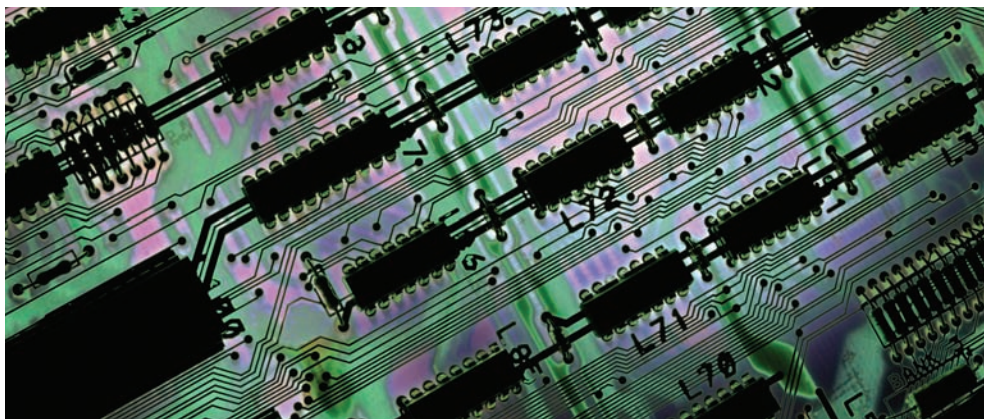
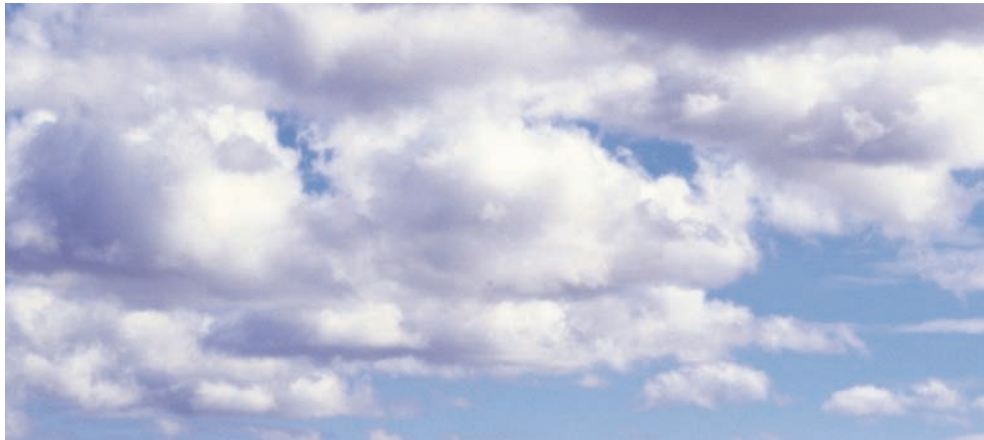


Middle Grades Science

7th Grade Support Document



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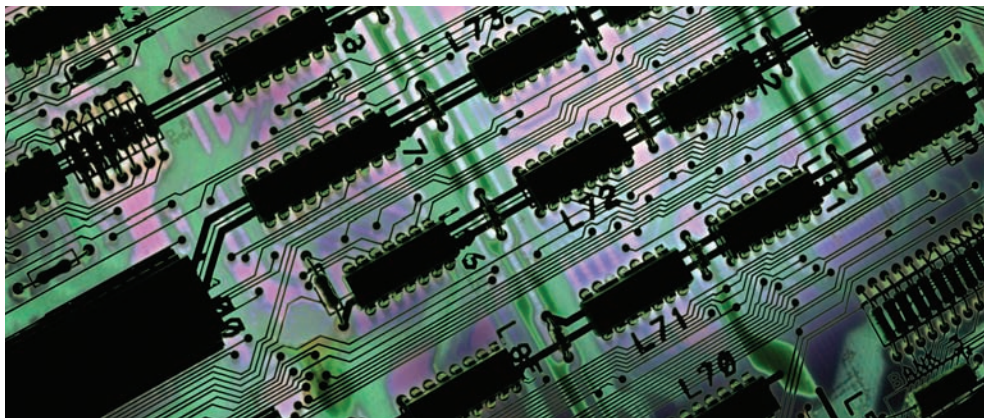
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Middle Grades Science

7th Grade Support Document

Goals 1, 2, and Atmosphere



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PUBLIC SCHOOLS OF
NORTH CAROLINA
Department of Public
Instruction

7th Grade Competency Goal 3 NC SCS

The learner will conduct investigations and utilize appropriate technologies and information systems to build an understanding of the atmosphere.

BIG Ideas

Atmosphere

The atmosphere is a mixture of gases, such as nitrogen, oxygen, argon, carbon dioxide, trace gases and water vapor. The amount of each gas in the mixture is usually very constant from the surface of the planet up to the top of the troposphere. These gases are constantly being used and renewed by the processes of respiration, photosynthesis, evaporation and condensation, the weathering of rock, and the decay of organic matter.

The atmosphere has different properties at different elevations and different locations around the Earth. The air pressure is less on the top of mountains (higher elevation) than in valleys. At the equator the atmosphere is warmer; at the poles it is cooler. The uneven heating of land and water causes a rising and sinking of warm and cool air masses creating convection currents and causes winds.

Five layers make up the atmosphere; the troposphere, stratosphere, mesosphere, thermosphere, and exosphere. Each of these layers has very unique properties. Weather occurs in the troposphere and is the physical condition of the atmosphere at a specific place at a specific time. Fronts, global wind systems, atmospheric pressure changes and many other factors influence the weather. Major atmospheric activities such as thunderstorms tornadoes and hurricanes affect humans and can result in huge natural disasters.

Atmosphere

Technology has greatly influenced the ease and accuracy of making weather predictions. Weather data at thousands of locations can be gathered instantaneously and applied to weather prediction models to produce weather maps. Weather maps show air masses, fronts, and pressure centers helping to predict approaching weather. Weather forecasting has been improved by the additional data gained from Doppler radar units and satellites.

Air quality affects the quality of life for all organisms on Earth. Natural and human activities greatly influence the quality of the air. Technology has allowed us to measure the characteristics of the air and to monitor how air quality changes. This information helps us to make informed decisions to protect air quality and risks to human health and other organisms.

The cumulative ecological effects of global ozone depletion, air pollution, increased particulate matter, acid rain, and global warming concern the entire global community. Studies have shown that the human impact on these factors has impacted the global ecosystem.

National Science Education Standards	AAAS Benchmarks
<p>Atmosphere</p> <ul style="list-style-type: none">• The atmosphere is a mixture of nitrogen, oxygen, and trace gases that include water vapor.• The atmosphere has different properties at different elevations.• Clouds, formed by the condensation of water vapor, affect weather and climate.• Global patterns of atmospheric movement influence local weather.• Oceans have a major effect on climate, because water in the oceans holds a large amount of heat.• When an area becomes overpopulated, the environment will become degraded due to the increased use of resources.• Risk analysis considers the type of hazard and estimates the number of people that might be exposed and the number likely to suffer consequences. The results are used to determine the options for reducing or eliminating risks.	<p>Atmosphere</p> <ul style="list-style-type: none">• The environment may contain dangerous levels of substances that are harmful to human beings. Therefore, the good health of individuals requires monitoring the soil, air, and water and taking steps to make them safe.• The length and quality of human life are influenced by many factors, including sanitation, diet, medical care, sex, genes, environmental conditions, and personal health behaviors.• Changes in environmental conditions can affect the survival of individual organisms and entire species.• New technologies increase some risks and decrease others. Some of the same technologies that have improved the length and quality of life for many people have also brought new risks.• Scientific investigations usually involve the collection of relevant evidence, the use of logical reasoning, and the application of imagination in devising hypotheses and explanations to make sense of the collected evidence.

National Science Education Standards

Atmosphere

- Students should understand the risks associated with natural hazards (fires, floods, tornadoes, hurricanes, earthquakes (pollutants in air, water, soil, and food), with biological hazards (pollen, viruses, bacterial, and parasites), social hazards (occupational safety and transportation), and with personal hazards (smoking, dieting, and drinking).
- Natural environments may contain substances (for example, radon and lead) that are harmful to human beings.
- Maintaining environmental health involves establishing or monitoring quality standards related to use of soil, water, and air.

