METEOROLOGY MADNESS

Grade Level: 4th Grade
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Length of Unit: Seven lessons (approximately 6 weeks (31 days); 1 day = 45 minutes)

I. ABSTRACT

Our weather is ever changing, can be extremely unpredictable and exciting, and often includes some of the most fascinating natural phenomena known to mankind. Throughout this unit, students will comprehensively cover components such as the hydrologic cycle, clouds, atmosphere, air movement, cold/warm fronts, forecasting the weather and realize how their lives revolve around our dynamic weather. Students will conduct a variety of experiments demonstrating the water cycle, wind speed, air masses, and air pressure. Other hands-on activities involve creating weather instruments, researching and orally presenting information about storm types, and simulating a weather forecast.

II. OVERVIEW

A. Concept Objectives
   1. Students will understand the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigations.
   2. Students will know and understand common properties, forms, and changes in matter and energy.
   3. Students will know and understand the processes and interactions of Earth's systems and the structure and dynamics of Earth and other objects in space.
   4. Students will know and understand interrelationships among science, technology, and human activity and how they can affect the world.
   5. Students will understand that science involves a particular way of knowing and understand common connections among scientific disciplines.

B. Content from the *Core Knowledge Sequence* (p. 106)
   1. Meteorology Vocabulary (not listed in *Core Knowledge Sequence)*
   2. Hydrologic cycle
   3. Clouds: cirrus, stratus, cumulus
   4. Atmosphere (including layers: troposphere, stratosphere, mesosphere, ionosphere and how the sun and the earth heat the atmosphere)
   5. Air movement: wind direction and speed, prevailing winds, air pressure, low and high pressure, air masses
   6. Cold and warm fronts: thunderheads, lightning and electric charge, thunder, tornadoes, hurricanes
   7. Forecasting the weather: barometers (relation between changes in atmospheric pressure and weather), weather maps, weather satellites

C. Skill Objectives
   1. The students will understand what meteorology is and will recognize and define terms associated with weather.
   2. Students will learn and demonstrate the steps of the water cycle.
   3. Students will be able to identify cirrus, stratus, and cumulus clouds and characteristics of each.
   4. Students will understand that the atmosphere is made up of different layers and that the sun and earth affect the way these layers are warmed.
   5. Students will indicate and record the relationship between atmospheric pressure and the weather through experimentation following the scientific process of

stating a question, formulating a hypothesis, listing materials and procedure, tabulating results, and drawing a conclusion based on these results.

6. Students will realize the components of air movement including wind direction and speed, prevailing winds, air pressure, low and high pressure, and air masses and will identify the scientific instrument used to measure each.
7. Students will learn differing weather patterns due to cold and warm fronts.
8. Students will review weather instruments including the thermometer, barometer, anemometer, weather vane, hygrometer, and satellite as well as several others not previously studied and predict what information we may gain from satellites or more advanced instruments in the future.
9. Students will observe various forecasts and judge what makes one more successful than another.
10. Students will chart daily observations of weather and use this data to create and orally present a weather forecast in which they will use a self-made weather map and data graph as visual aids to support their findings.

III. BACKGROUND KNOWLEDGE

A. For Teachers

1. Allaby, Michael. *How the Weather Works.* Pleasantville, NY: The Reader's Digest Association, Inc., 1995. 0-89577-612-X.
2. Wyma, Brenda. *Investigations in Science: Weather*. Cypress, CA: Creative Teaching Press, Inc., 1995. CTP 2803 Grades 4-8.
3. Zeman, Anne and Kate Kelly. *Everything You Need to Know About Science Homework: A Desk Reference for Students and Parents*. New York: Scholastic Inc., 1994. 0-590-49357-4.

B. For Students

1. Grade K: Seasons and Weather
2. Grade 2: Water Cycle

IV. RESOURCES

A. Appendices A-P
B. W*eather Words and What They Mean*, by Gail Gibbons (Lesson One)
C. *The Magic School Bus: Wet All Over*, by Joanna Cole (Lesson Two)
D. *The Cloud Book*, by Tomie de Paola (Lesson Three)
E. *How the Weather Works*, by Michael Allaby (Lesson Three and Five)
F. Encyclopedia set or assorted children's books on clouds (Lesson Three)
G. *The Ozone Layer*, by Rhonda Lucas Donald (Lesson Four)
H. *Investigations in Science: Weather*, by Brenda Wyma (Lesson Five)
I. "Storm Smarts" from *Teacher's Helper* April/May/June 1998. p.5 (Lesson Six)
J. Variety of children's books about thunderstorms, hurricanes, tornadoes, and blizzards (Lesson Six)
K. *Eyewitness: Weather*, narrated by Martin Sheen (Lesson Six)
L. *The Nature Company Discoveries Library: Weather* p. 34-41, by Sally Morgan (Lesson Seven)
M. Several videotaped weather reports from a local TV station (this will need to be done several days in advance of teaching Lesson Seven)

V. LESSONS

Lesson One: Introducing Meteorology (one day)

A. *Daily Objectives*

1. Concept Objective(s)
    a. Students will know and understand the processes and interactions of Earth's systems and the structure and dynamics of Earth and other objects in space.
2. Lesson Content
    a. Meteorology Vocabulary (not listed in *Core Knowledge Sequence*)
3. Skill Objective(s)
    a. Students will understand what meteorology is and will recognize and define terms associated with weather.

B. *Materials*

1. *Weather Words and What They Mean*, by Gail Gibbons
2. Appendix A: Weather Words (one copy per student)

C. *Key Vocabulary*

1. Meteorology- the study of weather
2. Temperature- measurement of hotness or coldness of air
3. Air pressure- the amount of air in atmosphere pressing down on Earth's surface
4. Moisture- drops of water in the air; slight wetness
5. Wind- the movement of air across the atmosphere

D. *Procedures/Activities*

1. Ask students what words come to mind when they hear the term Meteorology. Tell students that Meteorology is the study of weather and write the definition on the board. Now ask students for words that come to mind associated with weather. Compile these words into a list on the board. Let them know that throughout our study of Meteorology we will come across these and many other words about weather, and to completely understand concepts in this unit, it is important that they know what these words mean.
2. Read aloud *Weather Words and What They Mean*. Brainstorm together other words that were introduced and explained in the story other than the words listed on the board. Make sure to include temperature, air pressure, moisture, and wind.
3. Hand out Appendix A: Weather Words. Assign each student a term from his/her handout to define. Choices may include: fog, rain, drizzle, humidity, dew, frost, clouds, shower, rainstorm, flood, snow, sleet, thunderstorm, thunder, lightning, rainbow, flurries, snowstorm, blizzard, hail, gusty, gale, tornado, hurricane, front, air mass, etc. Students are to write the definition to their assigned word on Appendix A. On a separate sheet of paper, they are to write their definition as a sentence, leaving a blank where their term is supposed to be. Then they are to place a different term from the list in the blank. For example: After the rain shower a colorful <u>blizzard</u> filled the sky. Collect from students the sheet of paper with their replaced definition. Have students share their definition and fill in remaining definitions on Appendix A while others share.
4. Compile all the sentences with incorrectly filled-in blanks into a worksheet. Provide a word bank at the bottom listing all terms assigned to students. Their directions are to replace the incorrect word in each sentence with a correct word from the word bank. Have students complete this worksheet and go over correct answers. Students may include this sheet along with Appendix A in their Science Folders to use as reference throughout the course of the unit.

E. *Assessment/Evaluation*
   1. Students will discuss weather terms and their meanings, recording definitions on a given handout (Appendix A).

Lesson Two: The Water Cycle (six days)

A. *Daily Objectives*
   1. Concept Objective(s)
      a. Students will understand the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigations.
      b. Students will know and understand common properties, forms, and changes in matter and energy.
      c. Students will know and understand the processes and interactions of Earth's systems and the structure and dynamics of Earth and other objects in space.
      d. Students will know and understand interrelationships among science, technology, and human activity and how they can affect the world.
   2. Lesson Content
      a. Hydrologic Cycle
   3. Skill Objective(s)
      a. Students will learn and demonstrate the steps of the water cycle.

B. *Materials*
   1. *The Magic School Bus: Wet All Over*, by Joanna Cole
   2. Appendix B: Water Cycle Notes (one copy per student)
   3. Appendix C: Scientific Process Experiment Form (one copy per student)
   4. Instant water cycle experiment materials:
      a. electric skillet
      b. small metal saucepan
      c. water
      d. ice cubes
   5. Appendix D: Evaporation Experiment (one copy per student)
   6. Evaporation experiment materials per four students:
      a. one sheet typing paper cut into three strips
      b. one tin plate
      c. one damp sponge
   7. Appendix E: Condensation Experiment (one copy per student)
   8. Condensation experiment materials per four students:
      a. two jars with lids
      b. 3-4 ice cubes
      c. warm water
   9. Appendix F: Water Cycle Quiz (one copy per student)

C. *Key Vocabulary*
   1. Water cycle - the movement of water in the environment consisting of four steps: evaporation, condensation, precipitation, and run-off (or seepage)
   2. Hydrologic cycle - another name for water cycle
   3. Evaporation- process in which water changes from a liquid to a gas
   4. Condensation- process in which water vapor changes into a liquid
   5. Precipitation- liquid or solid particles that form in the atmosphere and then fall to the earth's surface
   6. Run-off- precipitation that has fallen to Earth and runs off into streams, rivers, and oceans
   7. Seepage - fallen precipitation which seeps or sinks in to the ground

8. Water vapor- the gas that forms when water evaporates

D. *Procedures/Activities*

1. Brainstorm/discuss water sources. Ask class how we get water, where it comes from, and how long it has been around.
2. Read aloud *The Magic School Bus: Wet All Over*. Review steps of the Water Cycle.
3. Hand out Appendix B: Water Cycle Notes. Read together background information about the water cycle. Have students add the following onto the notes section on the bottom half of the page.

