Earth and Space Systems: Energy Transfer between the Sun and the Earth in the Creation of Weather and Climate on Earth

Severe Weather Alert!

Background Knowledge:

For the **Investigation** portion of the lesson:

Students will need to know the basic steps of the Scientific Method (Ask a question, Make a Hypothesis, Conduct an Experiment, Collect Data, Analyze Data, Conclusion). Students will also need to be familiar with the Nature of Science (The natural world is understandable, science is based on evidence – observational and experimental, science is a blend of logic and innovation, scientific ideas are durable but are also subject to change, science is a complex social endeavor, scientists need to remain objective).

For the **Understanding** portion of the lesson:

Students will need to know basic observational weather terms (sunny, cloudy, partly cloudy, partly sunny, rain, snow, wind, ice, sleet and hail).

Students will need to know what the sun and Earth are and their respective locations

Students will need to know that the Earth rotates (24 hrs=1 day) and that the Earth revolves around the sun (1 yr=365 days).

Students will need to know the basics of the water cycle (evaporation, condensation and precipitation).

Students will need to know basic map skills and the location of the equator and poles.

Students will need to know the four seasons and which seasons deliver more sunlight

Students will need to know how to fill in a basic bar graph

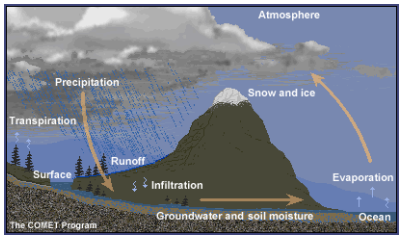
Overview:

For the **stem** portion of this lesson students will deepen their knowledge of the water cycle and the energy transfer between the sun and the Earth. Our weather is dependent on both of these concepts and without the water cycle and the energy transfer there would not be weather on our planet. Students will learn that the sun delivers more energy (radiation) at the equators than at the poles and varies by location and season. The Earth is also not one flat plain but rather has topography to include mountains and valleys.

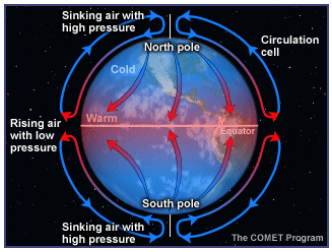
Start the lesson by looking for student's prior knowledge. This can be accomplished as a whole group activity on the SmartBoard by writing in a KWL chart.

Build into the lesson by teaching the complex vocabulary that makes up weather on our planet.

Then introduce the complex weather concept by teaching what the energy transfer between the sun and Earth is:



- Radiation --- in its most basic way is simply heat from the sun. The more sun that is available to an area the warmer it will be.
- Convection – Is dependent on how much heating/cooling of the Earth is present along with the topography and proximity to the Ocean. The rotation of the Earth is also a major player in convection.



- Conduction – The Earth is heated by the sun. During the day the sun heats the Earth. At night the ground cools. Warm air rises and cool air sinks.
- Weather – day to day changes in our atmosphere
- Climate – weather patterns for a particular area over a long period of time
- Atmosphere --- the layers of gases above the Earth that separate us from space and allow weather to occur.
- Weather instruments ----- are used to collect weather data
- Wind ---- occurs with the rotation of the Earth and the uneven distribution of heat on the Earth
- Land Breeze ----occurs in the evening hours. The warm air now located above the water is replaced by the cool air above the land. The wind is moved out to sea.
- Sea Breeze ----the land is heated by the sun and causes the cool air above the ocean to come ashore
- Jet Stream-----is like a huge weather highway about 12 km up in the atmosphere. The jet stream moves West to East moving air masses and weather along its track
- Farmer's Almanac – one of the longest running publications of weather predictions throughout the year. Is about 80% accurate.
- Weather technology (satellites, DOPLAR Radar and computer models)
- Tornado ---a rotating column of air from a severe thunderstorm. Winds can reach up to 300 mph
- Hurricane-----Are huge storms that can last over a week with inward spiraling winds of up to 200 mph around an "eye"
- Flood----Too much rain falls too quickly upon an area
- Blizzard ----a snowstorm that can last a day or more with high winds and large snowfalls.
- Weather Watch --- Are issued to help people prepare for a significant weather event.
- Weather Warning -----means the weather event is going to happen in your area.
- Coriolis Effect ----an important physics concept especially in the formation of hurricanes. The Coriolis Effect strength has to do with a storms location to the Equator and the rotation of the Earth. Think of a carousel. If you stand at the center of the carousel you feel few effects of the turning of the carousel when compared to the outside edge of the carousel.

Procedure:

1. Students complete a pre-assessment (attached)
2. Review daily weather forecast and document daily weather. Students complete basic weather prediction activity (attached)
3. Show students instructional video displaying severe weather concepts.