NC Science SCS	Content Elaboration	Ideas for exploration	Web Resources
<p>3.01 Explain the composition, properties and structure of the atmosphere:</p> <p>Mixture of gases.</p> <p>Stratified layers.</p> <p>Each layer has distinct properties.</p> <p>As altitude increases, air pressure decreases.</p> <p>Equilibrium.</p>	<p>The atmosphere, or air, refers to the gases which surround, or envelop the Earth.</p> <p>The atmosphere is a mixture of gases, such as nitrogen (78%), oxygen (21%), argon(0.93%), carbon dioxide(0.04%), trace gases and water vapor.</p> <p>The amount of water vapor in the atmosphere varies greatly from place to place. Water vapor plays an important role in weather.</p> <p>The atmosphere is hundreds of kilometers thick.</p> <p>Five layers make up the atmosphere; the troposphere, stratosphere, mesosphere, thermosphere, and exosphere. Each of these layers has very unique properties.</p>	<p>Illustrate the mixture of gases with various types of graphs. Which type of graph best visualizes the data?</p> <p><u>How High Is It?</u></p> <p><u>Structure Model</u></p>	<p>http://sciencebulletins.amnh.org Illustrates climate events, provides information about climate systems (EarthBulletin)</p> <p>www.classroomearth.org "best of the best" collection of environmental education programs</p> <p>www.ncdc.noaa.gov/extremes.htm current and historical information on weather events</p> <p>http://ww2010.atmos.uiuc.edu/ extensive meteorology information –how to read and interpret weather maps</p> <p>http://www.doc.mmu.ac.uk/aric/ea/e/ one-stop atmospheric encyclopedia</p>

7th Grade
 Middle Grades Support Documents
 Atmosphere

NC Science SCS	Content Elaboration	Ideas for exploration	Web Resources
<p>3.01 Explain the composition, properties and structure of the atmosphere:</p> <p>Mixture of gases.</p> <p>Stratified layers.</p> <p>Each layer has distinct properties.</p> <p>As altitude increases, air pressure decreases.</p> <p>Equilibrium.</p>	<p>Air has weight.</p> <p>Air molecules are in constant motion and are affected by gravity. This force of this movement causes air pressure.</p> <p>Air pressure changes with elevation. As you move up into the atmosphere, the air molecules are further apart. So, air pressure decreases as distance above the surface increases.</p> <p>Air pressure also decreases as the amount of water vapor in the air goes up.</p> <p>Since warm air is less dense than cool air, when temperatures are higher, the air pressure is usually lower.</p> <p>Air pressure is measured with mercury barometer (mm of mercury) or and aneroid barometer (millibars-mb).</p> <p>The atmosphere has constant change but strives to maintain equilibrium.</p>	<p>Design a graphic organizer that shows the relationship between elevation, water vapor, temperature and air pressure.</p> <p><u>Weather Word Maze</u></p> <p><u>Thermal Inversions</u></p> <p>Research asthma. How can poor air quality can trigger</p>	<p>http://www.islandnet.com/~see/weather/doctor.htm weather, history, facts, stories</p> <p>http://www.windows.ucar.edu/tour/link=/earth/Atmosphere/layers.html&back=/search visuals on the Earth's atmosphere</p> <p>http://www.EdHelper.com subscription service which provides downloadable materials; Weather Word Maze is a sample</p> <p>http://atm.geo.nsf.gov/instruction/observations.html information on how to make weather observations</p> <p>http://www.weather.com/weather</p> <p>The Weather Channel presents career as a meteorologist, maps, and interactive activities.</p>

NC Science SCS	Content Elaboration	Ideas for exploration	Web Resources
<p>3.02 Describe properties that can be observed and measured to predict air quality:</p> <p>Particulate matter.</p> <p>Ozone.</p>	<p>In addition to gases which compose the atmosphere, there are particles such as smoke, dust, and chemicals that float in the air.</p> <p>The upper stratosphere contains a layer of ozone, a form of oxygen. Ozone prevents most of the ultraviolet light from the sun from reaching the Earth. It is harmful to breath large amounts of ozone.</p> <p>Sometimes, the air inside can be more polluted than the air outside. Indoor air pollution is difficult to detect because it is often invisible.</p> <p>Measurement of particulate matter and ozone are indicators of air quality.</p>	<p>an asthma attack, How can the symptoms of asthma be controlled?</p> <p><u>Airborne Junk Detectors</u></p> <p>Identify ways to reduce indoor air pollution.</p> <p>Design an experiment to catch indoor pollutants, such as with petroleum jelly on notecards with grids. Suspend these at several locations and leave for a few days. Use a magnifying glass to examine the collection cards. Compare and hypothesize on the differences in sites.</p> <p><u>The Awful 8 Play</u></p> <p>Obtain ozone levels and air quality index information. Study trends over time and prepare a graphic to visualize the data. Use http://www.epa.gov/air/airtrends/factbook.html for data.</p>	<p>http://www.ncar.ucar.edu</p> <p>NCAR in Boulder, CO home page which links to a variety of information related to atmospheric science resources.</p> <p>http://www.enviroliteracy.org/subcategory.php/146.html ozone lessons</p> <p>http://www.tnrcc.state.tx.us/air/motors/lessons/lesson_plans.html web resource for The Awful 8 Play and many other lessons related to Air Quality</p> <p>http://www.epa.gov/air/airtrends/factbook.html ozone/air quality data source</p> <p>http://www.epa.gov/omswww information related to motor vehicles and energy consumption</p> <p>http://www.cpsc.gov/cpscpub/pubs/iaq.html</p> <p>Indoor air quality information from Consumer Products Safety</p>

7th Grade
Middle Grades Support Documents
Atmosphere

NC Science SCS	Content Elaboration	Ideas for exploration	Web Resources
<p>Conclude that the good health of environments and organisms requires:</p> <p>The monitoring of air quality.</p> <p>Taking steps to maintain healthy air quality.</p> <p>Stewardship.</p> <p>Evaluate how humans impact air quality including:</p> <p>Air quality standards.</p> <p>Point and non-point sources of air pollution in North Carolina.</p> <p>Financial and economic trade-offs.</p>	<p>Using less fossil fuel is the best way to improve air quality.</p> <p>Most forms of transportation and many industries produce carbon dioxide and add particles to the air and reduce the quality of the atmosphere.</p> <p>The burning of fossil fuels is the major cause of air pollution.</p> <p>Smog is a colloid of smoke, fog, and chemicals. Many areas have smog problems. Smog irritates the lungs.</p> <p>The burning of fossil fuels releases large amounts of carbon dioxide and other gases into the air. Some of these gases mix with water vapor and then form acid rain. Acid rain is harmful to both living and non-living things.</p> <p>Natural events also release pollutants (forest fires, volcanic eruptions, plant pollen).</p> <p>Point-source pollutants are pollutants from a single source.</p>	<p>Write a PSA or radio ad informing others of the importance of understanding air quality.</p> <p>Research EPA's Air Quality Index.</p> <p>What role does the local government play in the reporting of Air Quality?</p> <p>Research the Clean Air Act and efforts to minimize industrial emissions.</p> <p><u>What Do Concentrations Mean?</u></p>	<p>http://www.epa.gov/iaq/schools/index.html</p> <p>Information concerning indoor air quality in schools</p> <p>http://www.smogcity.com/welcome.htm interactive Smog City Game</p> <p>http://www.epa.gov/airnow Real time air pollution data</p> <p>http://www.k12science.org/curriculum/airproj/lessonscore5.html set of computer based lessons on air pollution</p> <p>http://epa.gov/opptintr/tri Toxics release inventory</p> <p>http://www.earthwayshome.org/inthear/6-8.html module, emphasis is placed on the students' personal experience and personal actions that are reasonable for them to take to reduce their exposure to air pollution.</p>

NC Science SCS	Content Elaboration	Ideas for exploration	Web Resources
<p>Local air quality issues.</p> <p>Conclude that the good health of environments and organisms requires:</p> <p>The monitoring of air quality.</p> <p>Taking steps to maintain healthy air quality.</p> <p>Stewardship.</p> <p>Evaluate how humans impact air quality including:</p> <p>Air quality standards.</p> <p>Point and non-point sources of air pollution in North Carolina.</p> <p>Financial and economic trade-offs.</p> <p>Local air quality issues.</p>	<p>Non-point source pollutants come from multiple sources and are often hard to identify.</p> <p>Because air pollutants are often carried along by prevailing winds, acid rain may fall far from the source of pollution.</p> <p>Temperature inversions</p> <p>Laws exist to help control and reduce air pollution.</p> <p>The Environmental Protection Agency (EPA) provides daily information about air quality. Local weather channels also issue information related to the health of the atmosphere.</p>	<p><u>Harmful Effects of Acid Rain</u></p> <p>Investigate the how acid rain is affecting the mountain region of North Carolina. What are some sources of the pollution?</p> <p>Analyze the economic impact from acid rain.</p> <p><u>How to Make a Wet Scrubber</u></p>	<p>www.GLOBE.gov Atmospheric Protocols which allow student data to be used by scientists.</p> <p>http://www.epa.gov/airmarkets/acidrain/ Acid Rain information from EPA</p> <p>http://www.epa.gov/airtrends/2005/ozonenbp/ new data on air data trends</p> <p>http://www.epa.gov/region5/students/air.htm EPA student site for air quality information</p> <p>http://www.epa.gov/region01/students/teacher/airqual.html Project AIRE challenges students to think critically and creatively about air pollution problems and the alternatives for resolving them.</p>

7th Grade
 Middle Grades Support Documents
 Atmosphere

NC Science SCS	Content Elaboration	Ideas for exploration	Web Resources
<p>3.03 Examine evidence that atmospheric properties can be studied to predict atmospheric conditions and weather hazards:</p> <p>Humidity.</p> <p>Temperature.</p> <p>Wind speed and direction.</p> <p>Air pressure.</p> <p>Precipitation.</p> <p>Tornados.</p> <p>Hurricanes.</p> <p>Floods.</p> <p>Storms.</p>	<p>Humidity is the amount of water vapor (water in the form of a gas) present in the air. Warm water can hold more water vapor than cool air.</p> <p>Relative humidity is the ratio between the actual amount of water vapor in the air and the maximum amount of water vapor the air can hold at that temperature. Relative humidity is measured with a hygrometer (wet-and-dry-bulb thermometer).</p> <p>Air temperature indicates the amount of heat in the atmosphere.</p> <p>Wind is the movement of air over Earth's surface. Wind speed is how fast the air is moving and measured in miles/hour or km/hour. Wind direction is the direction from which the wind is coming and is determined with a wind vane.</p> <p>Changes in air pressure readings indicate the passing of high and low pressure systems.</p> <p>Precipitation refers to water in any form-rain, snow, sleet, or hail.</p>	<p>GLOBE Protocols for Atmosphere</p> <p><u>Catch a Snowflake or a Snow Crystal</u></p>	<p>http://k12.ocs.ou.edu/teachers/lessons/default.html lessons aimed at Oklahoma-some are adaptable or use as templates to design studies</p> <p>http://k12.ocs.ou.edu/teachers/weatherseries/default.html</p> <p>OCS Weather Series. Most materials are aimed at the middle school grade level. The lessons typically require environmental data and many can be used with recent or real time data.</p>