   Notes
   -water covers 71% of the earth
   -50-70% of the weight of all plants and animals is water
   -H2O= 2 hydrogen molecules, 1 oxygen molecule
   another word for water
   -three forms of water: liquid, gas (water vapor), solid (ice)
   -water is constantly moving (Water or Hydrologic Cycle)
   -study of weather=Meteorology
   -studier of weather=Meteorologist
   -water has been around since the beginning of time
   -four steps of the water cycle:
   1. Evaporation
   2. Condensation
   3. Precipitation
   4. Run-off or Seepage

4. Tell students that they will be able to see an example of the water cycle in action through an experiment. Hand out Scientific Process Experiment Form (Appendix C). Explain to students that when scientists are trying to discover new things or figure things out they follow a given procedure such as the one on their form. Go through each of the steps together. Students will write their name for the scientist and title the activity "Making an Instant Water Cycle." The question they are finding out will be "Can we create an instant water cycle?" Next list materials on the board students will be using for the procedure. Students will need to copy these down under the Materials section. Now have them go back to the hypothesis. Ask them to make a prediction as to if we will or not be able to create a water cycle with the materials listed. Next, write the following steps on the board and have students copy these down under Procedures:
   1. Boil four cups water in electric skillet.
   2. Fill metal saucepan halfway with ice cubes.
   3. Hold saucepan over skillet.
   4. Observe saucepan for three minutes.

   Perform experiment following these directions.
   a. Beforehand, store saucepan and ice cubes in the freezer until ready for experiment.
   b. After step #1, point out the steam known as water vapor and explain that this is the water evaporating (evaporation).
   c. After step #3, have students observe drops of water forming on the bottom and sides of the saucepan (condensation). Note that those droplets fall back down into the skillet (precipitation).
   d. After step #4, students should see that these drops now begin to evaporate again, repeating the water cycle.

e. After the demonstration, have students record results of experiment on their form.
f. Finally, have students write what they learned from this experiment under the Conclusion section.

5. Tell students that they will perform a short experiment on Evaporation and hand out Appendix D. Have students work in groups of four, following directions and completing questions on their handout. Meet together again as a class and go over results. Be sure that students formed a conclusion such as moving air causes water to evaporate more quickly. Give an example of waving a wet beach towel in the air to dry quicker and that clothes hanging on a clothesline will dry much quicker on a breezy day. Review the fact that heat (the sun) also causes water to evaporate.
6. Review conclusions formed from evaporation experiment (heat and moving air causes water to evaporate). Ask students what the next step of the water cycle, after evaporation, is (condensation). Ask if anyone can think of examples demonstrating this step in the water cycle. A pop can sweating in a warm room is a good example. Hand out Appendix E: Condensation Experiment. Tell students that they will have a chance to perform an experiment in which they will create condensation. Have students work in groups of 4, following directions and answering questions on their handout. Meet again as a class to review results. Here the conclusion reached should be that water vapor changes from a gas to a liquid when it becomes colder (condensation). Tell them that this often forms on the outsides of cool containers left out at room temperatures and will appear to have "sweat" on the outside. Also mention that when water vapor collects in clouds and gets too heavy, condensation happens as the vapor turns into liquid drops and falls as rain.
7. Briefly review the last two steps of the water cycle. Brainstorm different types of precipitation and characteristics attributed to each. Students need to draw four squares on one side of the paper and choose four types of precipitation to illustrate in the squares. Explain runoff and seepage. Students may choose one example of this to draw on the backside of their paper.
8. Water Molecule Activity (to be done during Writing). Students are to pretend that they are a water molecule in a pond. They are to tell of their experiences as they evaporate, condense, and precipitate. Where do they end up? How do they feel in the process? They are to write one page on their experience.
9. Conservation of water. Discuss why it is important to use water sparingly. Brainstorm ways they can help work together to conserve water.

E. *Assessment/Evaluation*

1. Students will complete a Water Cycle Quiz, on which they will recreate a diagram for the water cycle, including a picture and label for each step and will answer a series of questions regarding the water cycle (Appendix F).

Lesson Three: Clouds (four days)

A. *Daily Objectives*

1. Concept Objective(s)
   a. Students will know and understand the processes and interactions of Earth's systems and the structure and dynamics of Earth and other objects in space.
2. Lesson Content
   a. Clouds: cirrus, stratus, cumulus

3. Skill Objective(s)
    a. Students will be able to identify cirrus, stratus, and cumulus clouds and characteristics of each.

B. *Materials*
1. *The Cloud Book*, by Tomie de Paola
2. Appendix G: *The Cloud Book* Review Questions (one copy per student)
3. *How the Weather Works* p. 92, by Michael Allaby
4. Appendix H: Cloud Types (make two copies and copy them front to back, this way there will be enough chart space for all ten cloud types; each student will need a front/back copy)
5. Encyclopedia set or page copies (or other reference books) of ten cloud types: cumulus, stratus, cirrus, nimbostratus, altostratus, cirrostratus, cumulonimbus, altocumulus, cirrocumulus, and stratocumulus
6. Appendix I: Altitude Chart (one copy per student)
7. Transparency of Appendix I
8. One large piece of light blue paper (long enough to hang on door)
9. Appendix J: Cloud Quiz (one copy per student)
10. One large bag of cotton balls
11. Light blue construction paper (one per student)

C. *Key Vocabulary*
1. Cirrus clouds- feathery, wispy clouds made of ice crystals found high in the sky
2. Stratus clouds- flat, layered, gray clouds which are found low to the ground
3. Cumulus clouds- puffy, white, low level clouds with flat bottoms and a dome-shaped tops
4. Alto- mid level clouds
5. Cirro- high clouds
6. Strato- sheets or layers
7. Nimbo- rain clouds

D. *Procedures/Activities*
1. Tell students that we will be doing a short observation outside. They will need to bring with them some lined paper, something hard to write on, and a pencil. Take the class outside and have them lie down and watch the clouds for a few minutes. Ask them to draw some of the clouds that they see on their paper. Underneath their pictures, have them include a written description of these clouds. Next, have them write the phrase "If I were a cloud, I" and ask them to finish the phrase explaining what type of cloud they would be and what they would do. Share responses together.
2. Return to the classroom and read aloud *The Cloud Book*. Hand out Review Questions (Appendix G) for students to fill out during the story. Summarize handout information afterwards.
3. Write prefixes "alto, cirro, strato, nimbo" on the board along with their meanings. Show students cloud classification picture from *How the Weather Works* p. 92 and read brief section about Luke Howard and the cloud classification system he developed. This picture shows the 10 different cloud types according to their placement in the sky. Ask students if they think the cloud name labeled on the picture describes it well according to prefix definitions.
4. Divide the class into 10 different research groups for the 10 different types of clouds. Hand out Appendix H: Cloud Types to each student. Students are to work as a group to research their cloud type, searching for a description of their cloud, the type of weather it brings, the altitude at which it can be found in the sky, and at least 3 other facts about their cloud. They will need to transfer

information they find and sketch an example of their cloud on their chart. Next, meet together as a class to exchange information, thus compiling a completed chart including information on all ten cloud types.

5. Distribute Appendix I: Altitude Chart to the class. Draw on transparency of Appendix I where their researched clouds would be placed on this chart. Have students transfer these sketches onto their own copies.
6. Before this lesson have a large light blue sheet of butcher paper hanging on the door. Label it with the same labels as Appendix I. After students complete their individual altitude chart (Appendix I), select a few students to draw the ten cloud types with chalk onto the butcher paper according to their placement in the sky and write its name underneath with black permanent marker.

E. *Assessment/Evaluation*

1. Students will complete a Cloud Quiz (Appendix J) reviewing material such as cloud types, names, and attributes of the various cloud types including the kind of weather associated with each.
2. Using cotton balls, students will construct cirrus, stratus, and cumulus type clouds on blue construction paper and will list at least three descriptors of each type.

Lesson Four: Atmosphere (three days)

A. *Daily Objectives*

1. Concept Objective(s)
   a. The students will know and understand the processes and interactions of Earth's systems and the structure and dynamics of Earth and other objects in space.
   b. Students know and understand interrelationships among science, technology, and human activity and how they can affect the world.
2. Lesson Content
   a. Atmosphere (including layers: troposphere, stratosphere, mesosphere, ionosphere and how the sun and earth heat the atmosphere)
3. Skill Objective(s)
   a. Students will understand that the atmosphere is made up of different layers and that the sun and earth affect the way these layers are warmed.