For the Tornado Investigation: http://youtu.be/qZ1DOaM_SeE -----short animation of a tornado with some humor to it. http://youtu.be/RwbUqur91xU ---- great tornado safety video

For the Hurricane Investigation: http://www.wral.com/weather/hurricanes/video/9924269/ ------video of a staged home in a lab and what happens to it with high winds like in a hurricane

4. Students complete vocabulary activities (attached)
5. Students complete energy transfer activity (attached).
6. Students complete a post assessment (attached)

ASOL: HSS-ESS 3----The student will investigate and understand that energy transfer between the sun and the Earth and its atmosphere drives weather and climate on Earth. Key concepts include:

A) Observation and collection of weather data
B) Prediction of Weather Patterns
C) Severe weather occurrences, such as tornadoes, hurricanes, and major storms

Other ASOLs that are covered

- 3S-ESS 1 --- The student will investigate and understand basic types, changes, and patterns of weather. Key Concepts include:
  A) Identification of common storms and other weather phenomena
  B) The uses and importance of measuring, recording and interpreting weather data
  C) The uses and importance of tracking weather data over time
- 5S- ESS 1 ---- The student will investigate and understand how weather conditions and phenomena occur and can be predicted. Key Concepts include:
  A) Weather phenomena
  B) Weather measurements and meteorological tools
  C) Use of weather measurements and weather phenomena to make weather predictions
- 8S- ESS 4 – The student will investigate and understand the properties of air and the structure and dynamics of Earth's atmosphere. Key concepts include:
  E--- The relationship of atmospheric measures and weather conditions

  F----basic information from weather maps including fronts, systems, and basic measurements

Materials Needed:

- Computer
- SmartBoard
- Provided worksheets and lab

Instructional Setting:

This activity can be done within the classroom environment. Students can also take brief trips outside if they are able and if time permits.

Community Connections and/or Peer Interactions:

Invite students to watch the weather report at home or to look up the following day's weather on the computer (www.theweatherchannel.com) students can share what they learned and practice making a prediction on what the following day's weather may be. This activity can be done as a whole group or in a pair and share type setting. It is important to also check to see if there is a severe weather forecast. Discussion can include the basics of a weather map (cold, warm and stationary fronts and how they drive our weather).

Reach out to the local National Weather Service Agency and see if a real meteorologist can come to visit the classroom.

Students can post the daily weather report in the classroom or on the teacher's door for all to benefit from.

Invite a local meteorologist in to speak with the class.

Functional Activity/Routine:

If there are classroom computers, students could access www.theweatherchannel.com in the classroom and document the current weather and the forecaster's prediction. On the following days, students can monitor the accuracy of the forecaster's prediction. This also includes severe weather predictions. Students can discuss in a whole/small group about what to wear the following day or what events to plan or cancel based on the current weather report or prediction. Predictions can be tracked and graphed as an extension and connection with mathematics.

Personal Connections:

Weather and climate changes affect all of us. It is vital for students to learn the basics of weather prediction and changes so as to be prepared in their everyday lives. Knowing how to prepare for severe weather is important.

Have a classroom discussion to activate a personal connection---- what students have experienced a flood or other severe weather such as a tornado or hurricane.

Strategies to Collect Evidence: Specific Options to Differentiating this Activity:

- Use word boxes
- Cut-and-paste
- Lower answer field to two answers
- Use more pictures
- Fill in a table
- Fillable word documents

Links to Other Content Areas and/or Concepts:

- Life Skills---dressing appropriately, staying safe and conversation starter
- Social Skills----conversation starter and safe planning of events
- History---weather has played a role throughout history…i.e. Indians planned their harvest and migration around weather patterns, the Donner Party, WWII invasions and past named Hurricanes as well as destruction done by tornadoes
- Math---- basic data collection and graphing, bar charts and looking at data over time
- English---reading/writing a prediction and reading/writing about a weather event; non-fiction comprehension and understanding new vocabulary in context or multi-meaning words in context
- Science- Hurricanes could be taught in September and Tornadoes in September and October. Blizzards could be taught from Nov-February.

Extension Ideas

1. **Adapt (How might I alter this lesson to make it meaningful and accessible for my students?)**
    - Limit weather predictions to your local area
    - Limit climate understanding to your local area
    - Take a poll to when students believe the first snow will fall and when the first snow day will happen. This concept can be extended into severe storms as well, i.e. when the first thunderstorm, hurricane, tornado will happen etc.
2. **Adopt (Can I teach this lesson, as is, to my students?)**
    - Use the worksheets provided
    - Use the worksheets provided on the weather links under additional resources
    - Modify worksheets by taking the main idea/main concepts and using Boardmaker/Google Images
    - Using charts, checklists and tables to assess knowledge of basic concepts

References:

1. Aligned Standards of Learning Curriculum Framework – High School – 2010
2. Overview graphics and vocabulary definitions are from: https://www.ucar.edu/learn/1_1_1.htm

Additional Resources:

1. Pebbles Go online resources through the Media Center – easy reading and understanding
2. MyOn books – leveled reading materials
3. ATS for Core Content Science books on weather – leveled reading materials
4. Teaching Science to the Standards
5. Attainment Earth Science with pictures
6. http://environment.nationalgeographic.com/environment/natural-disasters/forces-of-nature/?section=h ----incredible photo gallery of all types of severe storms. This is a great lead into a prediction or to teach what certain storms look like.
7. http://www.weatherwizkids.com/ ------amazing weather resource by meteorologist Crystal Wicker.
8. http://www.nssl.noaa.gov/education/svrwx101/ ----- incredible photos from the National Severe Storms Lab
9. http://www.nssl.noaa.gov/education/students/ ----- great resources for students. The Billy and Maria series is great for lower students and Owly for higher students. There are also multi-tiered interactive weather related games and worksheets.
10. http://eo.ucar.edu/webweather/thunderhome.html ---- easy to understand explanations of the major weather storms. There are also easy interactive games, activities and a life skill connection.
11. http://teacher.scholastic.com/activities/wwatch/hurricanes/index.htm --- An in depth look at a hurricane. There are links to other severe storms as well as activities and vocabulary building.
12. http://www.powertolearn.com/games/weatherflash.html ---- Fun weather prediction interactive game.
13. http://www.ready.gov/kids --weather disaster game that is life skills based.
14. http://www.ready.gov/kids/educators ---- free leveled material from K-12.
15. http://www.beaconlearningcenter.com/search/mastersearch.asp ---- easy to understand weather lessons. Most have an audio component and activities.
16. http://www.miamisci.org/youth/unity/Unity2/Sagledor/Clouds/cirrus.html -- Wonderful basic resource for clouds and their definitions.
17. http://teacher.scholastic.com/activities/wwatch/investigate/weather_maker.htm ----Interactive Weather maker game.
18. http://www.nhc.noaa.gov/outreach/games/movncane.htm ---Interactive Hurricane game
19. http://www.miamisci.org/hurricane/hurricane0.html -----Awesome real hurricane footage!
20. http://news.bbc.co.uk/cbbcnews/hi/newsid_4020000/newsid_4022100/4022129.stm - Animated graphic with explanation of the formation of a Hurricane
21. http://members.tripod.com/~star_43/weather.html -- weather clip art
22. http://www.cotf.edu/ete/modules/k4/online/Wonline1.html ---Cool weather interactive game
23. http://archive.fossweb.com/modulesK-2/AirandWeather/activities/whatstheweather.html ----Cute game to dress a bear for the weather.
24. http://www.crickweb.co.uk/Early-Years.html#Dressing%20Lecky ---Cute dressing of an Alien.
25. http://www.youngmeteorologist.org/ Wonderful game of prediction and being a meteorologist
26. http://www.edheads.org/activities/weather/ ---fun weather predicting game
27. http://www.glencoe.com/sec/science/activities/weather/ ---interactive weather map
28. http://www.eslgamesplus.com/weather-vocabulary-esl-interactive-board-game/ -Fun ESL weather vocabulary game.
29. http://www.youngmeteorologist.org/?page_id=37 -----A wonderful resource!
30. http://www.youngmeteorologist.org/game/index.html ----Fun interactive for severe weather.
31. http://studyjams.scholastic.com/studyjams/jams/science/index.htm ----Lots of weather and climate interactives.
32. http://www.kidsknowit.com/interactive-educational-movies/free-online-movies.php?movie=Tornadoes ----- easy to understand animated tornado short movie
33. http://www.sciencekids.co.nz/videos/weather.html ----Lots of cool storm clips
34. ----Great short tornado movie to do an investigation with. Some odd science humor in it!
35. http://www.cbsnews.com/htdocs/natural_disasters/hurricanes/framesource.html -----beautiful animation of the development of a hurricane.
36. http://teachertech.rice.edu/Participants/louviere/hurricanes/birth.html ------easy to understand steps to make a hurricane.

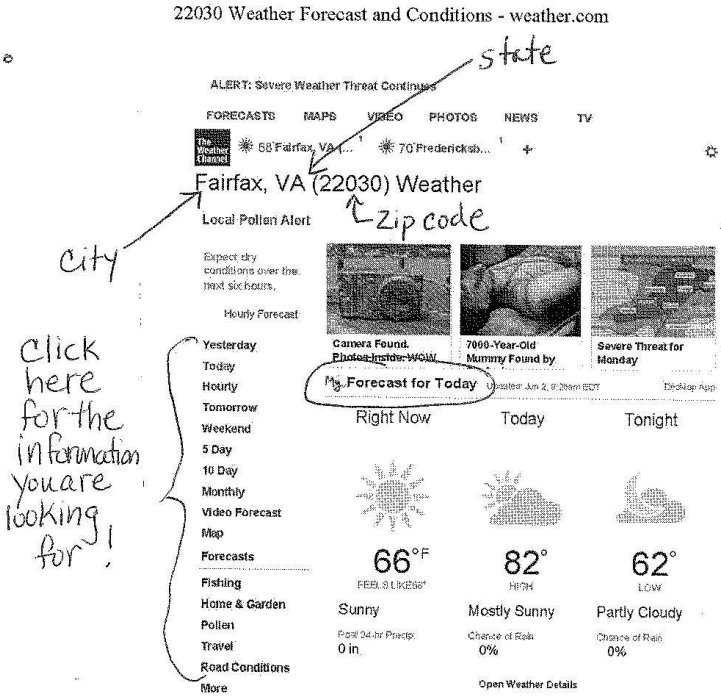
37. http://www.sun-sentinel.com/broadband/theedge/sfl-edge-t-canemaker,0,4142989.flash -----hurricane maker game
38. http://www.kidsknowit.com/interactive-educational-movies/free-online-movies.php?movie=Huricanes --- Easy to understand video about hurricanes
39. http://www.wral.com/weather/hurricanes/video/9924269/ ------ What a hurricane does to a house.
40. http://www.almanac.com/sites/new.almanac.com/files/2014_ofa_cvr1_cmyk.jpg - cover photo of the Farmer's Almanac

Weather Channel Activity

Name: Date:

The Weather Channel!

1.



