THE WEATHER CLASSROOM®

WEATHER & WATER

Preview

Water — 70% of our planet is covered with it and 70% of our bodies are made up of it. Without it, plants and animals could not live and the beautiful blues and greens of Earth would not exist.

Weather Fact

Flood Sense
Less than two feet of water can lift and carry a car or bus. Vehicles are involved in more than half of all flood-related fatalities. Many victims literally drive into harms way.

Weather Terms

All glossary terms can be found at http://www.weatherclassroom.com

altocumulus	altostratus	cirriform	cirrocumulus
cirrostratus	cirrus	cloud	cloud bank
condensation	condensation nuclei	cumuliform	cumulonimbus
cumulus	cumulus humilis	dew	dew point
drought	evaporation	flash flood	flood
flood plain	flood stage	fog	frost
high clouds	humidity	hydrologic cycle	hydrometeor
hydrosphere	hygrometer	ice	low cloud
middle cloud	nimbostratus	Palmer Drought Index	saturation
sky cover	stratiform	stratocumulus	stratus
transpiration	water	water cycle	water vapor

This lesson addresses the following National Standards:

Science as Inquiry
- Abilities necessary to do scientific inquiry
- Communicate scientiic procedures and explanations
- Understanding about scientific inquiry

Physical Science
- Properties and changes of properties in matter
- Transfer of energy

Life Science
- Structure and function in living systems
- Populations and ecosystems
- Diversity and adaptations of organisms

Earth & Space Science
- Structure of the earth's system
- Earth's history
- Earth in the solar system

Science in Personal and Social Perspectives
- Natural hazards
- Science and technology in society

Language Arts
- Write stories, make written and oral presentations

Visual Arts
- Illustrate

Geography
- Physical systems; environment and society

Q & A

Start Talking

Water is the single most important molecule on Earth. Without it no life would exist. In fact, all organisms are made mostly of water. What percent of the Earth is covered by water? What is the average percent of water in an organism's body?

Answer: About 70% of the Earth is covered by water. On average, 70% of an organism's chemical make-up is water. However, this varies among Earth's diverse species. For example, a jelly fish's body may contain over 90% water while some woody plants may contain less than 50% water.

Why is water so important to life?

Answer: Water is a polar molecule, that is, it has a slightly positive charge on one side (oxygen) and a slightly negative charge on the other (hydrogen). As a result water can easily form a chemical bond with other polar molecules, both organic and inorganic. This bonding can cause the molecules to dissolve and form a solution. For example, if a sugar cube is placed in a container of water, the water molecules will begin bonding with the sugar molecules allowing them to separate from each other. The sugar molecules will then diffuse throughout the water until they are evenly spread out (equilibrium). Since water can dissolve most compounds it is often called the 'universal solvent.'

This also happens across nature. When nutrient molecules are taken into the body, they are dissolved by water and digestive juices. Then, they become small enough to be absorbed across cell membranes and used by the cell for its many functions. Many organisms cannot take in large food substances and must absorb nutrient molecules directly from the environment. Precipitation and ground water dissolves minerals and organic materials in rocks and soils making those nutrients available for absorption by plants, fungi, bacteria and other organisms.

Why is water unique among known compounds on Earth?

Answer: It is the only substance that naturally exists in 3 different states of matter: solid - ice; liquid - water; gas - water vapor.

Is water found any place else other than Earth?

Answer: Earth is the only place known that has liquid water. Water ice has tentatively been located on the Moon, Mars, possibly a few of the moons of Jupiter and Saturn (eg. Europa, Titan). Venus, Mars, and possibly Jupiter, Saturn and Uranus have water vapor in their atmospheres. Also, comets are partly composed of water ice, and some types of meteors have halite (salt) crystals that contain water.

Q & A

How did water originate?

Answer: According to current astronomical theory, all 90 naturally occurring elements are formed in stars. Gravity and energy initially fuse hydrogen atoms into helium atoms (nuclear fusion). The same forces then form increasingly larger elements, including oxygen. The energy emitted from these fusion reactions also enables different elements to bond forming molecules and compounds, including water. When stars explode (nova) they scatter these elements and compounds across the universe. These scattered remains slowly accumulate, due to mutual gravitational pull, into larger and larger 'clouds' (nebulae). When enough material accumulates, a star may form. Material not initially included in this stellar formation, and that ejected during star 'birth,' may then coalesce into an 'accretion disc.' Within this disc, the material accumulates in ever-larger pieces eventually forming planets, moons and asteroids. The heat and pressure of this process releases water molecules trapped within the pieces (rocks) in the form of water vapor. As the young planet's surface begins to cool and form a crust, the temperatures drop sufficiently to allow the water vapor to condense and form precipitation.