B. *Materials*

1. Appendix K: Layers of the Atmosphere (two copies per student)
2. Appendix L: Layers of the Atmosphere Teacher Reference (teacher copy for reference)
3. One globe
4. One flashlight
5. *The Ozone Layer*, by Rhonda Lucas Donald

C. *Key Vocabulary*

1. Atmosphere- layer of air surrounding the earth consisting primarily of carbon dioxide, oxygen, nitrogen, and water vapor
2. Air- mixture of gases surrounding the earth called the atmosphere
3. Gravity- a force which pulls everything toward the earth
4. Troposphere- atmospheric layer closest to Earth where Earth's weather occurs
5. Stratosphere- second layer of the atmosphere beyond troposphere that contains the ozone layer
6. Mesosphere- extremely cold layer of atmosphere reaching up to 50 miles high

7. Thermosphere- layer of atmosphere which contains ionosphere, northern and southern lights and where temperatures reach several thousand degrees Fahrenheit
8. Exosphere- boundary between Earth and Space

D. *Procedures/Activities*

1. Ask students what the atmosphere is. Distribute Appendix K: Layers of the Atmosphere. Have students turn it over to the blank side to take down some notes. Have the students jot down the following:

Atmosphere

*the earth is surrounded by layers of air (6,200 miles thick) called the atmosphere
*the atmosphere acts like a blanket around the earth
*air= a mix of gasses: oxygen
nitrogen
carbon dioxide
water vapor
*gravity- holds the atmosphere around the earth and keeps moon in place
-pulls everything toward Earth
-helps speed downhill, but pulls against you going uphill

2. Turn Appendix K over now to the front side. Tell students that this 6,200 mile-thick blanket of air is layered above the earth in five main layers. Use Appendix L: Layers of Atmosphere Teacher Reference to give information about each of the layers. Have students fill in their blank template with this information along with the diagrams of objects found in the different layers.
3. Ask students how the sun and Earth work together to heat the atmosphere. Remind them that the water cycle is one way. Explain that the earth does not warm evenly due to Earth's rotation and tilt. Demonstrate seasonal changes by turning off the light and shining the flashlight on a globe directing the light beam at the equator. Show that the rays are less direct the farther away they are from the equator, especially at the poles. Identify polar, temperate, and tropical regions on the globe, pointing out that they live in the temperate region with changing seasons. Have a student rotate the globe around the flashlight, spinning it in the process. Discuss which hemispheres are most warmed in varying seasons.
4. Aside from the water cycle and seasonal changes, tell students that the Earth and sun also work together to heat the atmosphere through the Greenhouse Effect. Explain that heat energy from the sun is trapped near the earth's surface. The ground cannot change temperatures as quickly as the air can due to this insulation effect. If the days have been very hot, the ground will have also trapped this heat, taking several days to cool off, whereas the ground will store the cold after cold days, taking some time to warm up. In turn, the ground radiates heat, which is absorbed back into the atmosphere. Equate our atmosphere to a greenhouse where the heat is trapped, warming up everything inside the greenhouse. Similarly, warm air is trapped in our atmosphere. Draw a picture of a greenhouse with the sun shining on it. Show that the warm air inside rises and sinks, becoming a cycle of heat.
5. Read *The Ozone Layer* aloud to students. Hold a discussion of how they can help decrease environmental hazards affecting the ozone layer. Brainstorm what things might happen in the future if the ozone continues to deplete.

E. *Assessment/Evaluation*

1. Students will fill out a skeletal diagram of the layers of earth's atmosphere (another copy of Appendix K). Students need to label the layer, its altitude, and one fact about each layer. For extra credit, students may label additional information they know. On the back of the paper, students are to explain in two or three sentences how the earth and sun heat the atmosphere.

Lesson Five: Air Movement (four days)

A. *Daily Objectives*

1. Concept Objective(s)
    a. Students will understand the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigations.
    b. Students will know and understand common properties, forms, and changes in matter and energy.
    c. Students will know and understand the processes and interactions of Earth's systems and the structure and dynamics of Earth and other objects in space.
    d. Students will understand that science involves a particular way of knowing and understand common connections among scientific disciplines.
2. Lesson Content
    a. Air Movement: wind direction and speed, prevailing winds, air pressure, low and high pressure, air masses
    b. Barometers (relation between changes in atmospheric pressure and weather)
3. Skill Objective(s)
    a. Students will indicate and record the relationship between atmospheric pressure and the weather through experimentation following the scientific process of stating a question, formulating a hypothesis, listing materials and procedure, tabulating results, and drawing a conclusion based on these results.
    b. Students will realize the components of air movement including wind direction and speed, prevailing winds, air pressure, low and high pressure, and air masses and will identify the scientific instrument used to measure each.

B. *Materials*

1. Tumbler demonstration materials: tall clear plastic tumbler, paper towel, water, and large clear bowl
2. *Investigations in Science: Weather*, by Brenda Wyma
3. Wind sock materials per student:
    a. 9" x 12" sheet of colored construction paper
    b. Markers
    c. Tissue/crepe paper strips
    d. Three 12" pieces of yarn
    e. Pencil
    f. Ruler
    g. Glue
    h. Hole punch
4. *How the Weather Works* p. 58, by Michael Allaby
5. Twelve 2" x 2" cardstock squares per student
6. One sheet of poster board for every two students

7. Appendix C: Scientific Process Experiment Form (one per student)
8. Air pressure experiment materials:
    a. Balloon
    b. Wide-mouth jar
    c. Rubber band
    d. Straw
    e. Tape
    f. Paper
    g. Pen
    h. Scissors

    (students should supply these materials themselves at home, however it would be a good idea to have some on hand for students who need them)

C. *Key Vocabulary*

1. Wind- the movement of air across our atmosphere
2. Gale- very strong wind
3. Hurricane- large tropical storm with winds of 74 miles per hour or more
4. Jet stream- a band of high speed winds in the upper troposphere that blow or travel from west to east
5. Wind speed- how fast the wind is traveling
6. Air pressure- amount of air in atmosphere pressing down on Earth's surface
7. Weather vane- instrument to measure which direction the wind is blowing from
8. Barometer- instrument used to measure air pressure

D. *Procedures/Activities*

1. Introduce air movement by asking students if air is invisible, how can we show evidence of it. Show that it takes up space through tumbler demonstration:
    a. First, crumple the paper towel and push it tightly to the bottom of the plastic tumbler.
    b. Next, fill the bowl halfway with water.
    c. Then, push the tumbler upside down into the bowl of water.
    d. Now, pull the tumbler straight up out of the water and take out the paper towel. Have students notice that the paper towel is still dry. Brainstorm reasons why this might be.
    e. Guide students toward the conclusion that the air was taking up space in the glass, keeping the water from coming inside.
    f. Discuss other ways to tell that air is visible (by what is affected by it: blowing leaves, coldness, etc.)
2. Define wind and jet stream. Remind them that air is constantly moving in our atmosphere (water cycle). Explain that meteorologists use many instruments to measure weather and obtain the information they need. Several of these instruments use wind to help, one being a weather vane which tells which direction the wind is blowing from, and another is an anemometer which measures wind speed. Have students write these definitions on notebook paper labeled "Air Instruments." Have them also add the terms/definitions for thermometer- an instrument that measures the temperature of the air, barometer- an instrument that measures air pressure, and hygrometer- an instrument that measures relative humidity in the air.
3. Tell students that they will have a chance to make a type of weather vane called a windsock. This device also shows the direction of the wind. Directions for making simple models of the other air instruments can be found in *Investigations in Science: Weather*. pp. 26, 29-33, 40-43. For the windsock, draw diagonal lines a ruler's width apart across the construction paper. Next, color the stripes

different colors with the markers. Then, roll the paper into a cylinder gluing the edges together. Next, punch three holes near the top of the cylinder's ends. Tie a piece of yarn through each of the three holes, connecting them together at the top with a knot. Finally, attach the crepe/tissue paper strips to the bottom of the cylinder. Now the windsock can be hung outside their homes. They can tell the direction of the wind by looking at which direction their windsock is blowing.