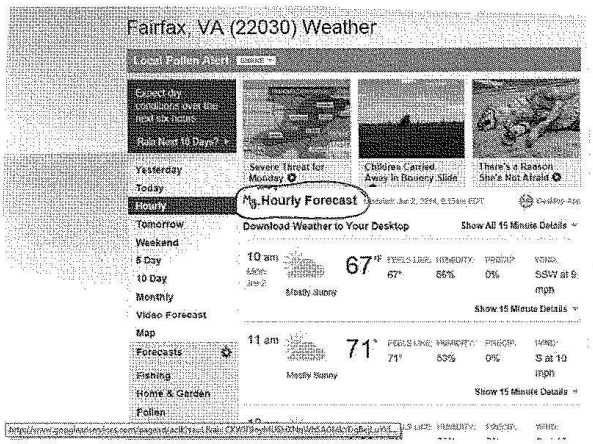
Click here for the information you are looking for!

After you type in www.weather.com you will need to put in your zip code.

You will then be taken to the page of your area and the current weather.

If you want more information go to the sidebar on the left side and click on what interests you?

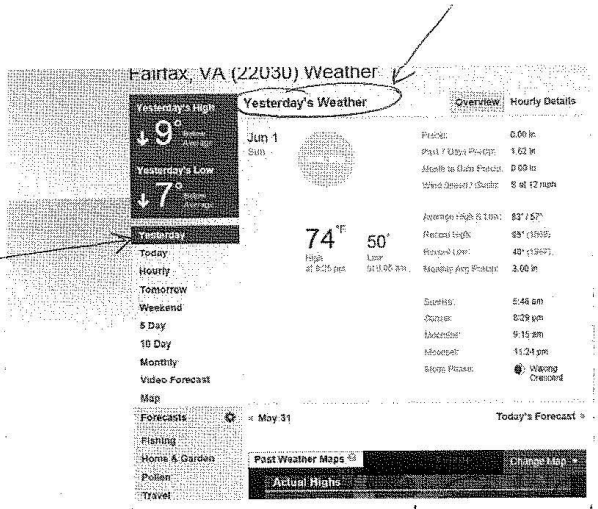
2.



current weather

What is today, June 2nd's weather at 10AM?

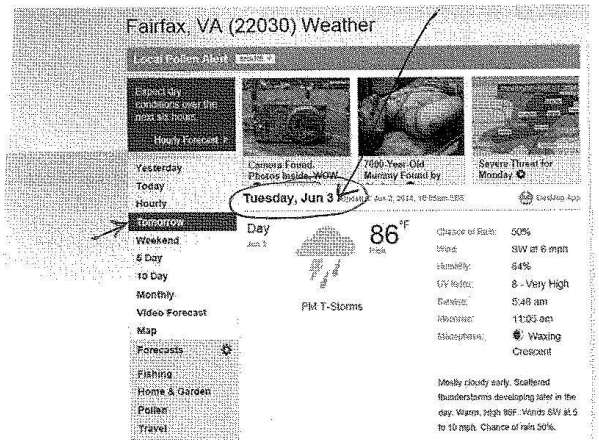
3.



If you want to Know yesterday's weather click on "Yesterday" on the left side bar.

What was June 1st's Low temperature?

4.



To get an idea of what the weather will be like tomorrow, click on "Tomorrow" on the left side bar.

What type of weather will we have on June 3rd?

Weather Images

1. 	2. 	3. 	4. 	5. 
6. 	7. 	8. 	9. 	10. 
11. 	12. 	13. 	14. 	15. 

1. Accurate
2. Not Accurate
3. Rain
4. Snow
5. Sleet
6. Hail
7. Snow storm
8. Flood
9. Sunny Day
10. Partly Cloudy
11. Cloudy
12. Thunderstorm
13. Tornado
14. Hurricane
15. Blizzard

Weather Observation Lab Reference for Images

1. http://suburgatory.wikia.com/wiki/File:Happy_face.jpg ----happy face image for accurate
2. http://www.zazzle.com/sad+faces+gifts ---- sad face image for not accurate
3. http://terbakarsunyi.blogspot.com/2013_10_01_archive.html --- rain image
4. http://www.its.caltech.edu/~atomic/snowcrystals/photos3/photos3.htm ----- snow image
5. http://www.ksdk.com/story/weather/2014/03/01/sleet-freezing-rain-difference/5927865/ --- sleet image
6. http://climate.atmos.colostate.edu/hail.php --- hail image
7. http://www.csmonitor.com/USA/USA-Update/2014/0103/Snowstorm-exits-but-temperatures-stay-frigid.-Why-so-cold --- snow storm image
8. http://www.huffingtonpost.com/2013/09/20/1000-year-storm_n_3956897.html ------flood image
9. http://www.iconsdb.com/orange-icons/sun-3-icon.html ---- image of a sun for sunny day
10. http://www.dut.ac.za/useful_links ----- partly cloudy day image
11. https://seekraz.wordpress.com/tag/cloudy-sky/ -- cloudy day image
12. http://www.trails.com/how_808_camping-thunderstorm.html -----Thunderstorm image

Name: _____ Date: _____

Weather Observation Lab

Weather Observation Chart

Date	Today's Weather Sunny/Cloudy/Partly Cloudy/Mostly Sunny	Today's High Temperature	Precipitation Rain/Snow/Sleet/Hail	Severe Weather Yes/NO	Prediction for tomorrow	Actual Forecast

Today's Weather Data Chart:

Type Of Weather	Number of Times
Sunny Days	
Cloudy Days	
Partly Cloudy Days	
Thunderstorms	
Blizzard	
Tornado	
Hurricane	
Snow Storm	
Flood	

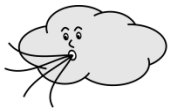
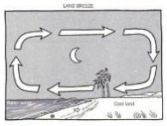
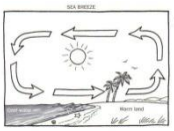
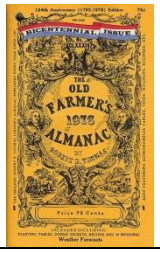
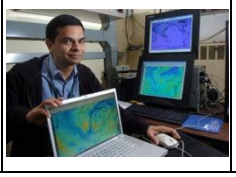
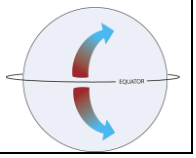
Type of Precipitation Data Chart:

Type of Precipitation	Number of Times
Rain	
Snow	
Sleet	
Hail	

Prediction Data Chart:

Prediction	Number of Times
Accurate	
Not Accurate	

Images for the Transfer of Heat Between Sun and Earth

1 	2 	3 	4 	5 	6 
7 	8 	9 	10 	11 	12 
13 	14 	15 	16 	17 	18 

19. 

Answers:

1. Sun's radiation
2. Convection
3. Weather
4. Climate
5. Earth's Atmosphere
6. Weather Instruments
7. Wind
8. Land Breeze
9. Sea Breeze
10. Jet Stream
11. Farmer's Almanac
12. Doppler Radar
13. Weather Satellite
14. Computer Models
15. Tornado
16. Hurricane
17. Blizzard
18. Coriolis Effect
19. Weather watch/warning

References for: Energy Transfer between the Sun and the Earth in the Creation of Weather and Climate on Earth

1. http://health4youdotme.wordpress.com/2012/07/06/sunstroke-hazardous-than-any-other-complication-through-suns-heat/ ---image of sun showing heat
2. http://www.physicsclassroom.com/class/thermalP/Lesson-1/Methods-of-Heat-Transfer --- image of convection
3. http://www.education.noaa.gov/Weather_and_Atmosphere/Weather_Systems_and_Patterns.html -- weather image
4. http://cleanet.org/clean/literacy/index.html ----- climate image
5. http://hdw.eweb4.com/out/1069255.html ----Earth's Atmosphere image
6. http://mslionelslearningcorner.wikispaces.com/Grade+5+Science-Earth+%26+Space+Science ---- weather instruments image
7. http://openclipart.org/detail/67723/wind-blowing-cloud-by-laobc ---- wind image
8. http://www.auburnschools.org/drake/aklecompte/sea_breezes_and_land_breezes.htm -----land and sea breeze images
9. http://www.nc-climate.ncsu.edu/climate/winter_wx/Patterns.php -----jet stream image
10. http://www.yankeemagazine.com/photography/the-1976-old-farmers-almanac ----Farmer's Almanac image
11. http://forkswa.com/2009/12/20/doppler-radar-funded/ ----Doppler Radar
12. http://en.wikipedia.org/wiki/Weather_satellite -----weather satellite
13. http://www.treehugger.com/natural-sciences/more-accurate-air-pollution-computer-model-by-the-argonne-national-laboratory.html ----computer models image
14. http://www.kidzone.ws/science/tornado/facts.htm ----tornado image
15. http://en.wikipedia.org/wiki/Hurricane_Fran ---- hurricane image
16. http://venturebeat.com/2012/08/09/blizzard-hacked/ ---blizzard image
17. http://oceanservice.noaa.gov/education/kits/currents/05currents1.html -----Coriolis Effect image
18. http://www.wnem.com/story/21919948/watch-vs-warning ----Weather watch/warning image

Name: _____ Date:_____

Weather Vocabulary Cut and Paste

1. Sun's radiation

2. Convection

3. Weather

4. Climate

5. Earth's Atmosphere

6. Weather Instruments

7. Wind

8. Land Breeze

9. Sea Breeze

10. Jet Stream

11. Farmer's Almanac

12. Doppler Radar

13. Weather Satellite

14. Computer Models

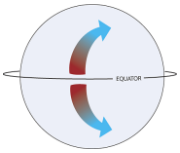
15. Tornado

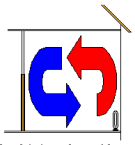
16. Hurricane

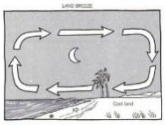
17. Blizzard

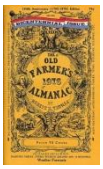
18. Coriolis Effect

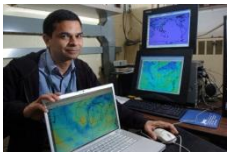
19. Weather watch/warning

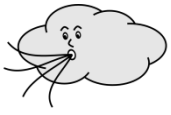


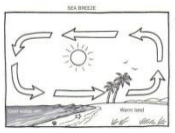












Name: _____ Date: _____

Weather Vocabulary Match

Please match the vocabulary word and Picture with its definition!