Going Further: What are the different 'types' of water on Earth? Investigate to discover and describe these types of water: connate, juvenile, hygroscopic, capillary, surface, ground, fossil, vapor, precipitation, frozen.

Teaching Note: Click into Online Resources and use Water Glossary to find out more about water on Earth.

What is the hydrologic cycle?

Answer: Also known as the water cycle, this is how water recirculates or cycles throughout Earth. Simply, water vapor in the atmosphere cools and forms water droplets (condensation). These droplets coalesce into clouds. When enough droplets accumulate, they fall as precipitation. Some of this water soaks into soils to become ground water, plants and other organisms absorb some, and some remains as surface water. Evaporation of surface water, respiration by animals and transpiration by plants releases water back to the atmosphere as water vapor. And the cycle continues.

What powers the hydrologic cycle?

Answer: Heat energy from the sun heats surface water to form water vapor. The molecules absorb this energy causing them to move faster. As they move faster they collide more often with neighboring water molecules. These repeated collisions cause the molecules to move farther and farther apart until their polar magnetic properties can no longer hold them together and they spread out forming water vapor. As the molecules move higher into the atmosphere, they slowly dissipate their energy (which escapes into space) and cool down. This loss of heat energy slows the molecular movement down enough to allow the molecules to bond together forming water droplets.

Q & A

What is hydrology?

Answer: Hydrology is the study of water movement on and in the Earth's surface. Scientists who perform these studies are hydrologists. Their studies show how and why water moves through rivers and streams, forms ponds and lakes, and accumulates in underground areas such as aquifers.

Why is it most important to prevent depletion or contamination of Earth's groundwater?

Answer: Oceans hold 97% of the Earth's water; .5% is found in surface lakes, streams, rivers and ponds. The remaining 2.5% of terrestrial water is underground, sometimes in aquifers, natural storage tanks. Surface water is replenished constantly and naturally, depending on shifting climate. Groundwater, however, takes millions of years to replenish.

Teaching Note: Click into Online Resources for information about "Aquifer Basics" and a map of U.S. aquifers.

What is a spring?

Answer: A spring is where underground water has penetrated through rock and soil to an impermeable layer of rock. The surface of the accumulating water is called the water table. The water moves 'downhill' along this barrier of rock. When this barrier or the water table is exposed to the surface, usually as a result of erosion, water will emerge, forming a spring.

What is an artesian well?

Answer: As water seeps through soil and rock, pressure increases. This hastens the movement of the water 'downhill.' However, sometimes other rock layers prevent this lateral movement and the pressure increases. If there is a crack or fault leading to the surface, the water is forced to the surface forming an artesian well. Sometimes people drill holes to trapped pockets of water under pressure to create artificial artesian wells.

Going Further: Are there springs and/or artesian wells in your area? Consult with the nearest branch of the US Geologic Survey, a local hydrologist and/or the municipal/county water authorities for information on water sources and movement locally. How are these waters used in your community?

Teaching Note: Check Online Resources to click into information from the US Geologic Survey.

The Weather Classroom Break

Q & A

What is humidity?

Answers: Humidity is the measure of the amount of water vapor in the atmosphere. The air temperature controls the amount of water vapor that can be held in the atmosphere. At higher air temperatures the gas molecules have more heat energy and move faster. This allows more space for water vapor molecules evaporating from Earth's surface. Therefore, on a warm summer day with a measurement of 70% water vapor in the atmosphere there is more water vapor present in the air than on a cool day with the same percentage. This measurement is called 'relative humidity,' because the percent of water vapor is based on its relation to air temperature.

Teaching Note: Find out more about humidity in Bad Hair Day in Hands On.

Why is it difficult to feel cooler on hot, humid days than it is on hot, dry days?