4. Introduce Beaufort's Wind Scale from *How the Weather Works* p. 58. Distribute twelve 2" x 2" squares of card stock to each student. Using these pictures as a guide, have students draw pictures of these wind types onto their squares including its number according to Beaufort's Scale and the type of wind it is. Pair each student with a partner and give each group a sheet of poster board. On their poster board, students need to design a board for a game. The will need a "start" and "finish" square with 100 squares in between. The design of their path does not matter, it can be windy, a spiral, etc., as long as they can move from start to finish. If they have extra time, they may decorate their board with weather symbols or blowing objects. Have them create and label a wind-related title for their game. Next, they are to combine each of their card sets into a pile, shuffling them up a bit and placing them face down. Then, each student needs to find an object in their desk to use as a placemarker for the game (coin, small eraser, etc.) and place their marker on "start." After deciding who will go first, the first player will draw from the top of the card stack. If they draw a wind type 0-6, they move backward that many spaces. If they draw a wind type 7-12, players move forward that many spaces. Players continue to draw wind cards to see how far and in what direction the wind blows them until the first player reaches the "finish" square. Students may then repeat the game, if time allows.
5. Have students add onto their notes the notation for wind direction and speed (example: W8= wind blowing from the west at 8mph). Next, explain that several things cause wind speeds to be different including friction, jet stream, prevailing winds, high and low pressure systems, and air masses, adding a brief explanation of each one onto their notes. A good reference source for this is *Investigations in Science: Weather* pp. 23-35.
6. Tell students that there is a direct relation between atmospheric pressure and the weather and that they will be experimenting to see what it is. This will be an evaluation not only to determine results, but to also assess whether students can properly complete the Scientific Process on their own, since they have already done several teacher-guided experiments leading them through the steps. Tell the students that the question they will be testing is "What is the relationship between air pressure and weather?" List materials on the board along with the set of procedures. Also copy down the chart below on the board. Given this information, they need to complete the rest of the Scientific Process Experiment Form (Appendix C) and perform the experiment at home. They will need to copy the chart below onto a sheet of paper, complete it during the experiment, and attach it to Appendix C when it is complete. They will have one week in which to complete this assessment. After one week, go over results as a class and make sure that students concluded that low pressure systems bring colder weather including winds, dropping temperatures, cloudy skies, and precipitation, and high pressure systems bring warmer weather, steady temperatures, and light winds.
7. Procedures for this experiment include:
    a. Blow up the balloon and then let the air out. Cut off and discard the neck.

b. Stretch the balloon over the mouth of the jar. Place the rubber band over it to secure it to the jar.
c. Tape the straw on top of the balloon so that the straw is three-fourths of the way across the mouth of the jar.
d. Tape the paper to a wall behind the jar, lining up the bottom of the paper with the bottom of the jar.
e. Draw a horizontal line on the paper at the height of the jar. Now draw four lines above this line and four lines below this line one-fourth inch apart. Write "High" above the top line and "Low" below the bottom line.
f. On the paper, mark and date the position of the straw for at least five days.

Date	What is the weather like today?	Is the air pressure HIGH or LOW?	What is your forecast for tomorrow?

E. *Assessment/Evaluation*
1. Students will demonstrate the relationship between air pressure and the weather through experimentation, and will independently follow steps in the Scientific Process and record findings including stating a question, forming a hypothesis, listing materials, following a procedure, recording results, and reaching a conclusion based on these results (Appendix C).
2. Students will divide a sheet of paper into two columns, writing the different wind instruments on the left-hand column and writing what they are used for in random order in the right hand column. Afterwards, students are to trade their sheet of paper with another student and match the wind instruments with their function by drawing a connecting line between the two.

Lesson Six: Cold and Warm Fronts (four days)

A. *Daily Objectives*
1. Concept Objective(s)
   a. Students will understand the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigations.
   b. Students will know and understand the processes and interactions of Earth's systems and the structure and dynamics of Earth and other objects in space.
   c. Students will know and understand interrelationships among science, technology, and human activity and how they can affect the world.
2. Lesson Content
   a. Cold and Warm Fronts: thunderheads, lightning and electric charge, thunder, tornadoes, hurricanes
3. Skill Objective(s)
   a. Students will learn differing weather patterns due to cold and warm fronts.

B. *Materials*
1. Several weather maps (one per every four students)
2. Air mass demonstration materials:
   a. Clear baking dish

b. Warm and cold water
c. Two cups cold milk

3. Appendix C (optional: one copy per student)
4. Appendix M: Fronts (one copy per student)
5. "Storm Smarts" from *Teachers Helper* April/May/June 1998 p. 5 (this is a reproducible that can be found at the public library or most schools; each student will need one copy)
6. Variety of children books on thunderstorms, hurricanes, tornadoes, and blizzards (enough books for every one or two students)
7. *Eyewitness: Weather*, narrated by Martin Sheen
8. Present day's newspaper weather map (need to reduce and make one copy per student)

C. *Key Vocabulary*

1. Cold front- the air mass sliding underneath the warm air and pushing it away creating strong winds and precipitation
2. Warm front- occurs when air moves in over a cold front creating gentle winds and light rain
3. Stationary front- occurs when cold and warm masses meet, creating a "stand off" and causing temperatures to remain constant
4. Front- a boundary between two air masses

D. *Procedures/Activities*

1. Before this lesson display several weather maps around the room for step 2. Show simple demonstration of what happens when a cold air mass meets a warm air mass. First, ask students the question, "What will happen when cold milk is poured into warm water?" You may wish to have students complete a Scientific Process Experiment Form for this lesson (Appendix C). If so, give them time fill in the question, hypothesis, materials, and procedures on their forms before proceeding. Share a few hypotheses together. Next, fill the clear dish halfway with very warm tap water. Then, pour the milk into the water at one side of the dish. Watch carefully, noting the movement and shape of the milk as it flows through the water. Repeat experiment using cold milk and cold tap water. Discuss results and form a conclusion that can be applied to cold and warm air masses such as when an approaching cold air mass meets a warm air mass, the heavier cold air pushes the warm air upward
2. Go over Appendix M: Fronts with students and have them include this information in their notes. Once they have received this basic information on fronts, assign groups of four to a weather map posted around the room. Groups are to record which type of front is on their weather map along with what type of weather it will bring. Gather again as a class and discuss results, mentioning that a lot of information about coming weather can be obtained by looking closely at weather maps.
3. Discuss weather types common where we live. What kinds of severe weather do we experience? What severe weather types do not occur here? What are the positive and negative aspects of living in regions where severe weather types occur?
4. List severe weather types thunderstorms, hurricanes, tornadoes, and blizzards on the board. Have students sign up under the weather type that most intrigues them, keeping groups fairly even. Distribute "Storm Smarts" from *Teacher's Helper* April/May/June 1998 p. 5 to students. On this sheet are four headings, "Thunderstorms," "Hurricanes," "Tornadoes," and "Blizzards." Each heading has 5-6 bullets in a column with blank lines next to them. In the center of the

page is a list of bullets with facts next to them about the four different topics. Students are to work in selected groups to find the correct fact to go with the heading, and then write it in the blank beside the bullet under the correct heading. Students may use storm reference books for research as needed. Upon completion, each group needs to provide five more interesting facts about their selected topic on the back of the page. Go over results to "Storm Smarts" as a class, making sure that students matched up correct facts to headings. Then have each group share their interesting facts to the rest of the class.

5. Show the movie: *Eyewitness: Weather*. While watching the movie, have students jot down 10 interesting facts about storms they did not already know.

E. *Assessment/Evaluation*

1. Given a weather map from the present day's newspaper including frontal patterns and pressure zones, students will attach a written explanation of the weather for one day.

Lesson Seven: Forecasting the Weather (five days)

A. *Daily Objectives*

1. Concept Objective(s)
   a. Students will understand the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigations.
   b. Students will know and understand the processes and interactions of Earth's systems and the structure and dynamics of Earth and other objects in space.
   c. Students will understand that science involves a particular way of knowing and understand common connections among scientific disciplines.
2. Lesson Content
   a. Forecasting the Weather: weather maps, weather satellites
3. Skill Objective(s)
   a. Students will review weather instruments including the thermometer, barometer, anemometer, weather vane, hygrometer, and satellite as well as several others not previously studied and predict what additional information we may gain from satellites or more advanced instruments in the future.
   b. Students will observe various forecasts and judge what makes one more successful than another.
   c. Students will chart daily observations of weather and use this data to create and orally present a weather forecast in which they will use a self-made weather map and data graph as visual aids to support their findings.