1. Sun's radiation

2. Convection

3. Weather

4. Climate

5. Earth's Atmosphere

6. Weather Instruments

7. Wind

8. Land Breeze

9. Sea Breeze

10. Jet Stream

11. Farmer's Almanac

12. Doppler Radar

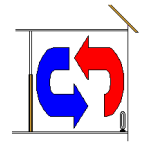
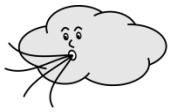
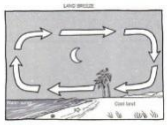
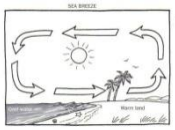
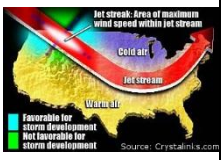
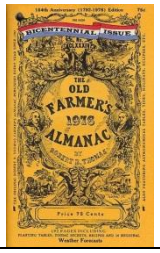
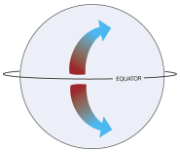
13. Tornado

14. Hurricane

15. Blizzard

16. Coriolis Effect

17. Weather watch/warning

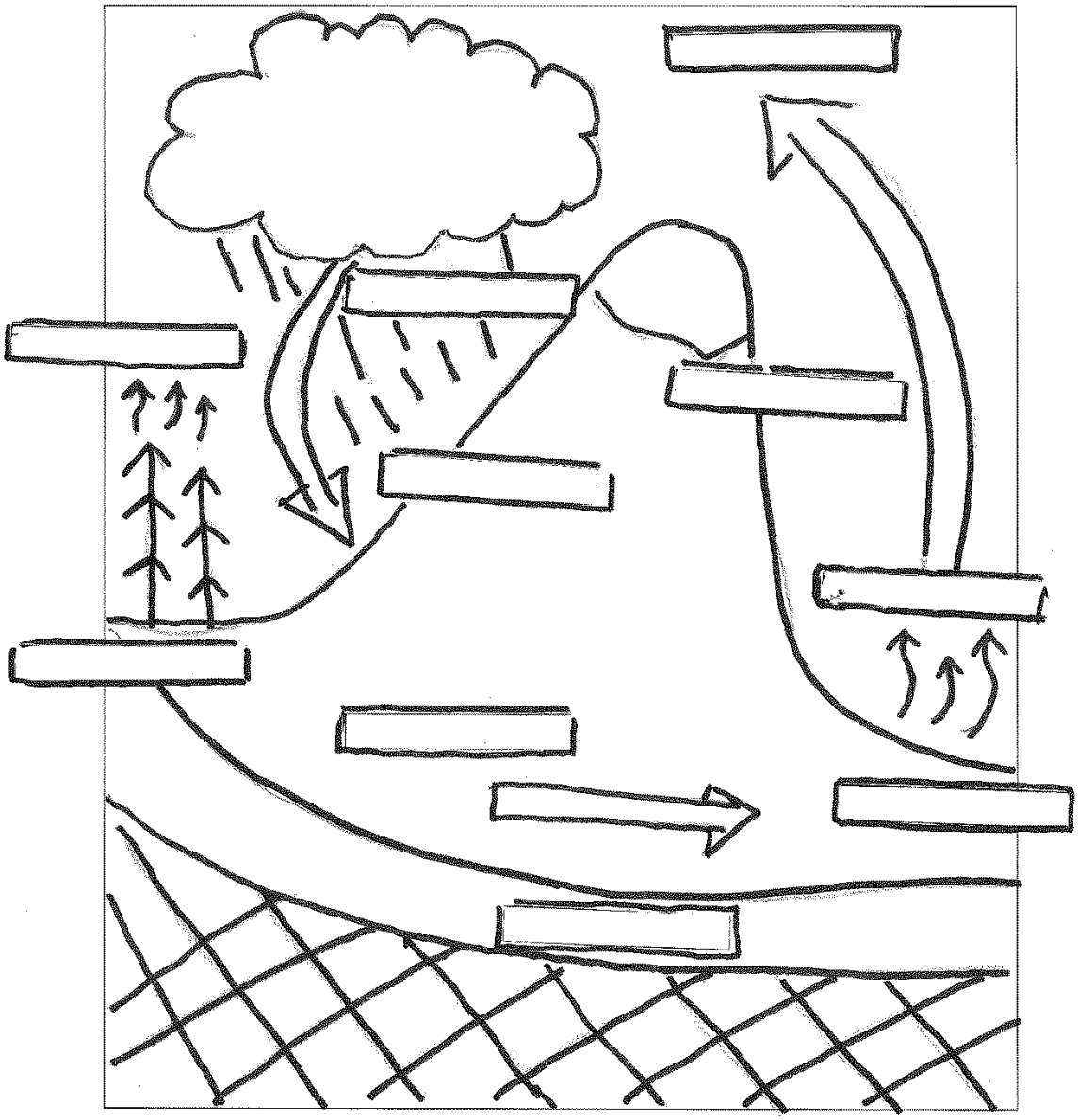
During the day the sun heats the Earth. At night the ground cools. Warm air rises and cool air sinks.
Day to day changes in our atmosphere
How much heating/cooling of the Earth
Weather patterns for a particular area over a long period of time
The layers of gases above the Earth that separate us from space and allow weather to occur.
Used to collect weather data
Occurs with the rotation of the Earth and the uneven distribution of heat on the Earth
Heat from the sun. The more sun that is available to an area the warmer it will be.