Answer: When the temperature increases our bodies adapt by perspiring. Slight breezes are enough to evaporate this water from our bodies and cool us off. In effect, the heat energy within the perspiration is dissipated to the atmosphere within water vapor molecules. As the heat leaves our skin surface, there is a cooling effect. On hot, humid days, the atmosphere is more saturated with water vapor and fewer molecules are able to evaporate into the air. As a result, the cooling effect of heat loss is lessened. So, we try to find places where the air temperature is cooler (shade, air conditioning, etc.) or the breeze is greater (open areas, electric fans, etc.).

What is fog?

Answer: Fog can be described as a ground-level cloud. Water vapor, when cooled, condenses to form water droplets. When these droplets accumulate, they form clouds. Normally this occurs in the cool upper atmosphere. However, when the surface level air is cooler than the ground, condensation occurs nearer the surface and ground-level clouds, or fog, form.

What is dew?

Answer: Dew forms when the ground is cooler than the atmosphere and water vapor condenses on the surfaces of plants, rocks, soil, etc.

What is the dew point?

Answer: The dew point is the air temperature at which dew will form. This is directly related to the ground temperature and relative humidity. That is, a higher relative humidity with a higher ground temperature will result in a higher dew point and vice versa. Often, when the dew pointis high, precipitation will be in the weather forecast.

Going Further: Create your own dew! Set out a glass of ice water or cold can of soda on a warm, humid day. Notice the water droplets that form on the outside of the container. Can you show that these droplets formed from cooling water vapor and didn't diffuse through the container to the outside?

Q & A

What is frost?

Answer: Frost forms when the surface temperature of an object and the dew point is at or below 0 degrees Celsius.

Besides precipitation, dew, fog and other weather phenomena already mentioned, does water vapor have any other effects on Earth's climates?

Answer: Absolutely! Water vapor is one of the major 'greenhouse gases'. These gases absorb heat energy dissipating from Earth's surface warming the atmosphere. This 'Greenhouse Effect' keeps our planet warm enough for life to exist, especially through the night hours when little insolation (reception of solar energy) is occurring.

Review the interview with The Weather Channel meteorologist Colin Marquis. What are the two types of clouds he discusses? What determines prefixes or suffixes associated with these types?

Answer: The two types of clouds are cumulus (puffy, cotton balls associated with rapidly falling temperatures) and stratus (smooth clouds that cover the entire sky when temperatures rise or fall slowly). Prefixes and suffixes are added to these terms depending on where the clouds are located in the atmosphere or whether or not the clouds will produce precipitation. For example: clouds in the middle atmosphere use the term "alto"; high clouds add the term "cirro." Adding "nimbus" to the cloud type means there may be precipitation.

Going Further: Have students use the information they've gathered to discuss the differences between cirriform, cumuliform and stratiform clouds. Then, see Weather Terms (http://www.weather.com/glossary) to find precise definitions and descriptions for these and other clouds. Challenge student groups to use cotton balls and construction paper to create charts to name and depict clouds within their appropriate altitudes.

Teaching Note: Find additional cloud activities in Cloud Chart Match in Hands On.

What is cloud seeding? Why and how is it done?

Answers: Clouds form when water vapor molecules condense around relatively cool dust particles (nuclei) in the atmosphere. [These dust particles may be bits of soil, insects and spiders, pollen grains and other microscopic bits of material.] If the relative humidity is low or there is little dust in the air, clouds will not form. If clouds don't form, precipitation doesn't occur. Cloud seeding is the act of spreading dust, especially hygroscopic powder such as silver chloride, in the atmosphere to provide nuclei for condensation. This is most effectively accomplished using airplanes, although cannons have also been used.

Going Further: Challenge groups of students to investigate the history of rainmakers and cloud seeding. From rain dances to the sophisticated technology of modern seeding techniques, trace the history of human attempts to initiate precipitation. What is the efficacy, positive and negative, of the different methodologies? What myths and legends surround rainmaking? Have students speculate on the possibilities for these and other attempts at controlling weather by producing short vignettes or pictures that illustrate a weather-controlled environment of the future.

Q & A

What is El Niño? What is La Niña?

Answer: These are both events that occur in the Pacific Ocean that result in global weather changes. In an El Niño, equatorial water temperatures in the Pacific Ocean are abnormally high in the eastern part near South America. This causes broad-ranging effects from heavy rains in normally dry areas (such as California) and droughts in normally wetter areas (such as the Midwest). La Niña is basically the opposite and results in prolonged droughts in some areas (such as the Southeast) and flooding in others (upper Midwest). How many and which weather phenomena are directly related to these events is not completely understood nor agreed upon by meteorologists and climatologists.