B. *Materials*

1. *The Nature Company Discoveries Library: Weather* pp. 34-41, by Sally Morgan
2. Several videotaped weather reports from a local TV station (this will need done several days in advance)
3. Appendix N: Weather Chart (one copy per student)

C. *Key Vocabulary*

1. Weather map- map that uses various symbols to show weather conditions over different parts of the world
2. Weather satellite- an orbiting instrument that monitors atmospheric conditions and transmits the information back to Earth
3. Forecast- prediction of coming weather
4. Climate- average weather in a region over a long period of time

D. *Procedures/Activities*

1. Ask students to think back to the different weather instruments studied so far. See how many students can list. Read aloud *The Nature Company Discoveries Library: Weather* pp. 34-39 about the history of forecasting and weather instruments developed over time including the thermometer, barometer, wind vane, anemometer, hygrometer, satellite, along with several others not studied in this unit. Discuss how these instruments have changed in style over the years and have become more advanced, although still based on the same basic principles. Discuss what kind of information we can learn from satellites, why they are helpful to us, and predict what information we might receive from them in years to come.
2. Review what information can be obtained from a weather map. Read aloud pages 40-41 from *The Nature Company Discoveries Library: Weather*. Point out Weather Symbols Key at the bottom of page 40. Mention that most of these symbols are fairly standard on every weather map, although different sources may vary a few of the symbols, therefore it is important to always look at the key before studying the map. Point out what isobars refer to and how Meteorologists can gain information from them. Review weather patterns of frontal systems (as learned in Lesson Six).
3. View several videotaped weather reports from a local television station. Afterward ask students how much information they recognized and understood. Then watch the tape again, replaying and discussing segments not understood. Evaluate the different weather reports, ranking which was best and discuss why this may be. What makes a weather report easier to understand and follow along with?
4. Let students know that many observations must take place before being able to forecast the weather and that they will have a chance to be a forecaster themselves. Distribute Appendix N: Weather Chart to the class. Go over the different terms, making sure students know what to record for each. Students will be filling in the chart at home for five consecutive days. At the end of this time, students will work in small groups to compare results. The group will need to come to an agreement on chart data they will present to the rest of the class. Then, as a group, students are to use these results to predict next week's weather. They will then need to decide how to present this information to the class in a simulated weather forecast and practice their presentation. They will also need to include a line or bar graph for temperature, air pressure, or humidity to help support their findings. They will need to use this graph along with a simple weather map as a visual aid during their forecast. Have students present after a few days of preparation (they may need to work on this project some on their own time).
5. Discuss how knowing an area's climate type and weather pattern plays an important role in our lives and that it gives us an indication on what to wear and what plans to make at different times of the year. Divide the class into teams of four and assign each team a weather type (such as blizzard, hurricane season, cloudy, sunny, slight chance of rain, etc.) Teams are to pretend they are on a vacation together. They will need to decide on a destination, compile a list of clothes they will need to bring to suit the climate, and write down what kind of activities they will do according to the weather. Have students share their vacation plans to the rest of the class.

E. *Assessment/Evaluation*

1. Through classroom discussion, students will predict future uses of weather satellites or types of weather information attainable from other advanced weather instruments after reviewing various weather instruments used in the past and present.
2. Students will observe and record weather data for five consecutive days on a weather chart (Appendix N). On the back of the chart students will write a brief summary of their findings including their weather predictions for the following week based on their data.
3. After viewing several television forecasts and determining which elements create a good forecast, students will work in teams and give an oral presentation to the class of the next week's upcoming weather. Within this forecast, students will include as visual aids a self-created weather map and a data graph based on their weather chart

VI. CULMINATING ACTIVITY (four days)

A. **Guest Speaker:** At the beginning of the year line up a time when a Meteorologist can visit the school (some Meteorologists are booked up a year in advance, so it is very important to schedule this as soon as possible). Several days before the guest speaker visits, brainstorm as a class a list of interview questions they would like to ask a meteorologist. Have students write a list of ten questions on notebook paper, including up to five of the brainstormed questions if they wish, however at least five need to be their own. If students would like to submit their list as a potential list of interview questions, have them turn it in. Read through these and select the top five lists. Present these to the class and have students vote on the best three and that will determine the interviewers. The three are to work together to combine and type 10 questions into a finalized list to use for the interview. Create a transparency of this list to share with the rest of the class. The class needs to copy these questions down for later reference. On the day of the guest speaker's appearance, interviewers will take turns asking questions. The rest of the class will bring along their copy of the questionnaire and record answers during or after the presentation. Afterward, interviewers will need to properly thank the speaker. Discuss as a class any questions that may have been left unanswered and collect response sheets. Have the class make a thank you card to send to the speaker.

B. **Culminating Examination:** Give students unit study guide (Appendix O) a week in advance to study from a little each night. The day before the test, have students play a review jeopardy game. The categories may be "Walkin' on Water" (water cycle), "Head in the Clouds" (clouds), "Up in the Air" (atmosphere), "Gone with the Wind" (air movement), "A Storm's a Brewin'" (cold and warm fronts), and "Fancy Forecasting" (forecasting the weather). Write five questions/answers based on these categories varying in difficulty, and assign a point value to each of the questions (100-500). When playing, divide the class into two teams and take turns asking the teams questions. As in standard Jeopardy, students will select a category, and hear the answer to the question. They need to correctly state the question to match the answer to receive the points. If they miss the question, the other team has a chance to answer. Play continues for as long as there is time or questions left. The winning team will be the team with the most points when the time limit is reached. The next day, have students complete the culminating unit exam (Appendix P).

C. **NCAR Field Trip:** If possible, try to arrange for the visit to take place soon after the unit exam. A few weeks before visiting, have students write a letter to NCAR (National Center of Atmospheric Research in Boulder, Colorado) asking what exactly it is they do there and how it may tie in with what they are studying (allowing for response time).

Discuss response letter (if received). Make a list of questions they might want to have answered by visiting the center. Explain that on the field trip they are to try to answer their questions by observation and perhaps asking questions. On the bottom of the worksheet they are to note what new machines or instruments they learned about on their visit and why they were so interesting. Upon returning, collect student sheets and discuss responses as a class.

VII. HANDOUTS/WORKSHEETS

A. Appendix A: Weather Words
B. Appendix B: Water Cycle Notes
C. Appendix C: Scientific Process Experiment Form
D. Appendix D: Evaporation Experiment
E. Appendix E: Condensation Experiment
F. Appendix F: Water Cycle Quiz
G. Appendix G: The Cloud Book Review Questions
H. Appendix H: Cloud Types
I. Appendix I: Altitude Chart
J. Appendix J: Cloud Quiz
K. Appendix K: Layers of the Atmosphere
L. Appendix L: Layers of the Atmosphere Teacher Reference
M. Appendix M: Fronts
N. Appendix N: Weather Chart
O. Appendix O: Meteorology Study Guide
P. Appendix P: Meteorology Unit Test

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Appendix A

Name_____#___
Date_____

WEATHER WORDS

1. temperature- _____
2. air pressure- _____
3. moisture- _____
4. wind- _____
5. humidity- _____
6. dew- _____
7. frost- _____
8. clouds- _____
9. fog- _____
10. rain- _____
11. drizzle- _____
12. tornado- _____
13. rainstorm- _____
14. flood- _____
15. thunderstorm- _____
16. thunder- _____
17. lightning- _____
18. sleet- _____
19. flurries- _____
20. hurricane- _____
21. blizzard- _____
22. hail- _____

(Optional: rainbow, shower, gusty, gale, front, air mass, high pressure, low pressure, snow, snowstorm)

Appendix B

Name_____#___
Date_____

WATER CYCLE NOTES

Background Information:

The **water cycle** is a constant process of evaporation, condensation, precipitation, and runoff or seepage. As the sun shines down over bodies of water, heating them, the water evaporates and turns into a gas, rising up into the air called water vapor. This is called **evaporation**, a change from water to water vapor.

As the gas travels higher, the air cools it down. Then some of the water vapor condenses around a small speck of dust to form clouds. **Condensation** is the change from water vapor (gas) to water (liquid).

When the drops become too heavy to stay in the cloud, they drop down as rain (**precipitation**). Some of this rain seeps into the ground (**seepage**) while other raindrops **run off** into rivers, streams, or back to the ocean where the water cycle began. Now the water is ready to begin its journey once more through the steps of evaporation, condensation, precipitation, and runoff or seepage.

Notes:

Appendix C

Name_____#___
Date_____

SCIENTIFIC PROCESS EXPERIMENT FORM

Activity Title: _____

Question: (What do you want to find out?) _____

_____

_____

Hypothesis: (Predict what you will find out) _____

_____

_____

Materials: (List items you will need for this experiment) _____

_____

_____

_____

Procedure: (List steps you will take to test your hypothesis)

1. _____
2. _____
3. _____
4. _____

Results: (What actually happened?) _____

_____

_____

Conclusion: (What did you learn from this experiment?) _____

_____

_____

Appendix D

Name_____#___
Date_____

EVAPORATION EXPERIMENT

Question: What causes water to evaporate?

Hypothesis: _____

_____

Materials per group: three strips of plain paper
one tin plate
one damp sponge

Procedure: 1. Dampen each strip of paper by *gently* patting them on the sponge.

2. Roll on strip into a ball, lay one strip flat, and wave the other back and forth in the air while counting slowly to 50.

3. Observe the three strips of paper for a few minutes, then answer the questions below.

Results:

1. Which strip of paper dried the most? _____

2. How was it different from the others? _____

_____

3. Which paper strip dried out the least? _____

4. How was it different from the others? _____

_____

5. Why do you think the one paper strip dried out the fastest? _____

_____

Conclusion:

What causes water to evaporate? _____

_____

_____

Appendix E

Name_____#___
Date_____

CONDENSATION EXPERIMENT

Question: What happens during condensation?

Hypothesis: _____

_____

Materials per group: two jars with lids
3-4 ice cubes
warm water

Procedure: 1. Fill both jars half full of warm water.

