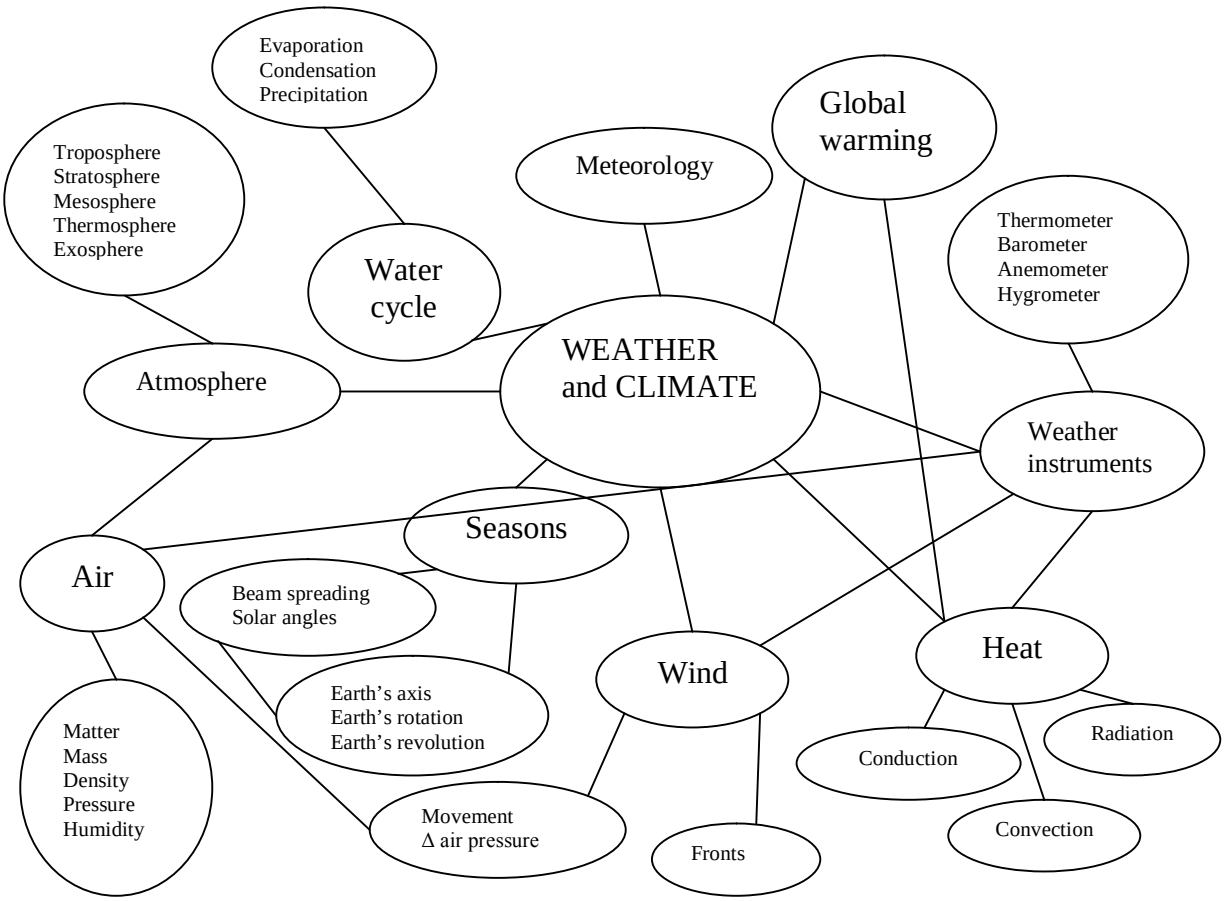
This lesson would have been worth while doing again even if only for the experience in reading a thermometer and graphing.

Again the science teacher from the other team was interested in doing the lessons for her classes.

If I had time:

- If I had extra time in my unit I would definitely consider using a temperature probe in Lesson 4. This way the students could repeat the experiment comparing some materials of their choice. They could compare the difference between salt water and water.
- If I had extra time I would definitely like to take a field trip to a television station. To often the children had a meteorologist come to their school. I would rather take them there. I think they would love to see how the graphics are made, stand in front of the blue screen, see all the equipment or computer models that he meteorologist use to predict the weather.

Concept Map


Evaporation
Condensation
Precipitation
Global warming
Troposphere
Stratosphere
Mesosphere
Thermosphere
Exosphere
Meteorology
Thermometer
Barometer
Anemometer
Hygrometer
Water cycle
WEATHER and CLIMATE
Atmosphere
Weather instruments
Seasons
Air
Beam spreading
Solar angles
Heat
Wind
Earth's axis
Earth's rotation
Earth's revolution
Radiation
Matter
Mass
Density
Pressure
Humidity
Conduction
Movement
Δ air pressure
Convection
Fronts