Are issued to help people prepare for a significant weather event.
A rotating column of air from a severe thunderstorm. Winds can reach up to 300 mph
Weather technology

A publication of weather predictions throughout the year. It is usually about 80% accurate.
Is a huge weather highway about 12 km up in the atmosphere. Moves weather West to East.
Occurs in the evening hours. Warm is above the water. The wind is moved out to sea.
A huge storms that can last over a week with inward spiraling winds of up to 200 mph around an "eye"
Too much rain falls too quickly upon an area
the land is heated by the sun and causes the cool air above the ocean to come ashore
A snowstorm that can last a day or more with high winds and large snowfalls.
Means the weather event is going to happen in your area.
An important physics concept especially in the formation of hurricanes.

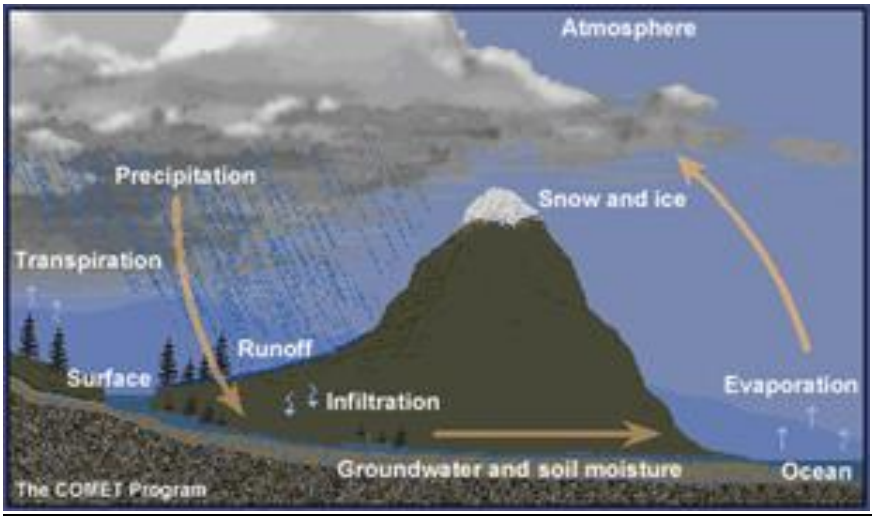
Name: _____ Date:_____

Energy Transfer between the Sun and the Earth



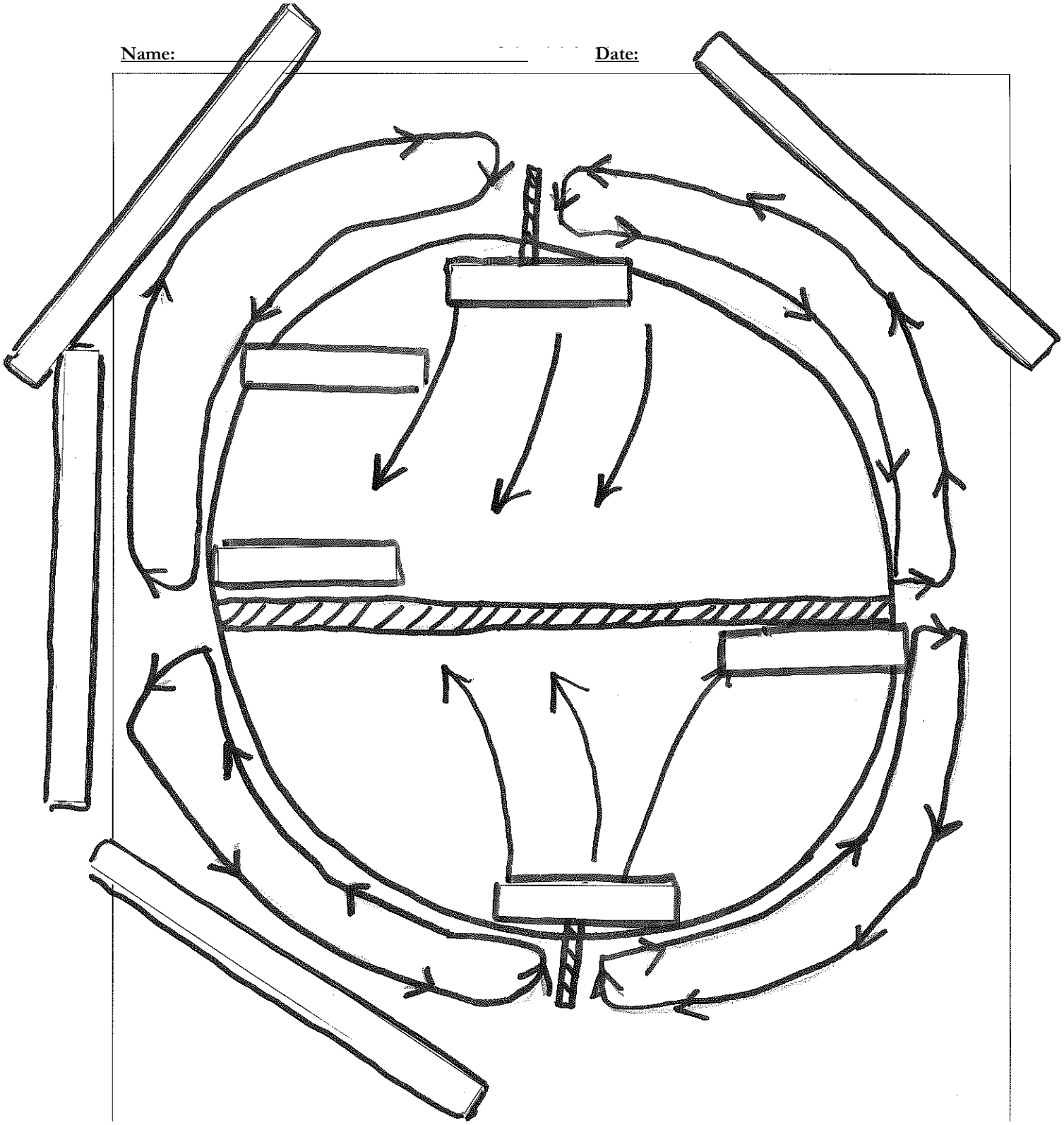
Atmosphere	**ocean**
precipitation	**runoff**
snow and ice	**transpiration**
Infiltration	**surface**
Ground water	**evaporation**