2. Place the lids upside down on the mouths of the jars. Place as many ice cubes as will fit on only one of the lids.

3. Observe the two jars for a few minutes, then answer the questions below.

Results:

1. Describe the bottom of each lid. _____

2. How are the two jars different? _____

_____

3. Why do you think one jar changed while the other one did not? _____

_____

4. In the space below draw a picture of your experiment. Be sure to label your materials.

Conclusion:

What happens when water condenses? _____

_____

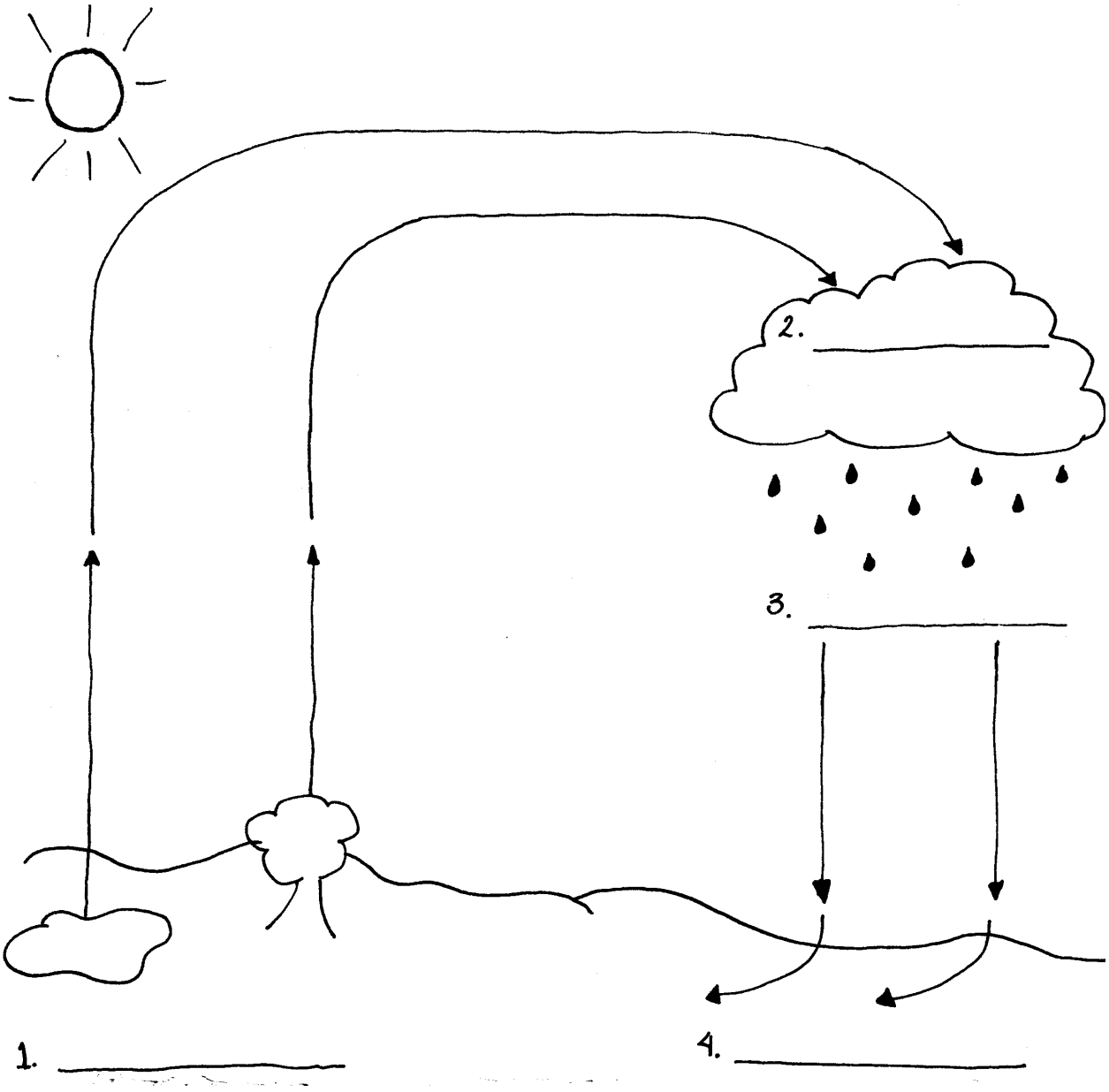
_____

Appendix F-1

Name_____#___
Date_____

WATER CYCLE QUIZ

Directions: On the diagram below, label the numbered areas with the following words:
CONDENSATION, RUN-OFF/SEEPAGE, PRECIPITATION, EVAPORATION



Appendix F-2

PLEASE ANSWER THE FOLLOWING QUESTIONS:

1. What is another name for the water cycle? _____
2. What does H_2O stand for? _____
3. How much of Earth's surface is covered in water? _____
4. Tell me in *complete sentences* what a meteorologist is and what he/she does:

   _____

   _____

5. List three forms of precipitation:

   A. _____
   B. _____
   C. _____

6. How long has our water been on Earth?

MATCH THE FOLLOWING:

1. Condensation	A. Invisible Gas
2. Water Vapor	B. A constant process of evaporation, condensation, precipitation, and runoff/seepage
3. Evaporation	C. the process of liquid water changing to water vapor
4. Water Cycle	D. the process of water vapor changing to liquid water

ANSWER THE FOLLOWING QUESTION IN COMPLETE SENTENCES:

Remember back to the different experiments done in class. Which experiment showed condensation? Describe the experiment and why this is an example of condensation. Next explain how this is different than evaporation. (Please answer all parts of this question using at least 3 complete sentences.)

BONUS: TELL ME YOUR FAVORITE PART OF THE WATER CYCLE AND WHY IT IS YOUR FAVORITE.

Appendix G

Name_____#___
Date_____

THE CLOUD BOOK REVIEW QUESTIONS

1. Clouds are: _____

2. The three main types of clouds are:_____, _____, and _____

3. Draw a picture of and label the three main types of clouds:

4. The highest clouds which are sometimes called “mares’ tails” are called _____clouds.

5. Puffy clouds that look like cauliflower, have flat bottoms, and are always changing shape are _____ clouds.

6. Low clouds that look like wide blankets of gray sometimes known as “high fogs” are called _____ clouds.

7. List the names of three cloud names other than cirrus, stratus, and cumulus:

   _____, _____, and _____

8. What is fog? _____

9. Write a saying that tells about weather: _____

   _____

10. Draw and label a shape that you have seen formed in the clouds:

Appendix H

Name_____#___

Date_____

CLOUD TYPES

CLOUD TYPES	DESCRIPTION	TYPE OF WEATHER	ALTITUDE (WHERE IN SKY)	OTHER FACTS	[ICTURE

Appendix I

Name_____#___
Date_____

ALTITUDE CHART

LOW LEVEL (6,500 ft. or less) -water droplets-	MID LEVEL (6,000-20,000 ft.) -some ice-	HIGH LEVEL (20,000-45,000 ft.) -ice crystals-
	6,000 ft.	20,000 ft. 40,000 ft.

Appendix J

Name_____#___
Date_____

CLOUD QUIZ

1. What are clouds? _____

2. List the 3 main kinds of clouds:_____, _____, and _____

MATCH THE FOLLOWING:

Cirro _____	A. Mid-level Clouds
Alto _____	B. Stratus
Nimbo_____	C. Sheets or layers
Strato _____	D. Rain cloud
Low-level Clouds_____	E. High clouds
Mares' Tales_____	F. Cirrus Clouds

3. Fluffy clouds that look like cauliflower are called _____.

4. What is fog?_____

5. Which cloud would tell you if a thunderstorm were going to happen?
   A. Cumulonimbus
   B. Stratocumulus
   C. Cirrostratus