NC Science SCS	Content Elaboration	Ideas for exploration	Web Resources
<p>3.03 Examine evidence that atmospheric properties can be studied to predict atmospheric conditions and weather hazards:</p> <p>Humidity.</p> <p>Temperature.</p> <p>Wind speed and direction.</p> <p>Air pressure.</p> <p>Precipitation.</p> <p>Tornados.</p> <p>Hurricanes.</p> <p>Floods.</p> <p>Storms.</p>	<p>Storms are natural disturbances in the atmosphere that involve air pressure, clouds, precipitation, and strong winds. The major types of storms are thunderstorms, hurricanes, tornadoes, and winter storms. Each type has its own characteristics and dangers.</p> <p>Tornados are violently whirling winds sometimes visible as a funnel-shaped cloud. They are produced by severe thunderstorms. Spiraling high winds and extremely low pressure are the unique features of tornadoes.</p> <p>Hurricanes are huge, rotating storms that form over the ocean near the equator. They produce very strong winds, heavy rains, and large, powerful waves and can cause severe flooding and damage from strong winds.</p> <p>Floods occur when an area is inundated with water. Weather related flooding is most often associated with hurricanes and thunderstorms.</p> <p>Thunderstorms are brief, intense storms that affect a small area. They are produced rapidly when rising warm air causes cumulus clouds to build upward into a thunderhead. Characteristics include thunder, lightning, strong gusty winds and sometimes hail. Winter storms include blizzards and ice storms.</p>	<p>Research lightning strikes and the correlation to soil type.</p> <p>Create illustrations of the types of fronts which affect weather in North America- Stationary, Occluded, Warm Front, and Cold Front.</p> <p>Create illustrations of the types of air masses that affect weather in North America-maritime, continental, polar, and tropical. Show regional sources of mP, cP, mT, and cT air masses and explain how the source indicates characteristics of the air mass.</p> <p><u>Stormy Memories</u></p> <p><u>Pathways of Pollution</u></p>	<p>http://sln.fi.edu/weather/index.html historical weather data, careers in meteorology</p> <p>http://www.usatoday.com/weather/satpic/wsatusa.htm satellite images of weather patterns</p> <p>http://www.usatoday.com/weather/wsawork.htm explains how satellites view clouds</p> <p>http://www.cnn.com/WEATHER/NAmerica/radar_image.html explains radar use in weather forecasting</p> <p>http://www.usatoday.com/weather/wearadar.htm explains radar</p> <p>http://www.usatoday.com/weather/radpic/wrindex0.htm radar images</p> <p>http://www.weather.com/maps/maptype/currentweatherusnational/index_large.html current surface maps</p> <p>http://www.spaceacademy.jhuapl.edu/shared_files/Activities/TIMED_eaa.pdf satellite information</p>
<p>3.04 Assess the use of</p>	<p>Weather forecasting is an attempt to</p>		

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NC Science SCS	Content Elaboration	Ideas for exploration	Web Resources
<p>technology in studying atmospheric phenomena and weather hazards: Satellites.</p> <p>Weather maps.</p> <p>Predicting.</p> <p>Recording.</p> <p>Communicating information about conditions.</p>	<p>make accurate predictions of future weather. The accuracy of weather prediction is improving as technology advances.</p> <p>A weather map is useful for making predictions. Weather maps usually show precipitation, wind direction, temperature, cloud cover, high or low pressure systems, cold and warm fronts, stationary and occluded fronts.</p> <p>Weather systems generally move from west to east across the US.</p> <p>Long range weather forecasting is more difficult than short-range weather prediction.</p> <p>Technologies such as computers, satellite images, and radar enable forecasters to track movements of large-scale weather systems like air masses and fronts.</p>	<p>What do satellite images show? Why is this information important?</p> <p>How do we get satellite images? How do satellites travel?</p> <p>What can meteorologists learn by the shade of the clouds on a satellite image?</p> <p>What does radar show?</p> <p>How do you use the map key on a radar map?</p> <p>How do we get radar images?</p> <p>What are some of the limitations of radar maps?</p>	

How High Does the Atmosphere Go?

Engage

Compared to the size of the Earth, how big is the Earth's atmosphere?
How much of Earth's atmosphere contains most of the weather we experience?

Materials needed for the scale models-reference materials or internet access, NASA Information Sheets, Numbered Layers pages, scissors, glue, clear tape, colored pencils or markers, sticky pad sheets

- Ask students to describe what they know about the atmosphere including, the layers and their altitudes above the Earth and where in the atmosphere weather occurs.
- Review the concept of a scale model.
- Have reference materials and/or internet access available for students to use to determine the layers of the atmosphere, as well as, their heights above the Earth.
- Place students in groups of three or four and have them complete the scale models. After completing the scale model of the atmosphere compared to Earth, have students produce a scale model of the layers of the atmosphere.
- Students should come away with an awareness that the Earth's atmosphere is VERY small compared to the size of the Earth. Also, the part of the atmosphere which supports life (troposphere) is exceedingly small in comparison to the other layers of the atmosphere.

Inquiry/Explore

- Allow students to use reference materials or information from internet sources to acquire all of the needed information for building the scale models.
- Tape the numbered pages end to end like a banner. Label and color each layer. Predict altitudes at which NASA vehicles fly or orbit. Cut out NASA vehicles and glue 1 per sticky pad sheet. Arrange them on the atmospheric layers sheet. Use the NASA information sheet to check your predictions. Put a star by each that you were reasonably close in predicting. Rearrange the vehicles to their correct flight altitude or orbit range.

How High Does the Atmosphere Go?

- After students have completed their scale models, review the concept of scale and how they were determined in the activities.
- Discuss the layers of the atmosphere and their properties.
- Ask students why jets typically fly at the altitude they do (35,000 ft.). *To fly above “the weather.”*
- Ask students why jets cannot fly into “space?” *The atmosphere is so thin, there is not enough oxygen to support the burning of the jet fuel.*
- Discuss the fact that the layers of the atmosphere are really not defined places but are gradual transitions from one layer to another.
- Discuss the fact that many satellites and the space shuttle orbit the Earth in the upper layers of the atmosphere. At those altitudes, the air is so thin, it does not affect the spacecraft.
- Ask students why most of the air of the atmosphere is in the lowest level. *Gravity.*
- Have students create another scale model of the atmosphere using a different scale. For example, consider that you wanted to build a scale model of the atmosphere such that all of the layers were represented within a 100 foot building. What would the scale model look like?

Adapted from Project LEARN's Introduction to the Atmosphere.

Structure Model

Materials-1000 mL graduated cylinder, 4 colors of sand.
Build a model of the layers of Earth's atmosphere:

Atmospheric Layer	Color Code	Thickness	Top of Layer
Troposphere	Color 1	15 mL	15
Stratosphere	Color 2	45 mL	60
Mesosphere	Color 3	45 mL	105
Thermosphere	Color 4	895 ml	1000

Have students make comparisons between layers. Review where weather takes place, satellites orbit, etc.

Have students to calculate the dimensions for a model of a planet that has similar structure but the atmospheric layers are 1.5 that of the earth's.

Weather Word Maze

Move up, down, left, and right. You can use the same word more than once.

Start spelling words at R and end at R. The starting and ending points are underlined in the puzzle. Start at shaded R.

I	I	A	G	T	O	L	D	I	M	S	C	H	Y	T	L	E	<u>R</u>	H	O	I	U	E	H	R	R	N	H	A	E	
T	E	R	I	M	N	T	I	H	U	V	A	A	D	I	A	T	I	V	L	E	U	D	N	O	R	T	O	P	I	T
L	I	U	N	T	R	S	T	L	I	A	L	I	I	M	U	H	E	F	M	E	N	L	O	F	L	A	N	W	O	H
M	O	S	E	M	R	L	T	V	I	E	A	P	O	A	R	E	H	E	R	L	A	H	T	O	O	S	H	F	O	C
C	O	O	W	O	U	W	N	H	E	P	L	N	O	C	E	I	M	E	I	W	O	I	S	H	F	O	R	C	P	
A	T	N	R	P	E	B	D	H	E	L	C	M	E	R	L	R	O	M	E	C	R	A	E	T	N	Y	E	A	D	
H	A	R	G	O	D	U	R	O	R	O	R	A	D	A	R	R	P	E	E	R	O	R	F	M	M	Y	E	A	D	
T	E	E	S	I	R	T	S	A	H	U	D	E	O	T	O	I	A	S	Y	L	I	I	F	N	W	D	A	D	P	
S	A	I	E	N	I	A	N	R	A	F	B	U	D	L	R	R	M	H	M	E	E	E	E	E	E	Y	D	L	R	
N	H	E	U	T	D	O	D	G	D	T	S	R	R	C	R	O	G	O	D	N	R	C	R	H	T	N	P	R	S	
E	R	I	R	E	P	D	L	A	E	R	I	N	S	I	R	E	Y	O	E	R	D	A	R	T	H	N	P	R	S	
S	I	C	R	E	L	P	M	O	R	O	R	A	N	N	I	O	L	L	R	U	T	I	M	E	T	L	E	R	H	U
E	S	A	R	U	S	T	H	T	S	T	H	D	P	U	R	I	E	T	T	M	E	E	Y	R	M	L	A	I	H	A
M	V	S	D	S	R	O	C	E	I	B	R	T	F	R	R	N	R	S	O	A	H	P	R	H	O	T	M	L	A	W
I	I	E	A	N	E	A	C	T	R	G	T	I	E	R	L	A	S	E	N	R	I	S	M	R	C	T	E	L	I	M
S	I	U	R	R	L	L	U	A	R	W	I	E	A	E	T	F	L	E	C	C	A	L	F	O	N	A	R	H	E	T
R	W	L	M	A	A	U	L	I	T	R	E	S	P	E	L	C	D	W	O	R	N	E	P	C	D	Y	O	R	H	A
P	R	R	E	A	H	I	O	R	C	G	T	S	T	I	H	T	S	R	L	T	N	E	E	P	H	O	O	C	A	S
S	S	U	T	T	D	E	A	N	I	I	N	D	U	I	P	D	E	R	M	A	V	R	C	R	T	H	T	M	O	C
E	W	R	E	D	N	O	Y	T	A	A	N	E	A	N	E	T	R	E	C	I	R	C	R	N	T	C	E	H	D	L
O	I	R	O	I	T	U	U	D	N	P	T	E	F	E	R	N	E	V	U	S	U	L	M	A	T	C	H	A	D	A
O	N	I	R	O	E	O	O	O	W	I	O	T	F	O	L	I	E	U	L	S	O	M	R	T	S	T	E	L	A	H
D	C	R	L	O	S	I	H	R	I	S	L	T	R	M	R	O	N	S	C	A	L	R	O	N	U	L	E	L	I	A
C	H	Y	G	O	R	C	M	A	F	S	L	T	R	D	L	I	A	S	O	D	A	A	P	T	L	E	H	I	T	R
L	I	E	A	H	O	I	B	S	L	A	I	T	W	I	S	M	F	S	T	R	A	R	E	L	M	H	T	R	W	
L	A	C	E	E	L	G	T	D	R	I	T	R	E	L	N	E	T	A	L	S	H	U	R	M	P	C	R	O	E	U
F	T	O	<u>R</u>	A	N	A	W	N	N	H	E	E	T	I	E	P	O	O	R	M	P	D	A	E	U	R	D			