Are El Niño and La Niña relatively new phenomena?

Answer: No, although they have only been studied in the past couple of decades, these events have evidently occurred with some regularity for thousands of years. By looking at historical references of weather events, meteorologists have determined that El Niños occur about every 7 years, with La Niñas following each. The recent discovery of a 10,000-year-old forest in China has added new information. The forest was apparently destroyed by a flood and covered by preserving muds. When erosion exposed the stumps scientists were able to obtain core samples and study the tree ring growth patterns (dendrochronology).These samples show periodic growth changes that correlate well with El Niño occurrence patterns. If examples of tree rings between then and now can be located, we may then be able to understand these weather phenomena more fully.

Teaching Note: Click into Resources for information and activities on El Niño and La Niña.

Why are dams built?

Answer: Dams are built for a variety of reasons, but primarily for water retention for municipal and farming uses, and to generate hydraulic energy - either mechanical (grist mills, lumber mills) or electrical. The reservoirs created by damming streams also provide areas for recreational activities such as boating, swimming and fishing.

Going Further: Are there dams and reservoirs in your area? Why were they initially built? What are their current uses? Research and discover the methods and uses of water retention sites in your area. Is the use of these dams controversial in any way? Explain.

The Weather Classroom Break

Q & A

What is a drought?
Answer: A drought is a prolonged period of time of lower than average precipitation. Many areas experience short-term droughts of a few months, while others may have droughts that last for years. Several factors contribute to droughts, including El Niño and La Niña, deforestation and atmospheric pollution.

What is a flood?
Answer: A flood occurs when precipitation falls on areas in which the ground is saturated with water and/or snow melts quicker than the ground can absorb it or streams can transport it away.

Going Further: What are/have been the effects of drought and/or flooding in your area? How have these affected the economy, wildlife, quality of human life, etc.? Investigate how your community and surrounding areas have prepared for and responded to these extreme weather conditions.

Teaching Note: As a class, or in small groups, click into Online Resources and work through the activity in Predicting Floods and Droughts. Use The Weather Channel's Storm Encyclopedia: Floods as one of your resources.

For what do people in your area use water?
Answers will vary but include the following: drinking, cooking, bathing, washing, irrigation, recreation, etc.

Is the water in your area clean or polluted?
Answer: Answers will vary. Students should discuss causes of pollution, if present, including siltation due to farming or development, sewage, hot water (especially from electrical generating facilities), detergents, chemicals from factories and other businesses, deforestation, etc.

How is polluted water cleaned?
Answers: Naturally, streams 'clean themselves' by moving and dispersing pollutants downstream. Some of these substances settle into the streambed and into the soils, some evaporate and organisms take some up. How long this takes depends upon the volume and velocity of the stream waters. However, when too much pollution is added the stream can no longer efficiently clean itself. Sewage treatment plants help reduce the amount of pollutants from municipalities by filtering (screening) and the use of chemical treatments. Factories and other businesses often have waste treatment facilities that also reduce the amount of pollutants released into streams.

How is drinking (potable) water made available?
Answers: Water treatment facilities obtain water from surface or ground resources, then put it through physical and chemical treatment processes to purify and decontaminate it, providing a clean and safe valuable resource.

Going Further: How is water cleaned in your area? Are facilities and production adequate for the population? Visit a local sewage treatment plant to get a first-hand view of how your waste is prevented from moving into the local streams. Ask businesses how they address the problem of local water pollution. Visit the water treatment plant in your community to see how water is made safe and drinkable. Investigate other methods of water and waste treatment available and/or in use in other communities.

Q & A

Hands On

Bags of Water

As a class, discuss the average percentage of water found in organisms. (Probable Response: 70%) As a class, discuss ways this answer can be verified.

Provide, or have students bring to class, various items: fruits, vegetables, cuts of meat (poultry, beef, pork), animal organs (kidney, liver, heart), houseplants (with all soil removed).

Students will weigh each item to be tested. Record the measurements.

Dry the items in an incubator, food dehydrator, conventional oven (set on low), or in a container with a desiccant. (Drying time and temperature should be the same for all items.)

When the items are thoroughly dried, re-weigh them. Record the measurements. (The time for drying will vary depending on size of items, nature of items and method of drying.)

Calculate the difference between the weights. Record this number.