Answers:



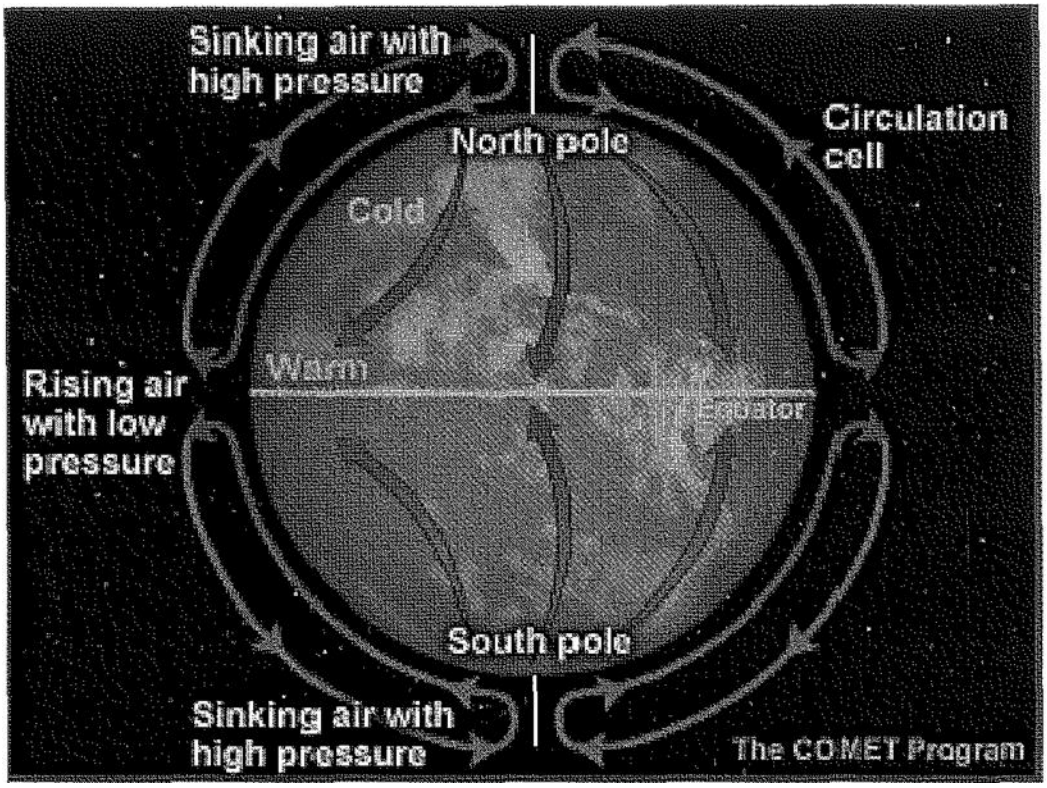
Convection Graphic Organizer

Name: _____ **Date:**



North Pole	**Cold**
Warm	**Equator**
South Pole	**Sinking air with high pressure**
Cell Circulation	**Rising air with low pressure**
Rising air with low pressure	

Answers:



Name: _____ Date: _____

Tornado Lab

Have students ask a question and make a prediction prior to watching the video.

Question:

_____

_____

Hypothesis:

_____

_____

Procedure:

Use the following link for the tornado lab.

http://youtu.be/qZ1DOaM_SeE

Observation Data:

_____

_____

_____

_____

_____

Analysis:

1. **What was destroyed by the tornado in the video?**

   _____

   _____

   _____

2. **Is it a good idea to get in a car and try to out run a tornado?**

   _____

   _____

   _____

3. **What animal was carried away by the tornado?**

   _____

   _____

4. **What did you like the best in the video?**

   _____

   _____

5. **How fast do you think the winds were in this tornado?**

   _____

   _____

Conclusion:

My Hypothesis was correct/incorrect?

Name: _____ **Date:** _____

Hurricane Lab

Have students ask a question and make a prediction prior to watching the video.

Question:

_____

_____

Hypothesis:

_____

_____

Procedure:

Use the following link for the Hurricane lab.

http://www.wral.com/weather/hurricanes/video/9924269/

Observation Data:

_____

_____

_____

_____

_____

Analysis:

1. **What was destroyed by the hurricane force winds in the video?**

   _____

   _____

   _____

2. **Is it a good idea to get in a car and try to out run a hurricane?**

   _____

   _____

   _____

3. **What did you like the best in the video?**

   _____

   _____

4. **How fast do you think the winds were in this hurricane?**

   _____

   _____

Conclusion:

My Hypothesis was correct/incorrect?