ANSWER KEY

Order of Words:

- 1 relative humidity
- 2 hail
- 3 Doppler radar
- 4 cloudburst
- 5 Fahrenheit
- 6 hail
- 7 humidity
- 8 cloudburst
- 9 air
- 10 dew point
- 11 Doppler radar
- 12 meteorology
- 13 cirrus
- 14 wind chill factor

Source: EdHelper.com-materials such as this word puzzle for a subscription fee

Temperature Inversion

Demonstration of how weather conditions can trap air pollutants close to the ground during a temperature inversion.

Teacher Notes

Tiny solid particles from automobile exhaust, soot from factory smokestacks, fireplaces, and leaves and trash burning are largely responsible for the formation of the haze that can be seen hovering over many large cities and industrial areas. Many people who breathe this air experience some discomfort and suffer some health problems. The severity of this form of pollution is increased when local weather conditions and/or the unique topography of a region cause the pollutants to be trapped in a layer of still air that prevents them from moving away from the area. Usually, the air that is close to the ground is warmer than that which is found at higher altitudes. This is because there is less pressure at higher altitudes than near the ground and as a volume of air expands it cools. Since there is less pressure, there are fewer collisions of molecules because they have to travel farther before they encounter another molecule. (It is the collisions that give off heat, which we measure as air temperature.) However, this is only true for a column of air with uniform density. When the density of the air at the surface is dramatically different than the air above it (that is, dense, cold, DRY air is at the surface and less dense, warmer, moister air is above) then we see a warmer temperature at say 5,000 feet than at the surface. This almost always happens at night and happens frequently during the day in the winter months. When the air is especially still at times like these, the cooler air, because of its greater density, settles close to the ground, and the warmer air forms a blanket above it in a temperature inversion. Pollutants in the air, such as smoke and soot, are also trapped close to the ground. Fog, formed when moisture in the cool air condenses close to the earth's surface, becomes smog when combined with these pollutants.

Materials wide-mouthed gallon jar with cover, plastic bags, chilled sand bags, hot water, funnel, incense plastic tubing, twist-ties masking tape.

Procedure- Place a wide-mouthed gallon jar on a table top where all students can view it easily.

- Place one or more very cold sand bags in the bottom of the jar.
- Fill one or more small plastic bags with very hot water and use twist-ties to close the tops
- Suspend the plastic bags containing hot water inside the jar by taping their closed top edges to the rim of the jar.
- Attach one end of a length of plastic tubing to a funnel stem and place the free end in the jar.
- Position the mouth of the funnel over a small container of burning incense.
- Hold the jar top securely in place atop the jar and direct smoke from the incense through the funnel and tube into the jar.
- Observe the activity in the jar.

Temperature Inversions

Materials PPE, water, food coloring, heat source, resealable plastic bag, pin, aquarium, ice.

Another demonstration to show what happens to pollutants during a temperature inversion.

First, create simulated normal atmospheric conditions for comparison to a temperature inversion:

- Heat a pan of water on a hot plate and add a few drops of food coloring to the water.
- Fill one of the aquariums about $\frac{3}{4}$ full of cold water. Add ice (equivalent to several cubes).
- Fill one-half of a plastic, resealable bag with the warm water and food coloring.
- Seal the bag with as little air inside as possible.
- Remove any ice not melted from the aquarium.
- Lower the bag with the colored water (air pollution) into the cold, colorless water of the aquarium.
- Without disturbing the water in the aquarium, poke a hole in the bag with a pin and observe the interaction of the warm water with the cold water.

To simulate a temperature inversion:

Materials PPE, water, food coloring, heat source, resealable plastic bag, pin, aquarium, ice.

- Add several ice cubes and several drops of food coloring to the water (enough for a plastic resealable bag).
- In another container, heat enough water to fill the second aquarium half full.
- Fill a plastic bag and seal it so that there is no air in the bag.
- Lower the bag with the cold, colored water (air pollution) into the aquarium which has been filled with the colorless, warm water.
- Without disturbing the water in the aquarium, poke a hole in the bag with the pin and observe the interaction of the warm and cold water.

Compare observations and describe temperature inversions and pollution interactions.

(Adapted from Texas Natural Resource Conservation Commission)

The Awful Eight Lesson Plan

Materials

Markers, yardsticks, large pieces of poster board, background information on air pollution, library books that cover air pollutants, materials for "costumes" copies of play for each student, video camera.

Teacher Notes: The U.S. Environmental Protection Agency (EPA) has established national ambient air quality standards for six air pollutants - ozone, carbon monoxide, sulphur dioxide, nitrogen dioxide, respirable particulate matter, and lead. Volatile organic compounds (VOCs) are emitted from sources as diverse as automobiles, refineries, chemical manufacturing, dry cleaners, paint shops, and other sources using solvents. VOCs are precursors to ground-level ozone, and some of the VOCs are toxic. Chlorofluorocarbons (CFCs) are a family of chemicals commonly used in air conditioners and refrigerators as coolants and also as solvents and aerosol propellants. CFCs drift into the upper atmosphere where their chlorine components destroy upper-level ozone. CFCs are thought to be a major cause of the ozone hole over Antarctica.

The main man-made source of carbon dioxide emissions is fossil fuel combustion for energy-use and transportation. Methane comes from landfills, cud-chewing livestock, coal mines, and rice paddies. The extent of the effects of climate change - or the "greenhouse effect" on human health and the environment is still uncertain, but could include increased global temperature, increased severity and frequency of storms and other "weather extremes," melting of the polar ice cap, and sea-level rise.

The Awful Eight Lesson Plan

Teacher Notes-Ground-level ozone is a photochemical oxidant and the major component of smog. Ground-level ozone is not emitted directly into the air but is formed through chemical reactions between natural and man-made emissions of VOCs and oxides of nitrogen in the presence of sunlight. Since the reactions are stimulated by temperature, peak ground-level ozone concentrations occur in the summer months. Elevated levels above the national standard may cause lung and respiratory disorders. Short-term exposure can result in shortness of breath, coughing, chest tightness, or irritation of nose and throat. Individuals exercising outdoors, children, the elderly, and people with pre-existing respiratory illnesses are particularly susceptible.

Nitrogen dioxide is formed both by the combustion of nitrogen and the reaction of nitric oxide with oxygen in the atmosphere. Nitrogen dioxide emissions result almost entirely from fuel combustion by industry, energy producers, and motor vehicles. In addition to being a precursor to ground-level ozone, oxides of nitrogen react chemically in the atmosphere to form nitrates. These pollutants can be transported long distances from the source and can contribute to acid rain and impair visibility. Nitrogen dioxide can harm humans at elevated levels above the national standard. In particular, may cause increased respiratory illness such as chest colds and coughing with phlegm in children. For asthmatics, can cause increased breathing difficulty.

Carbon monoxide is produced by incomplete combustion of carbon in fuels. The majority of carbon monoxide emissions come from transportation sources, principally from highway motor vehicles. Carbon monoxide reduces blood's ability to deliver oxygen to vital tissues, affecting primarily the cardiovascular and nervous systems. Lower concentrations have been shown to adversely affect individuals with heart disease and to decrease maximal exercise performance in young. Higher concentrations above the national standard can cause symptoms such as dizziness, headaches, and fatigue.

The Awful Eight Lesson Plan

Teacher Notes-Sulphur dioxide results primarily from combustion of sulphur-bearing fuels, smelting of sulphur-bearing metal ores, and industrial processes. Major sulphur dioxide emission sources are power plants, refineries, some types of chemical plants, primary metal smelters, and cement plants. These pollutants can be transported long distances from the source and can contribute to acid rain and visibility impairment. Sulphur dioxide becomes sulfuric acid once it comes in contact with moist mucous membranes. At elevated levels above the national standard, it irritates the respiratory tract, causing restricted air flow and breathing difficulty. Individuals with pre-existing pulmonary disease are particularly susceptible to these effects.