6. Which clouds are the highest clouds in the sky?
   A. Stratus
   B. Cumulus
   C. Cirrus

7. Where in the sky would altostratus be found?
   A. Middle
   B. Low, at ground level
   C. High in the sky

8. On a day with stratus clouds, what type of clothes would you wear?_____
   _____

9. On a sunny summer afternoon, what type of cloud would you see? _____
   _____

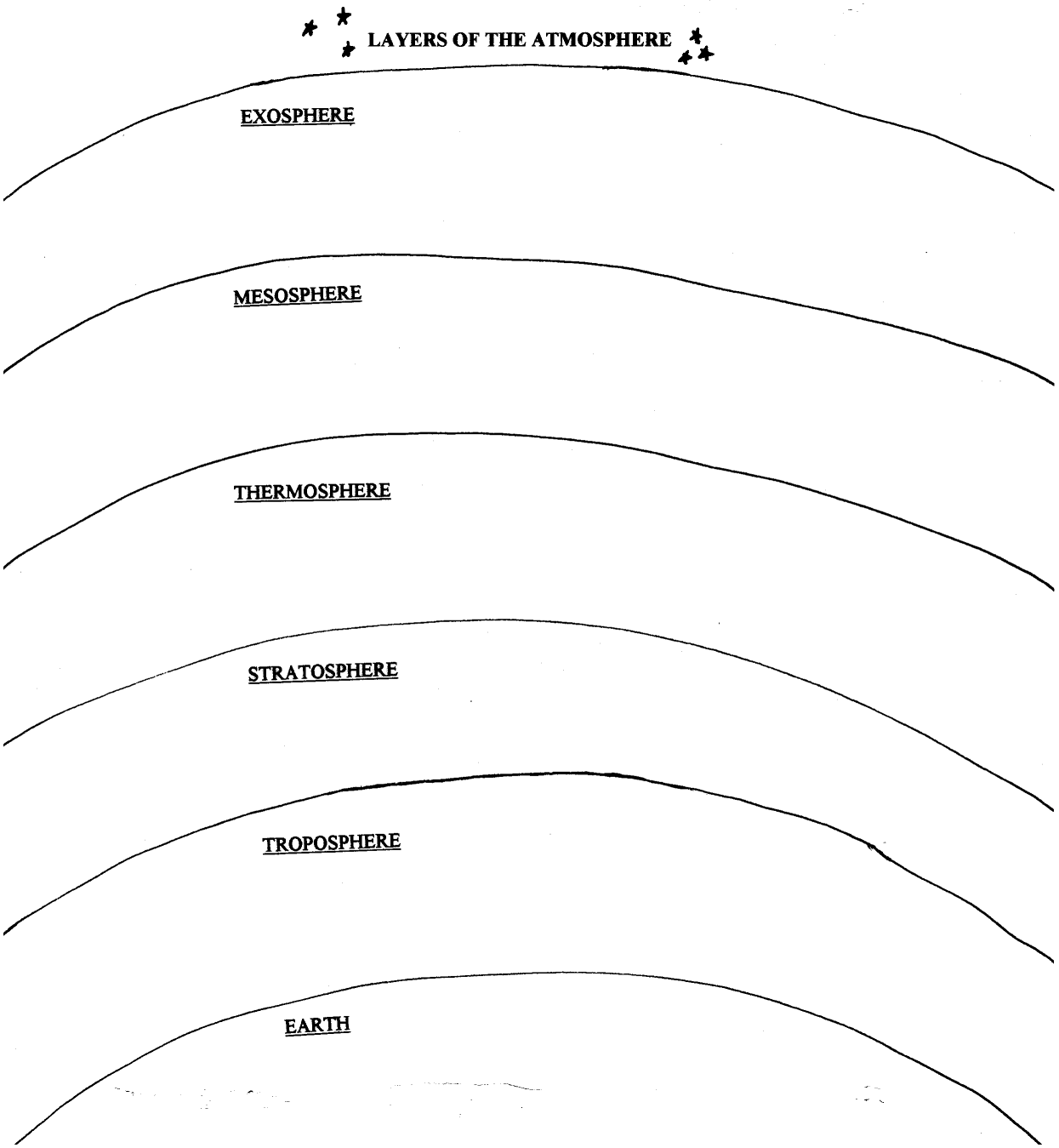
10. Somewhere on this test, draw and label an example of a cirrus, stratus, and cumulus cloud.

BONUS: Did Luke Howard invent:
   A. The Water Cycle
   B. Cloud Names
   C. Meteorology

Appendix K

Name_____#___

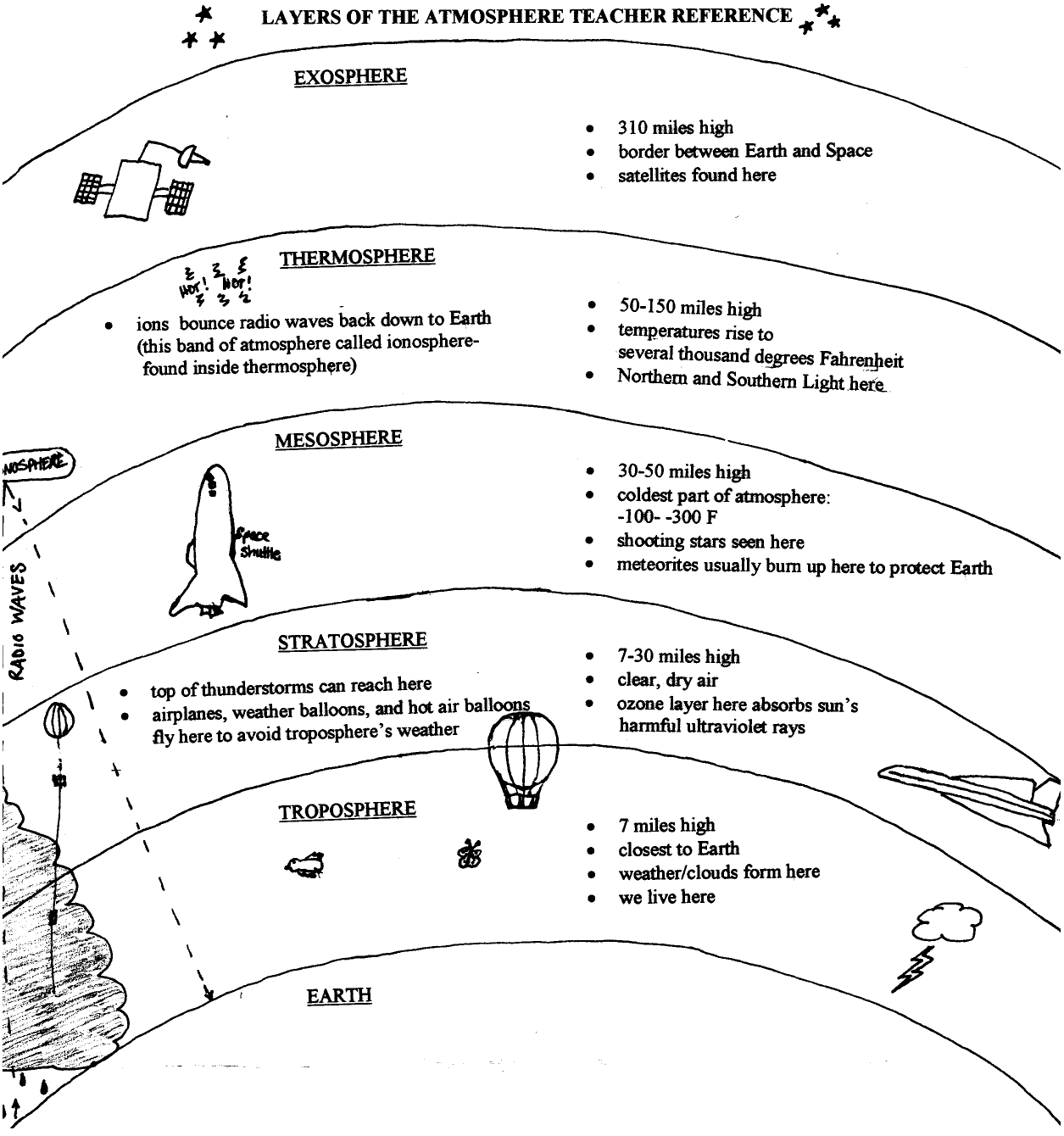
Date_____



Appendix L

Name_____#____

Date_____



Appendix M

Name_____#___
Date_____

FRONTS

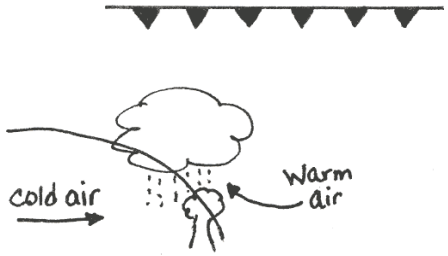
Front- a boundary between warm and cold air masses

-sun's heat and earth's rotation cause these air masses to move

1. Cold Front- quick moving cold front can displace warm air creating clouds, strong winds, and precipitation

   -forms when cold air is moving under a mass of warm air

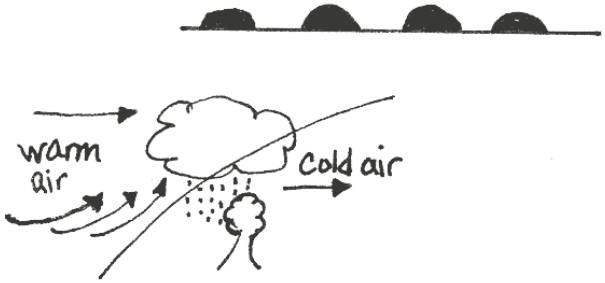
   -brings: clouds
   strong winds
   precipitation



2. Warm Front- slow moving warm front may slide over cold air to create gently blowing winds and light rain

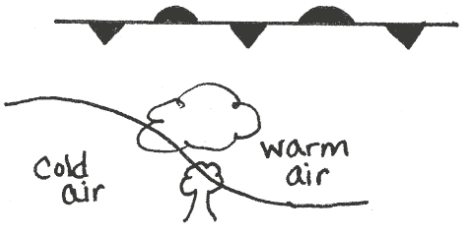
   -forms when warm air moves over a mass of cold air

   -create: gentle winds
   light rain

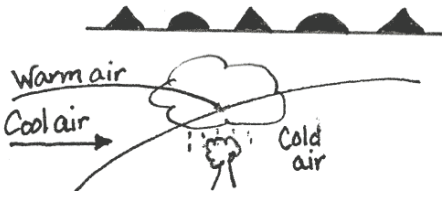


3. Stationary Front- a "stand off" between warm and cold air masses. Neither air mass advances; they remain stationary.

   -weather stays about the same
   -when the masses move, watch for changing weather!