Divide the difference by the original weight. The result will then be the percent of water lost to dehydration. Record this number.

Was the percentage of water lost the same for all items?
Answer: Probably not. The answers will vary depending upon which items are used.

Was all the water in the item lost to dehydration?
Answer: This will depend upon how long the dehydration process lasted and which method was used, but most water should have evaporated.

Going Further: Do similar organisms in different ecosystems have the same percentage of body water?

Answer: In general, they would. However, organisms in different ecosystems will use and store water in different manners. For example, a plant in an arid environment has adaptations that allow for the rapid absorption of water through its roots and will store it in expandable tissues in its roots, stems or leaves. Some animals, too, hold water in their urinary system and slowly absorb it, ultimately excreting a more concentrated waste. Aquatic organisms and those in rainforests lack these adaptations, and tend to move water more quickly through their bodies.

Challenge students to investigate and present adaptations in organisms for maintaining water balance based on their needs and environments.

Hydrology

Guide students to discuss water in your area:

- Where are the streams, lakes and ponds?
- Where does water used in homes, at work and at school originate?
- What is a watershed?
- Where is the watershed in your area?

Answer: A watershed is the area into which water drains. The size of a watershed depends on the body of water being investigated. For example, the Mississippi River watershed would include much of the United States from the Rocky Mountains to the Canadian border to the Appalachian Mountains. But, the watershed for a local stream may only include a few square kilometers.

Demonstration 1

Materials:
- laminated topographic maps of your area
- wax pencils or erasable markers

Demonstration1: Provide students with laminated topographic maps of your area. Have students locate their homes, the school and other points of interest — especially water and waste treatment plants. Have students locate streams, lakes, ponds, reservoirs and other water sources. Using wax pencils or erasable markers, instruct students to trace rivers, streams, lakes, etc. Have students trace the path of the water from its source (beginnings of streams) to where it joins with a larger stream or river, or from where the local water authority pumps its water supply, or a recreational area uses the water supply, etc. Now, have students indicate the watershed for the local water system. Explain that the watershed is the area from which the streams flow to the place they're investigating.

Extension: Place a piece of onionskin or other transparent tracing paper over the map.Trace the stream paths onto the paper. Use the topography to locate the highest points above the origin of the streams. Draw a line connecting these points. This delineates the watershed. Then place the tracing paper over a piece of graph paper and count the squares within this outlined area. Using the map scale, determine the area of each square. Then multiply this number by the number of squares. The result will be the total area of the watershed.

Going Further: What businesses, development, farms or other potential sources of water pollution are along the streams in the watershed? How do these pollutants affect the drinking water downstream? How are the organisms in and around the streams affected?

Flash Floods

Guide students to use Student Handout: Flash Floods to demonstrate two factors that could result in flash flooding. After completing their demonstrations, have students discuss: What do the different settings on the spray bottle represent?

Answer: Different settings simulate different intensities of precipitation.

How does the difference in low and high intensity rainfall affect the likelihood of a flash flood?

Answer: In general, high intensity rainfall increases the likelihood of flash floods?

What type of soil, in relation to moisture content, did the different sponges represent?

Answer: Dry sponges = dry, sandy, rocky soils; wet sponges = moist, clay or loamy soils.

How does this relate to soils and climates in the western and eastern U.S.?

Answer: Western soils tend to be more dry, sandy and rocky; eastern soils tend to be more moist, clay and loamy. Exceptions would include the moist soils of the upper west coast and the sandy soils of the southeastern coastal plains.

Based upon these observations, are flash floods due to soil absorption more likely in the western or eastern U.S.?

Answer: Flash floods would most likely occur more often in the southwestern U.S. because dry, sandy/rocky soils would not absorb water quickly. However, mountainous regions in both the eastern and western U.S. would likely experience flash floods as a result of the topography.

Going Further: Flash floods can also be caused by situations such as the failure of a dam or the thaw of an ice jam. Challenge student groups to set up classroom demonstrations of these situations.

The Hydrologic Cycle

As a class, outline the hydrologic or water cycle.