Respirable particulate matter includes dust, dirt, soot, smoke, and aerosols emitted into the air by various sources. Major sources of particulate pollution are factories, power plants, refuse incinerators, motor vehicles, construction activity, fires, and natural windblown dust. These microscopic particles can be inhaled and deposited deep in the lungs where they can be trapped on membranes. If trapped, they can cause excessive growth of fibrous lung tissue, which leads to permanent injury. Children, the elderly, and people suffering from heart or lung disease are especially at risk.

The primary sources of lead in the atmosphere are lead-containing gasoline additives, nonferrous smelters, and battery plants. There has been a steady decline in lead levels in the air as a result of the phase out of leaded gasoline and pollution control programs. Elevated levels above the national standard can adversely affect mental development and performance, kidney function, and blood chemistry. Young children are particularly at risk due to their increased sensitivity of young tissues and organs.

The Awful Eight Lesson Plan

- Assign each part under the "Cast of Characters" and pass out copies of the play.
- Give students time to learn their lines, design costumes, and plan any special effects they might want to add.
- After the group performs the play, review the eight major air pollutants by having each "pollutant" come out and take a bow.
- The Pollutants should state their name; what causes them; how they affect people, wildlife and the environment; and what people can do to help reduce this type of pollution.
- Or you can have the audience supply this information to see how much they learned from watching The Awful 8.

Procedure

- Distribute copies of the play to each student.
- Have class read play aloud, following seating arrangement for each part.
- Assign students to different roles; for homework practice lines and bring own props.
- Practice play.
- Present and/or video record play when students are ready.
- List ways we can prevent or reduce the types of air pollution mentioned in the play.
- Brainstorm solutions to air pollution problems - be creative.

Harmful Effects of Acid Rain

Teacher Notes-Acid rain is more acidic than normal rain and forms through a complex process of chemical reactions involving air pollution. The two most important pollutants that contribute to the formation of acid rain are oxides of nitrogen and sulfur dioxide, which react with moisture in the atmosphere to form nitric and sulfuric acid. The sulfur and nitrogen compounds that contribute to acid rain primarily come from man-made sources, such as industries and utilities. Emissions also come from automobiles and other forms of transportation and industrial processes, such as smelting. Acid rain can harm forests and crops, damage bodies of water, and contribute to the damage of statues and buildings. Researchers are considering the possible effects of acid rain on human health. These acidic pollutants can be deposited through rain, snow, fog, dew, or sleet. Large quantities can also be deposited in a dry form through dust. Pollutants that contribute to acid rain may be carried hundreds of miles before being deposited on the earth. Because of this, it is sometimes difficult to determine the specific sources of these acid rain pollutants.

Materials: PPE, vinegar, water, 2 medium sized eggshell pieces, 2 small green leaves, two paper clips, two containers with lids.

Procedure

- Before activity, make predictions. If vinegar contains acid, then how will some items placed in vinegar change? If these items were placed in water, would they change in the same ways as in vinegar?
- Pour vinegar in one container. Place an eggshell piece, a leaf, and a paper clip in the container. Put the lid on the container.
- Pour water in the other container. Place an eggshell, a leaf, and a paper clip in this container. Put the lid on the container.
- Let the two sealed containers sit overnight.
- Remove the container lids. Observe any changes that took place in the two containers. Write down observations.

What Do Concentrations Mean? Comparing Concentrations of Gases in Our Atmosphere

Teacher Notes Certain gases, such as the greenhouse gases (for example, carbon dioxide, water vapor, methane, and ozone), occur in the atmosphere in miniscule amounts. In a random air sample from the troposphere, for example, you would likely find only about 350 molecules of carbon dioxide for every one million molecules of air mixture. Scientists would express this amount as 350 parts per million (ppm). Gas concentrations can also be expressed in mass units. With gases in the atmosphere, we usually think in terms of volume and may express this as parts per million by volume (ppmv). Some substances occur in such small amounts that scientists measure them in even smaller amounts such as parts per billion by volume (ppbv) or even parts per trillion by volume (pptv). Because these measurements are very important to atmospheric scientists, it is useful for students to realize just how important even vanishingly small amounts of certain gases can be. This exercise is designed to give students an appreciation of how many dilutions it takes to achieve a part-per-million dilution of a common substance (food coloring). You may want to share some of the following interesting comparisons with your students and encourage them to come up with their own:

Part per million:

- 1 12-oz can of soda pop/30-meter swimming pool
- 1 3-oz chocolate bar/football field
- 1 bogey/3,500 golf tournaments

Part per trillion:

- 1 square inch/250 square miles
- 1 postage stamp/an area the size of Dallas, Texas
- 1 flea/360,000,000 elephants

Part per billion:

- 1 square foot/36 square miles
- 1 bad apple/1,000,000 barrels of apples
- 1 pinch of salt/10 tons of potato chips

What Do Concentrations Mean?

Comparing Concentrations of Gases in Our Atmosphere

Materials Per Team Ice cube tray (preferably white), Water jug filled with water, Three small plastic cups, Pipette or eye dropper, Food coloring, Marker, Data chart

Cell	1	2	3	4	5	6	7	8	9	10
Color										
ppm	1,000,000	100,000								

Prepare a drawing that shows the abundances of five of the most important gases in the earth's atmosphere. They may use pictures, charts, graphs, or drawings.

GAS	PPM
Nitrogen	780,000
Oxygen	210,000
Water vapor (variable, up to) *	40,000
Argon	10,000
Carbon dioxide *	345
Neon	8
Helium	5
Methane *	1.7
Low-level ozone * (variable, up to) (troposphere)	0.01 to 0.5
High-level ozone (stratosphere)	0.04 to 0.2
Chlorine from CFCs	0.035

What Do Concentrations Mean? Comparing Concentrations of Gases in Our Atmosphere

Explore how many dilutions it takes to achieve a part-per-million dilution of a common substance (food coloring). As you learn more about the concentrations of gases in our atmosphere, think about how these dilutions relate.

Procedure

- Label ice cube tray "cells" 1 to 10 with a permanent marker.
- Fill the three plastic cups about half full of water for eye dropper (or pipette) cleaning.
- In cell #1, place 10 drops of food coloring. This represents a pure substance, or a concentration of 1 million parts per million.
- Take one drop of the food coloring from cell #1 and place it in cell #2.
- Rinse the dropper in one of the plastic cups to remove all traces of food coloring.
- Add 9 drops of clean water to cell #2 and stir the mixture. The mixture is now diluted to 1/10th of the original concentration, or 100,000 parts food coloring per million parts of solution.
- Take one drop from cell #2 and place it in cell #3.
- Rinse the dropper again.
- Add 9 drops of clean water to cell #3 and stir the mixture. How concentrated is the food coloring now, in ppms?
- Repeat the above procedure for cells #4 to 10 (remember to clean the dropper between uses). After each dilution, record the new concentration in the cell in ppm.

What Do Concentrations Mean? Comparing Concentrations of Gases in Our Atmosphere

Observations and Questions

- In which cell is the color most intense? Why?
- In which cell is the color least intense? Why?
- Are there any cells where the liquid is colorless? Is there any food coloring in these cells? How do you know?
- Cell #1 contains food coloring with no water added. What is the percent concentration of food coloring in cell #1?

- 100 percent can be written as the fraction 100/100. Complete the following fraction so that both sides are equal:

$$100/100 = \underline{\hspace{2cm}}/1,000,000$$

- The earth's atmosphere contains 78% nitrogen and 21% oxygen. Write these percentages as concentrations in ppm.

$$78\% = \underline{\hspace{2cm}}/100 = \underline{\hspace{2cm}}/1,000,000 = \underline{\hspace{2cm}} \text{ ppm}$$

$$21\% = \underline{\hspace{2cm}}/100 = \underline{\hspace{2cm}}/1,000,000 = \underline{\hspace{2cm}} \text{ ppm}$$

What Do Concentrations Mean? Comparing Concentrations of Gases in Our Atmosphere

- Which of your cells of food coloring is closest in concentration in ppm to nitrogen? Which cell is closest to the concentration of oxygen?
- Carbon dioxide, methane, nitrous oxide, and chlorofluorocarbons are gases that affect the temperature of the earth's atmosphere. Their concentrations are listed below. Which of your cells of food coloring is closest in concentration to the concentration of each gas? Convert the ppm concentrations to ppb.

GAS	CONCENTRATION	CELL NUMBER
CO ₂	355 ppm = ___ ppb	
CH ₄	1.7 ppm = ___ ppb	
N ₂ O	.3 ppm = ___ ppb	
CFC-12	.0005 ppm = ___ ppb	
CFC-11	.0003 ppm = ___ ppb	

- How does the concentration of the greenhouse gases compare to the concentration of oxygen and nitrogen?
- How can gases such as carbon dioxide and methane, with their small concentrations, have such a large effect on our atmosphere?

Airborne Junk Detectors

Engage

How can we observe particulate matter in the air?

- Ask students to identify the types of particulate matter that may be found in the air.
- Ask students to describe how some of this particulate matter that is in the air can be captured and studied.
- Record ideas for student to refer back to.
- Discuss the importance of controlling variables, that is EVERYTHING stays the same except for the location of the detectors. Guide students into understand that the detectors should be located at the same elevation, free from confinement, placed at the same time and recovered at the same time. The detectors should all be the same size and the same shape.

Explore

Build a device that can be used to capture particulate matter in the air. Examine/identify the captured particles.