4. Occluded Front- forms when a cold front catches up with a warm front, creating a boundary which suspends warm air above the ground



Appendix N

Name_____#___
Date_____

WEATHER CHART

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
Date/ Time					
Temperature					
Air Pressure					
Humidity					
Wind Direction					
Wind Speed					
Precipitation (type/amount)					
Cloud Cover					
Cloud Type(s)					
Next Day Predicted Forecast					
Other Observations					

Appendix O-1

Name_____#___
Date_____

METEOROLOGY STUDY GUIDE
Test Date: _____

DEFINITIONS:

Meteorologist is a scientist who studies and forecasts weather.

Weather occurs in the troposphere layer of the atmosphere. Weather occurs in the forms of temperature, air pressure, moisture, and wind.

Water Cycle is called the Hydrologic Cycle. It is the constant process of evaporation, condensation, precipitation, and run-off (or seepage.)

4 STEPS OF THE WATER CYCLE (ECPR):

Evaporation is the change of liquid water to water vapor.

Condensation is the change of water vapor to liquid water.

Precipitation comes down in the form of snow, rain, hail, and sleet.

Run-off is precipitation which has fallen to Earth. Some precipitation runs off into streams, rivers, and oceans. Other precipitation seeps (or soaks) into the ground and is called seepage.

CLOUDS:

Clouds- are millions of tiny water droplets or ice crystals hanging in the upper atmosphere.

The three basic categories of clouds are:
1. Cumulus
2. Stratus
3. Cirrus

Cumulus clouds are puffy, look like cauliflower, and bring fair weather.

Stratus clouds are flat, layered, gray clouds which bring rain or drizzle. When they occur at ground level they are called fog.

Cirrus clouds look like mares' tails. They are feather wisps or curls made of ice crystals. They are found high in the sky.

"Cirro" means high-level clouds
"Alto" means mid level clouds'
"Strato" means sheets or layers
"Nimbo" means a rain cloud

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ATMOSPHERE:

Atmosphere- the Earth is surrounded by a thick layer of air
-also known as a "blanket around Earth"

Air is a mixture of gases. The gases which make up the air are:

1. Carbon Dioxide
2. Oxygen
3. Nitrogen
4. Water Vapor

Gravity is a force which pulls everything toward the Earth. If we didn't have gravity, we would float like astronauts do when in space.

The higher in the atmosphere you are, the less oxygen is in the air. For example, if you climbed a mountain (Pike's Peak), at the top there is less air than when you are at home or school. Near the oceans there is more air than in Denver.

There are 5 layers in the Atmosphere, they are:

Troposphere- We live in this layer. All weather occurs here. 7 miles high.

Strotosphere- The layer above the troposphere. Airplanes fly in the low part of this layer. The top of a thunderstorm breaks into the stratosphere. The ozone layer, which absorbs harmful sunrays, is here. This layer is above the clouds. 30 miles high.

Mesosphere- Very cold here. The temperature can reach below –300 F. Shooting stars and meteorites can be seen here. Meteorites burn up here. Space shuttles travel here. 50 miles high.

Thermosphere- Temperatures may rise to several thousand degrees Fahrenheit. Northern and southern lights can be found here. In this layer, the ionosphere will bounce radio waves back down to Earth. 150 miles high.

Exosphere- This layer is the border between Earth and space. It is 310 miles away. Satellites are found in this layer.

How does the atmosphere receive heat?

1. **Water Cycle**: Earth is warmed and water molecules evaporate which then warm our atmosphere.

2. **Season Changes**: The Earth's tilt on its axis and position around the sun causing seasonal changes brings unequal warming of the sun's rays to Earth.

3. **Greenhouse Effect**: Ultraviolet rays from our sun shines on Earth, warming land and water, bounces back up and becomes trapped in the stratosphere, keeping the heat in the atmosphere.

Remember: The sun does not heat the Earth evenly. The poles are cold and frigid. The equator is warm and tropical. The Earth is tilted on its axis, so the equator receives more sun than the poles.

Appendix O-3

AIR MOVEMENT:

Wind is the movement of air across our atmosphere. The air moves when the sun heats the Earth (land and water).

Jet Stream- is a band of high-speed winds (150 mph) in the upper troposphere that blows or travels from west to east.

Wind Direction- is the direction the wind is blowing from (measured by a **weather vane**). If a Northern wind occurs, the wind is blowing from the North. If wind blows from the Northeast, the wind direction is Northeast. Northwest wind is from the Northwest. (Example: W8= west wind blowing at 8 mph)

Wind Speed is determined by using an anemometer. The faster the cups move, the higher the wind speed.

Wind Speed (examples from the Beaufort Scale)

1-3 mph = light air, smoke goes straight up
13-18 mph = moderate breeze, small branches move
39-46 mph = gale, twigs and branches snap off
75+ mph = hurricane, widespread destruction

Air Pressure is the air in the atmosphere pressing down on Earth's surface (measured by a **barometer**). Airplanes have low pressure because they are moving in the air. Air keeps them in the sky. There is lots of air pressure in cars, trucks, and bikes because they support the weight of people and the automobile.

The speed of wind determines the air pressure so if it is very windy weather it is low pressure. If the weather is warm, fine and calm, then it is high pressure. Because of the uneven heating of the Earth, it creates large bodies of air (air masses) over areas of the Earth.

COLD AND WARM FRONTS:

Cold Front is the air mass sliding underneath the warm air and pushing it away. This creates strong winds and precipitation.

Warm Front is when air moves in over a cold front. This creates gentile winds and light rain.

Stationary Front is when cold and warm masses meet. Often clouds will form, but stationary fronts hang around or are stationary. The weather stays about the same.

Storms:

Hurricane- violent thunderstorm which occurs in oceans. Brings heavy rains and winds. Winds can be 74-200 mph. The **Eye of the Storm** is the center of the hurricane. In the center of the storm, it is calm and cloudless. It can have clear blue skies. The strongest winds are around the center of the storm.

Tornadoes- windstorms which can reach 300 mph. Winds are powerful. They form over land. "Tornado Alley" is located in the Central US and Canada. Many tornadoes occur here.

Thunderstorms- are powerful storms containing lightning and thunder.

Lightning travels at 60,000mps. More than 100 lightning bolts strike the Earth in a day. Lightning is electricity in the air.

Thunder is a sound we hear during a thunderstorm. Thunder is heated air that is cooled and explodes. The explosion you hear is shock waves in all directions, which makes thunder.

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Name_____#___
Date_____

METEOROLOGY UNIT TEST

Please use the words below to fill in the blanks:
Meteorologist, Clouds, Run-off, Water Cycle, Weather, Precipitation

1. Condensed tiny droplets of water which float above the earth. _____
2. _____ comes down in the form of snow, rain, hail, or sleet.
3. Mike Nelson is a scientist who studies and forecasts weather, what is his job title? _____
4. I occur in the troposphere layer of the atmosphere. I occur in the form of precipitation, wind, temperature, and humidity. What am I? _____
5. _____ is also called the Hydrologic Cycle. It is the constant process of evaporation, condensation, precipitation, and runoff/seepage.

What are the three basic categories of clouds?

1. _____
2. _____
3. _____

Match the following:

1. Cirro means _____	A. rain cloud
2. Strat means_____	B. sheets or layers
3. Nimbo means _____	C. High-level cloud
4. Alto means _____	D. instrument which measures temperature
5. Thermometer means _____	E. mid level clouds
6. Blanket around the earth_____	F. moving air
7. Wind is _____	G. atmosphere

Name two of the gases, which make up air. If you name all four, you will receive extra points.

1.

2.

Appendix P-2

There are 5 layers in the atmosphere. Use their names below to fill in the blanks:
Troposphere, Stratosphere, Mesosphere, Thermosphere, Exosphere

1. Which layer is the border between Earth and space? Satellites are found in this layer. _____

2. In this layer, weather occurs and we live here. _____

3. This layer is really cold, and shooting stars and meteorites can be found here. _____

4. In this layer right above the Troposphere, airplanes and hot air balloons travel. The top of a thunderstorm cloud may break into this layer at times. _____

5. In the _____, temperatures may rise to several thousand degrees. The Northern and Southern lights may be seen here at times.

Please answer the following questions and answer in complete sentences:

1. What is gravity?

2. How does the atmosphere receive heat? (Choose at least one way to explain)

3. Does the sun heat the Earth evenly? Yes or No. Please tell me why or why not.

4. What is the jet stream?

5. Draw a picture of a cold front:

6. Draw a picture of a warm front:

Appendix P-3

7. Draw a picture of a stationary front:

8. If the meteorologist says the wind is a "W 12," what does he/she mean?

9. Tell me two things about a hurricane.

    1.

    2.

10. What is a tornado? Please tell me two things about it.

    1.

    2.

11. What is a thunderstorm? Please list two things I should know about it.

    1.

    2.

12. Tell me what the "eye of the storm" is.

13. Thunder is _____.

14. What was your favorite thing about this Meteorology unit? (include at least three sentences)