Answer: The cycle includes three main parts: evaporation, condensation, precipitation

Demonstration 2: Have students demonstrate the basic parts of the hydrologic cycle by doing the following: Place water in the bottom of a clear container (glass jar, drinking glass, glass beaker, other) to a depth of about 5 cm. Place 5 drops of food coloring into the water. Fill another container, one that will fit tightly and cover completely the first container, with ice. Place the container with the ice on top of the container with colored water. Then place the paired containers in a sunny location. Write a prediction of what will occur in the containers. Observe the containers over several days. Record those observations. Create a labeled illustration of the hydrologic cycle as demonstrated in this activity. Do all main parts of the hydrologic cycle occur as predicted?

Demonstration 2

Materials:

- container
- food coloring
- ice

Answer: Yes. Water evaporated from the bottom container, condensed on the cold upper container, and precipitated water droplets back to the bottom container.

Were the water droplets colored like the water in the bottom container?

Answer: No. Only the water molecules evaporated leaving the color molecules (impurities) behind.

Extension: Have students demonstrate that plants lose water by transpiration and animals lose water by respiration. For animal respiration, have students heavily exhale onto a mirror or window and observe the condensation that occurs. For plant transpiration, they should tie clear plastic bags around a leaf on a tree or bush and observe the condensation that occurs. [Note: Plant observations should take place the next afternoon. Also, this demonstration works best on plants in full sun on clear days.]

Demonstration 3

Materials:
- Cloud Match Handout

Cloud Match

Demonstration 3: Challenge students to use Student Handout: Cloud Match to match the names of clouds with their correct picture. Have students use Weather Terms (www.weatherclassroom.com) and other online resources to help in their identification. As a class, discuss the answers.

Answers:

#1: Ciro Stratus, #2: Alto Cumulus, #3: Cirrus, #4: Cumulus Congestus
#5: Billow Alto Cumulus, #6: Fair Weather Cumulus, #7: Mammatus
#8: Ciro Cumulus, #9: Cumulonimbus

Extension: Create a class cloud chart. Have students take sky pictures at various times and from various places to create a pictorial selection of cloud types or, have them search the Internet for pictures of clouds or invite them to paint skyscapes. Use these, along with descriptions and labels, to create a bulletin-board sized cloud chart.

Demonstration 4

Materials:
- human hair
- student handout

Bad Hair Day

Is human hair affected by humidity?

Answers will vary, but should reflect that at least some types of hair are affected by humidity.

Demonstration 4: Provide laboratory groups with Student Handout: Bad Hair Day and materials, including samples of human hair. [***Note:*** These can be obtained at a local beauty salon or barbershop. Take care to collect only recently washed hair. Longer samples (5cm+) are preferred over shorter samples. Varieties could include different colors and textures textures, strands from different races and different genders, and/or strands that have been treated with different chemicals (permanents, coloration, etc.).] Have students work through the demonstration and share their observations to determine which hair samples are most affected by humidity.

Extension: If a very sensitive balance is available, the hair samples can be weighed before and after the experiment to determine their water absorbing characteristics. This information can then be used to further quantify student observations.

How Much Water Do We Use?

Create a class list of activities that use water at home or at school:
washing dishes, clothes, bathing/showering, brushing teeth, outdoor watering, flushing toilets, etc. Have students estimate how much water is used in each of these activities. Supply student groups with measuring instruments — gallon jugs, 2-liter plastic containers, etc. At school, have them work with maintenance or cafeteria staff to discover how much water is used in particular activities — per student, per day, etc. At home, have them set up experiments to determine water usage for different appliances or activities--how much water does the bathtub hold or how much water runs while brushing teeth? Back in class, have students share and compare their water usage estimates with their findings. Were there any surprises? Why? Challenge students to determine strategies to cut water usage in school and at home by 20%. Then, use water/sewer bills to see if there is a change for the better.

Materials:
- samples
- balance
- petri dishes (one per sample)
- drying apparatus

All organisms are composed of many types of molecules. In mostorganisms, the vast majority of these molecules are water. Work with your scientific team to discover the water within various organic samples.

Student Handout:

Bags of Water

Purpose: To determine the percent of water in the tissues of different organisms.

Procedure: On a separate sheet of paper, observe and weigh each organic sample. Illustrate, label and record the weight for each in the chart below. Place your samples on petri dishes (one sample per dish) in the drying apparatus.Your teacher will adjust the temperature. When it is determined that the samples have completely dried, remove them from the apparatus. Once again, observe and weigh each sample. Illustrate, label and record the weight for each in the chart below. Subtract the second measurement from the first and record that value. Divide the last value by the first value and record the result to illustrate percentage. Share your results with the rest of the class. Record all of groups' observations and values.