- Using the list on the board and some examples of your own, have students (in groups) design a device that can be used to capture particles. Their ideas should include some type of container or holder that has a piece of sticky tape or sticky label on it. Have the students keep in mind that they are going to observe the captured particulate matter under a microscope, so the device should not be too big.
- Have the groups plan how many “detectors” they wish to build and where they wish to place them. Have students collect particulate matter several times during a week and in different weather conditions.
- Have students create an experimental question and hypothesis to go along with their study. For example: Where does the most particulate matter exist on the school grounds? (experimental question) There is more particulate matter in the air around the cafeteria than there is around my classroom. (hypothesis)
- Have students keep records of where they placed the detectors, when they were placed and what the weather conditions were like when they were placed. Notes can be kept directly on the detectors. The data tables they create should include Data and Time, Location, Temperature, Wind Direction, Wind Speed, Number of particles, Type of Particle.
- Have the students investigate references to find drawings, photos, etc, of the major kinds of particulate matter. Have them draw sketches of these and use them to help identify their captures.
- After collecting their detectors, have students examine the collected particles under a magnifying glass AND a microscope. Use a stereoscope or a low power of a microscope. If students cannot identify ALL of the different particles, that is to be expected. They may not be able to count ALL of the particles. Have them to place a piece of graph paper behind the tape to determine the amount of the tape that was covered by the particles.
- Have students write an answer to their experimental question and determine if their hypothesis was true or false.

Airborne Junk Detectors

Ideas for Construction of the Device to Capture Particulates in the Air

- One way of doing this activity is to take a file folder or cardboard and cut it into the size and shape of a playing card. Cut out a small rectangular window in the card and place a piece of sticky tape or label in the window. You can punch a hole in the top of the card and place a piece of string through it to tie on to a tree limb, post, etc.
- Another approach to accomplishing this task is to take a vacuum cleaner and secure a piece of filter paper over the end of the hose. Make sure air can pass through the filter paper and the filter paper is not sucked into the hose.

Explain/Elaborate

- Why is it important to control variables in the experiment?
- Where do you think the most particulate matter would likely be found in Earth's atmosphere? Why?
- How does particulate matter affect our weather?
- Is it possible to make our air truly "clean?" Explain.
- What would our environment be like if there wasn't any particulate matter in the air?
- How could you improve your method to get more particles out of the air?
- Did weather have any influence over the amount of particles you collected? Explain.

Evaluate

- Have students repeat their experiment (with revisions for improvement) in their home or their neighborhood.
- Students should write a laboratory report.
- Evaluate student work within the group.
- Evaluate data tables and research on particulate matter.
- Have students to design a better way of collecting particulate matter.

Airborne Junk Detectors

Have students research the relationship between air pollution and particulate matter. They should be able to identify specific locations around the world where this type of pollution is a problem and what the sources of the pollution are.

Catch a Snowflake or a Snow Crystal

Are all snow flakes alike?

Have students research snow crystals and snowflakes noting conditions which determine the type of snow that falls. Consult the International Commission of Snow and Ice Classification (ICS) scheme.

Explore

Materials-Dark material, thermometer, jumbo paper clips, microscope slides, ICS classification sheet, clothespins, hair spray or NuSkin®, cardboard box, microscope, magnifying glass, PPE.

Catch snowflakes/crystals outside and look at them with a magnifying glass. Sketch and classify according to ICS. Collect temperature data.

To preserve the snowflakes/crystals, use the following technique and tips.

The microscope slides and hairspray or NuSkin® should be placed outside (in a covered box) to chill before use. Spray slides right before you are ready to collect. Another tip is to minimize the transfer of body heat to the slides. Use the clothespins to hold the slides. Another way minimize heat transfer to the prepared slides is to “catch” the snow with a bent straight jumbo paper clip and then transfer to the prepared slide. Leave slides in the box for several hours. Examine slides under a microscope and classify according to ICS.

Collect snow for several storms. Compare types and temperature to see if the sizes and shapes of snow vary with the temperature.

How to Make a Wet Scrubber

Teacher Notes The wet scrubber is one of the most common pollution control devices used by industry. It operates on a very simple principle: a polluted gas stream is brought into contact with a liquid so that the pollutants can be absorbed.

Materials PPE, paper towels, 12-cm piece of glass tubing, three 2.5-cm pieces of glass tubing, three 55-ml flasks, two glass impingers (glass tubing drawn at one end to give it a smaller diameter so as to let out smaller bubbles), heat source (burner or hot plate), three 2-hole rubber stoppers (of a size to fit the mouths of the flasks), two 30-cm pieces of rubber tubing, ringstand apparatus, vacuum source,

Procedure

- Set up the apparatus as shown. Put a paper towel in a 55-ml flask and place this above the burner.
- Using a 2-hole stopper that makes an air-tight seal with the flask, insert a 12-cm section of glass tubing through one of the holes. The tubing should reach to approximately 1.2-cm from the bottom of the flask.
- Insert a 2.5-cm piece of glass tubing into the other hole of the stopper.
- Connect a 30-cm piece of rubber tubing to the 2.5-cm piece of glass tubing, making sure an air-tight seal exists.
- Fill a second 500-ml flask approximately 3/4 full of water. Using a second double-hole stopper, put a 2.5-cm piece of glass tubing into one of the holes, and insert the glass impinger into the other.
- Construct a third flask like the second.
- Connect the rubber tubing and heat the first flask (combustion chamber) until smoke appears.
- Put a vacuum on the third flask to draw a stream of smoke through the second flask (the wet scrubber). If smoke collects in the second flask above the water, a second scrubber can be added.
- Ask the students if particles are the only pollutants produced by industry. Discuss how a wet scrubber collects not only particulate matter but also captures waste gases. Demonstrate how the water scrubber works. Discuss that the white plume you see coming from a smokestack may really be steam coming from a water scrubber.

After observing the wet scrubber, answer the following questions:

- Why does the water in the wet-scrubber change color?
- Why does the wet-scrubber have an impinger (in other words, why is it important for small bubbles to be formed)?
- What does the scrubber filter out of the air? Not filter out?
- Suggest ways to dispose of the pollutants that are now trapped in the water.

Stormy Memories

Materials tape recorder or notebook to record interviews

Procedure

- Have students prepare questions to ask their parents, neighbors, or other people in their community about a major storm they experienced in the recent or distant past.
- Ask students to find out as many details as possible about the storm: when it occurred, how people prepared for it, what damage it did, and how long it took to recover.
- If possible, they should talk to more than one person who experienced the storm so they can compare and contrast recollections.
- Tell students to tape record or write notes as they interview their storm eyewitnesses.
- Have students piece together the information they gathered to write an account of the storm.
- Ask them to present their "storm history" to the class.

The Path of Pollution

Materials student copy of "Explosion at Chernobyl", pencil, sticky dots or stickers to mark map, world map, atlas of encyclopedias, map of Europe, "Pollution Points"

Teacher Notes: Most major air pollutants are invisible, although large amounts of them concentrated in areas such as cities can be seen as smog. One often visible air pollutant is particulate matter, especially when the surfaces of buildings and other structures have been exposed to it for long periods of time or when it is present in large amounts. Particulate matter is made up of tiny particles of solid matter and/or droplets of liquid. Natural sources include volcanic ash, pollen, and dust blown by the wind. Coal and oil burned by power plants and industries and diesel fuel burned by many vehicles are the chief sources of man-made particulate pollutants, but not all important sources are large scale. The use of wood in fireplaces and wood-burning stoves also produces significant amounts of particulate matter in localized areas, although the total amounts are much smaller than those from vehicles, power plants, and industries. Our air does not know any boundaries. Wind can carry pollutants hundreds of miles from their origin. The distance air pollutants travel depends on how high in the atmosphere they go. If the pollutants don't rise very high, they are deposited close to their source. However, pollutants that are lifted high into the atmosphere may travel thousands of miles before they drop back to Earth. Air does not know local, state, national or international boundaries.

By tracing the movement of radiation released during an accident at the Chernobyl nuclear power plant, students will see how air pollution, like particulate matter, can become a global issue.

Procedure:

- Students may work individually or in groups. Discuss with the students what air pollution is and how it travels. Pass out the Explosion at Chernobyl information sheet. The students can read and discuss the article.
- Using the Pollution Points handout, plot the course the radiation took each day. Points should be plotted in sequence, chronologically.
- Consult reference materials or internet to locate countries.

Write an essay on the topic-"Air Pollution is a Global Issue".

The Explosion at Chernobyl

The Big Blast

On April 26, 1986, at 1:23 a.m., Chernobyl became the site of the world's worst nuclear power plant accident. Operators were shutting down one of the reactors for maintenance when the power suddenly surged and the reactor exploded. The blast blew the reactor apart and sent radioactive gases and particles as high as three miles into the atmosphere. Two plant workers were killed by the explosion. Twenty-nine others later died from radiation exposure. Within days, more than 120,000 people were evacuated from an 18-mile radius around the plant. As fires inside the reactor burned, helicopters dumped tons of lead, sand, and other minerals on the flames. Despite these efforts, the fires burned for 10 days after the blast, continuing to release radioactive pollutants into the air.

Where It Went

The explosion resulted in a huge cloud that soon split into two parts. One part of the cloud moved northwest toward Poland and Scandinavia, and then southwest across central Europe. The other part of the cloud moved east across Asia, over Japan and the North Pacific, and eventually reached western North America. And as the reactor continued to burn, it released radiation that moved south and west of the plant. But scientists believe that in most cases, the amounts of radiation deposited outside the Soviet Union were relatively low.

Effects of the Explosion

The first few weeks following the Chernobyl blast were filled with confusion. Some European countries ordered the destruction of millions of dollars worth of contaminated produce, milk, and livestock. But in other nearby European countries, people were told that there was no danger and that it was safe to consume these products. Farmers suffered huge financial losses when countries in other parts of the world refused to import produce from Europe. A significant portion of the released radioactive material has a very long half-life, i.e., it will be around for a very long time, thousands of years. Radiation, even at low levels, can increase incidence of cancer. Particularly sensitive are the effects on the digestive system, blood pressure, and the heart. The explosion also strained relations between the Soviet Union and other nations. Many countries were angered by the Soviet Union's delay in reporting the accidents. Officials announced it on April 29.

Chernobyl's Legacy

The damaged reactor at Chernobyl now stands entombed in thick layers of concrete and steel, while the other reactors at the same plant are again producing energy. But the disaster is still taking its toll. Some scientists predict that within the next few decades, thousands of people who were exposed to the radiation could develop cancer.

The Explosion at Chernobyl- Pollution Points

Day 2 -- April 27, 1986

- Winds blow radioactive cloud northwest over Gdansk, Poland.

Day 3 -- April 28, 1986

- Radioactive cloud reaches Stockholm, Sweden. Radioactive cloud reaches Helsinki, Finland.
- Radioactive cloud reaches Oslo, Norway.

Day 4 -- April 29, 1986

- Radiation continues moving north through Scandinavia and reaches Trondheim, Norway.
- Radiation detected in Copenhagen, Denmark.
- Winds carry radioactive cloud to Prague, Czechoslovakia.

Day 5 -- April 30, 1986

- Cloud moves over Munich, West Germany.
- High amounts of radioactive particles wash out when it rains in Vienna, Austria.
- Radioactive cloud reaches Geneva, Switzerland.

Day 6 -- May 1, 1986

- Cloud travels to Rome, Italy.
- Radioactive cloud reaches Budapest, Hungary.
- Winds carry radioactive cloud to Zagreb, Yugoslavia.
- Radiation detected in Paris, France.
- 15. Radioactive cloud reaches Tromso, Norway.

The Explosion at Chernobyl- Pollution Points

Day 7 -- May 2, 1986

- Small amounts of radiation measured near Reykjavik, Iceland.
- Radiation reaches Bucharest, Romania.
- Winds carry radioactive particles into Brussels, Belgium.
- Radioactive cloud moves over London, England. High amounts of radiation wash out when it rains north of London.
- Radioactive cloud detected in Sofia, Bulgaria.

Day 8 -- May 3, 1986

- Radioactive cloud reaches Glasgow, Scotland.
- Winds carry radioactive cloud to Athens, Greece.
- Radioactive particles detected in Ankara, Turkey.

Day 9 -- May 4, 1986

- Radiation reaches Beirut, Lebanon.

Day 10 -- May 5, 1986

- Radiation detected in Damascus, Syria.

Day 11 -- May 6, 1986

- Radioactive particles reach Kuwait, the capitol of Kuwait.
- Radioactive cloud moves over Xian, China.

The Explosion at Chernobyl- Pollution Points

Day 12 -- May 7, 1986

- Radioactive particles reach Tokyo, Japan

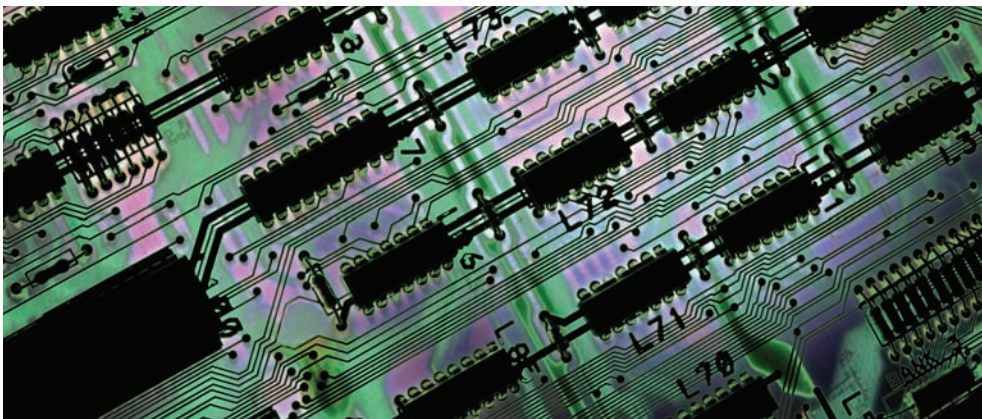
Day 18 -- May 13, 1986

- Slight amount of radiation detected in Richland, Washington, in the United States.

Middle Grades Science

7th Grade Support Document

Goals 1, 2, and the Human Body System



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PUBLIC SCHOOLS OF
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 Instruction

7th GRADE COMPETENCY GOAL 4

The learner will conduct investigations, use models, simulations, and appropriate technologies and information systems to build an understanding of the complementary nature of the human body system.

BIG Ideas

**Human
 Body
 Systems**

Living systems have the following levels of organization—atoms, molecules, organelles, cells, tissues, organs, organ systems, organisms, populations, and communities. The complexity and number of fundamental units change in extended hierarchies of organization. Within these systems, interactions between components occur. Further, systems at different levels of organization can manifest different properties and functions.

The human body has a set of systems, which regulate the internal environment and strive to give our cells the necessary conditions they need to function. These systems are made up of organs; each organ system functions in the human body and works in cooperation with other systems to benefit the entire organism. The skeletal system provides the support for movement and protection of internal organs. The muscular system creates the force that enables the body to move and carry out different functions related to movement. The body's circulatory, respiratory, digestive and urinary systems work in combination to supply all cells with what they need to function properly and remove wastes. The reproductive system enables the organism to make more of its kind. The immune system protects cells from microscopic invaders. The nervous system controls body processes by using electrical impulses via a network of nerves. The endocrine system uses chemical messages called hormones, which are released into the blood and regulate many bodily processes. The endocrine and nervous systems are two control systems that keep the body in homeostasis. Body systems work together in maintaining a constant internal environment. When this balance is disrupted, the body systems may not function properly and human health can suffer.

Life style choices, environmental factors, and genetics can cause abnormalities to occur during embryonic development as well as later in life. Human activities such as smoking, consumption of alcohol and the use of drugs lead to a variety of adverse conditions within the human body and interfere with the efficient operation of the systems of the body. Technology and medical advances can help us understand how the human body functions and allow us to make informed decisions regarding our health.

National Science Education Standards	AAAS Benchmarks
<p>Human Body Systems</p> <ul style="list-style-type: none">• Living systems at all levels of organization demonstrate the complementary nature of structure and function.• Important levels of organization for structure and function include cells, organs, tissues, organ systems, whole organisms, and ecosystems.• The human organism has systems for digestion, respiration, reproduction, circulation, excretion, movement, control, and coordination, and for protection from disease. These systems interact with one another.• Specialized cells perform specialized functions in multicellular organisms. Groups of specialized cells cooperate to form a tissue, such as a muscle. Different tissues are in turn grouped together to form larger functional units, called organs.• Each type of cell, tissue, and organ has a distinct structure and set of functions that serve the organism as a whole.	<p>Human Body Systems</p> <ul style="list-style-type: none">• Systems: Thinking about things as systems means looking for how every part relates to others. Any system is usually connected to other systems, both internally and externally. Thus a system may be thought of as containing subsystems and as being subsystems of a larger system.• Cells: Various organs and tissues function to serve the needs of all cells for food, air, and waste removal. Lungs take in oxygen for the combustion of food and they eliminate the carbon dioxide produces. The urinary system disposes of dissolved waste molecules, the intestinal tract removes solid wastes, and the skin and lungs rid the body of heat energy. The circulatory system moves all these substances to or from cells where they are needed or produced, responding to changing demands.• Heredity: In sexual reproduction, a single specialized cell from a female merges, with a specialized cell from a male. The fertilized egg cell, carrying genetic information from each parent, multiplies to form the complete organism. Following fertilization, cell division produces a small cluster of cells that then differentiate by appearance and function to form the basic tissues of an embryo.• Physical Health: Toxic substances, some dietary habits, and some personal behavior may be bad for one's health. Some effects show up right away, others years later. Avoiding toxic substances, such as tobacco, and changing dietary habits increases the chance of living longer.

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Middle School Support Document
Human Body Systems

National Science Education Standards	AAAS Benchmarks
<p>Human Body Systems</p> <ul style="list-style-type: none">• Reproduction is a characteristic of all living systems; because no individual organism lives forever, reproduction is essential to the continuation of every species. Some organisms reproduce asexually; some reproduce sexually.• All organisms must be able to obtain and use resources, grow, reproduce, and maintain stable internal conditions while living in a constantly changing external environment.• The use of tobacco increases the risk of illness. Students should understand the influence of short-term social and psychological factors that lead to tobacco use, and the possible long-term detrimental effects of smoking and chewing tobacco.• Alcohol and other drugs are often abused substances. Such drugs change how the body functions and can lead to addiction.	