Sample Type	Description/Weight *(Before Drying)*	Description/Weight *(After Drying)*

Analysis: What was lost from the samples in the drying process? Where did it go?

Which samples lost the most weight? The least? Why?

What materials and cell structures account for the remaining weight after drying?

Would this information be important for dietary reasons? Explain.

1. Why do the two waters mix later during your observation?
2. How does this illustrate the movement of air masses in the atmosphere?

Materials:
- hair sample
- forceps or latex gloves
- 2 petri dishes
- 2 glass jars or beakers
- water
- paper towel
- tape

Caution:
Even though your hair sample has been recently washed, remember to handle it only with forceps or while wearing latex gloves.

Student Handout:

Bad Hair Day

Directions: Many of us have either heard someone say, or said ourselves "I'm having a bad hair day!" Most people are aware that their hair behaves differently under different weather conditions. Work with others in your group to determine whether or not hair is affected by humidity.

Purpose: To determine which types of hair humidity levels affect most and what factors may effect these changes.

Procedure: Illustrate and write a description of your hair sample. Divide the sample into two equal parts. Place each in a separate petri dish. In your classroom study area, place one dish on the counter and the other on a water-soaked paper towel on the counter. Cover both containers with glass jars or beakers. Place tape around the bottom of each to prevent the passage of air into or out of the containers. Illustrate the set up of your experiment. After a 24-hour period, again observe the hair samples. Illustrate and write a description of your observations. Form a conclusion describing the effects of humidity on your hair sample. On a separate sheet of paper share your observations with the class and record the observations of other groups.

Analysis: What factors were apparently involved in how humidity affects human hair? Consider: gender, race, hair color, texture, and chemical additives.

Challenge: Based on the class discussion, what is a hair hygrometer and how might it work? Which hair sample would be most effective in determining changing humidity? Explain.

Directions:
Place the number of the cloud picture in the box of the correct caption below.

Student Handout:

Cloud Match

☐ **Billow Alto Cumulus:** Middle (15,000 to 25,000 feet) Usually long rolls of cloud occurring in alto or cirrocumulus due to shearing motion.	☐ **Cirrus:** High (25,000 feet) Ice crystal clouds in a wide variety of feathery shapes, evaporating as they precipitate. (A type of virga) Cumulus Conge	☐ **Ciro Cumulus:** Middle (15,000 to 25,000 feet) Small rounded white puffs that are isolated or in long rows; rarely cover the entire sky. Their small ripples look like the scales of a fish — thus, mackerel sky.
☐ **Mammatus:** Middle (15,000 to 25,000 feet) Layer of cloud with pouch-like downward extensions, associated with cumulonimbus in latter stages of development.	☐ **Cumulus Congestus:** High (25,000 feet) An active form of cumulus with many convective cells yielding cauliflower appearances to the top. Flat base represents the condensation level. Can produce showers.	☐ **Ciro Cumulus: Cumulonimbus:** Middle (15,000 - 25,000 feet) Most active member of cumulus family; flat base, tops sometimes extending 5 miles and can be anvil shaped or flattened
☐ **Fair Weather Cumulus:** Low (0 to 15,000 feet) Widely separated heaps with flat bottoms and rounded tops. Small vertical development.	☐ **Alto Cumulus:** Middle (15,000 to 25,000 feet) Mid-level, layered, heap cloud with many convective cells; sometimes rolled out in parallel waves or bands.	☐ **Ciro Stratus:** High (25,000 feet) Widespread layer of thin, veil-like, ice crystal cloud. Though it appears thin, it can be deceptively thick.

Internet Resources

USGS: Water Science for Schools
http://ga.water.usgs.gov/edu/

Water Basics: ***A Quiz***
http://ga.water.usgs.gov/edu/sc3.html

USGS: ***Earth's Water Topics***
http://ga.water.usgs.gov/edu/mearthall.html

Aquifer Basics
http://sr6capp.er.usgs.gov/aquiferBasicsindex.html

Are raindrops shaped like teardrops?
http://ga.water.usgs.gov/edu/raindropshape.html

GOES-8 Interactive Water Vapor Satellite Images
http://wwwghcc.msfc.nasa.gov/GOES/goes8conuswv.html

GOES-10 Interactive Water Vapor Satellite Images
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