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 Human Body Systems

NC Science SCS	Content Elaboration	Ideas for exploration	Web Resources
<p>4.01 Analyze how human body systems interact to provide for the needs of the human organism:</p> <ul style="list-style-type: none"> • Musculoskeletal. • Cardiovascular. • Endocrine and Nervous. • Digestive and Circulatory. • Excretory. • Reproductive. • Respiratory. • Immune. • Nervous system. 	<p>The human body is composed of many systems that interact and work together to maintain homeostasis in the body.</p> <p>The Muscular system enables movement. Muscles work in pairs—one contracts while the other in the pair, relaxes to its original length.</p> <p>The Skeletal system:</p> <ul style="list-style-type: none"> • shapes and supports, • enables movement, • protects organs, • produces red blood cells, and • stores minerals and other materials. <p>The Cardiovascular system</p> <p>The Endocrine system</p> <p>The Nervous system detects and responds to information from the environment and controls body functions.</p> <p>The Digestive system takes in and absorbs nutrients.</p>	<p><u>Interaction of Body Systems</u></p> <p>Why is it easier for a child to learn new skills such as playing the piano or learning a foreign language?</p> <p>Pick a sport and design a warm up routine to appropriately stretch the muscles used in the sport.</p> <p>Pick a “universal” exercise. Do the muscles stretched during this exercise apply to all sports? Do push-ups help a baseball pitcher? etc.</p> <p>Determine dietary needs for maintaining healthy bones.</p> <p>Research Osteoporosis. What can you do as a teenager to prevent osteoporosis later in your life?</p> <p>What are some common skeletal and muscle injuries?</p> <p>Describe the role of all the systems that are involved in getting nutrients to the cells.</p> <p>Examine the muscles and joints of a chicken wing.</p>	<p>http://www.biology.arizona.edu/default.html wealth of resources related to cell theory, genetics, toxicology, and other cell-related topics</p> <p>http://www.ncsu.edu/sciencejunction/station/gameroom/bonehead/index.html allows comparison of skull structures and other Quick time movies</p> <p>www.mii.org/ information about elements and minerals needed by living things</p> <p>www.nei.nih.gov/education/visionschool Free teaching guide from the National Eye Institute</p>

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 Middle School Support Document
 Human Body Systems

NC Science SCS	Content Elaboration	Ideas for exploration	Web Resources
<p>4.01 Analyze how human body systems interact to provide for the needs of the human organism:</p> <ul style="list-style-type: none"> • Musculoskeletal. • Cardiovascular. • Endocrine and Nervous. • Digestive and Circulatory. • Excretory. • Reproductive. • Respiratory. • Immune. • Nervous system. 	<p>The Circulatory system transports materials to and from cells.</p> <p>The Excretory system removes wastes.</p> <p>The Reproductive system produces specialized cells that unite to result in offspring.</p> <p>The Respiratory system takes in oxygen and eliminates carbon dioxide.</p> <p>The Immune system responds to foreign materials that invade the body.</p> <p>Through the process of digestion, food is broken down into nutrients (sugars, fatty acids, glycerol, and amino acids) that the cells can use.</p>	<p><u>Bitter Tastes</u></p> <p>Research the history of medical advances related to a specific body system.</p> <p>Create a graph to show how long food stays in each part of the digestive system: mouth and esophagus (approximately 15 minutes); stomach (about 4 hours); small intestine (about 7 hours); and large intestine (about 12 hours).</p> <p><u>Digestive System Enactment</u></p> <p>Explain the chain of events necessary for a nerve impulse to travel through the body. Include in your explanation the relation between: neuron, synapse, neurotransmitter, sodium and potassium ions, and receptor sites.</p>	<p>http://www4.tpgi.com.au/users/amcgann/body/circulatory.html information about body systems</p> <p>http://kidskonnnect.com/HumanBody/HumanBody.html links to numerous general and system specific sites</p> <p>http://www.kidinfo.com/Health/human_Body.html numerous</p> <p>http://www.aviationnow.com/content/ncof/lo_elf04.htm lab to demonstrate the exchange of oxygen and carbon dioxide in the capillaries of the human body</p>

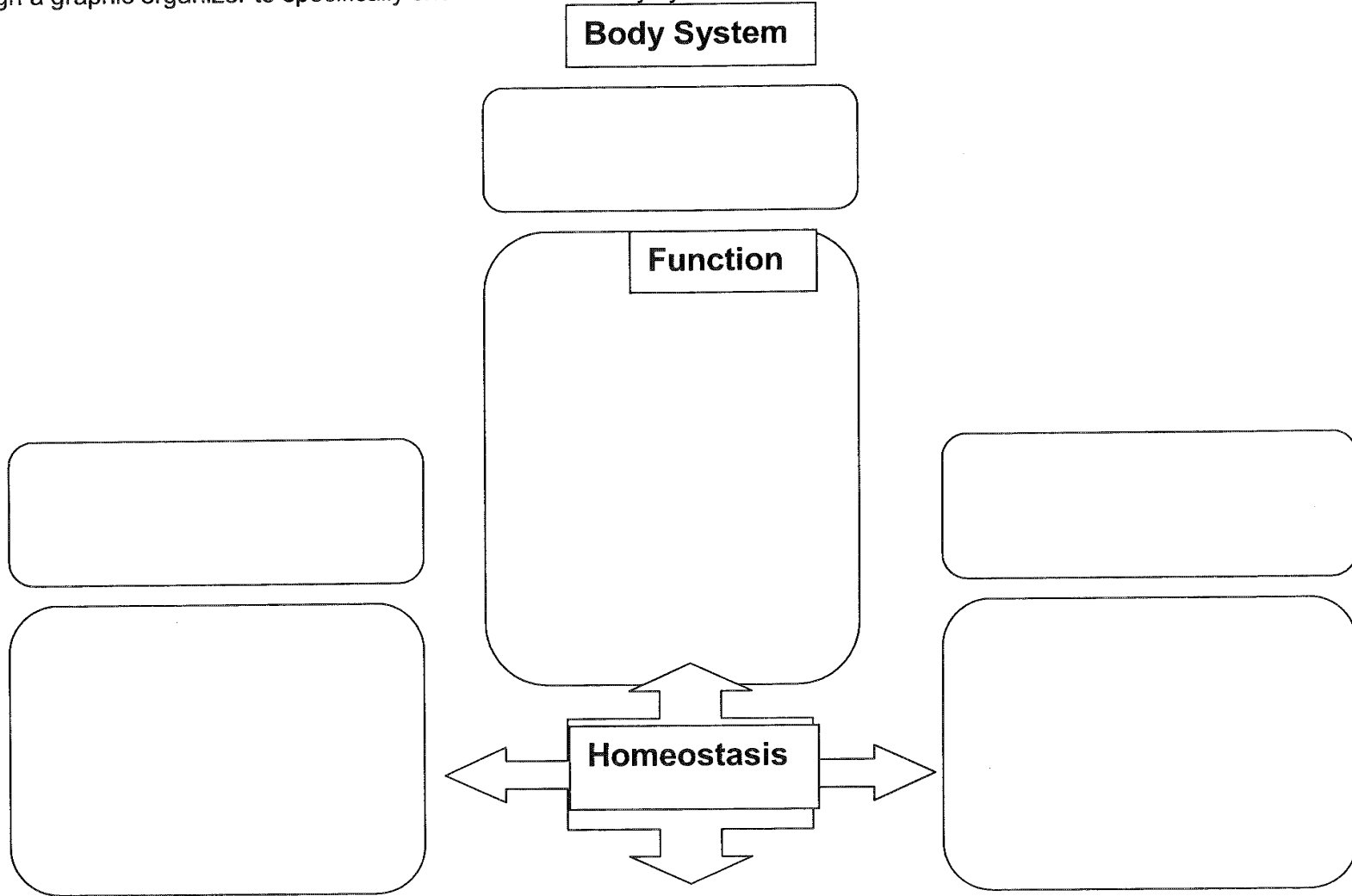
NC Science SCS	Content Elaboration	Ideas for exploration	Web Resources
<p>4.02 Describe how systems within the human body are defined by the functions it performs.</p> <p>4.03 Explain how the structure of an organ is adapted to perform specific functions within one or more systems:</p> <ul style="list-style-type: none"> • Liver. • Heart. • Lung. • Brain • Stomach. • Kidney. <p>4.04 Evaluate how</p>	<p>Organs work together in organ systems to perform major functions.</p> <p>Different organ systems depend on one another.</p> <p>It is important to body functions that healthy, normal blood pressure be maintained. Blood pressure readings consist of two numbers: systolic pressure which tells how much pressure is exerted against artery walls when the heart contracts, and diastolic which tells the pressure exerted when the heart relaxes and receives blood from the veins.</p>	<p>Research an athlete that the student feels best exemplifies a physically fit human machine. Students might consider how the athlete uses biomechanics to train for a sport, how his or her body type fits the sport, and whether the athlete has ever suffered a strained ligament or other injury that has required rehabilitation. Illustrate reports with a picture or drawing of their athlete performing his or her sport.</p> <p>Illustrate the pathway of oxygen-rich blood and oxygen-poor blood to and from the heart and lungs and body.</p> <p>Research the damage to organs caused by high blood pressure. What are some ways to control high blood pressure?</p> <p>Design an investigation to determine the capacity of your lungs. Compare results of the class.</p> <p>The lungs contain about 2400 km of air passage ways. Create models to illustrate how long this passage way is.</p> <p>How have technologies such as X-rays, Magnetic Resonance Imaging, EKG and EEG increased our knowledge and ability to treat the human body.</p>	<p>http://dir.yahoo.com/Recreation/Sports/Athletes provides sites on athletes in categories ranging from baseball to wheelchair racers, ice skaters to surfers, and offers other site listings</p> <p>http://school.discovery.com/lessonplans/programs/seehowtheyrun/ lesson plan on use of muscles making model of muscle system</p> <p>http://science-education.nih.gov/snapshots.nsf/story?openform&rt~Dyslexia story of dyslexia and the research of Guinevere Eden</p>

NC Science SCS	Content Elaboration	Ideas for exploration	Web Resources
<p>systems in the human body help regulate the internal environment.</p> <p>4.05 Analyze how an imbalance in homeostasis may result from a disruption in any human system.</p> <p>4.06 Describe growth</p>	<p>Blood is the liquid that moves materials and wastes continuously through the body.</p> <p>Red blood cells pick up oxygen in the lungs and transport it throughout the body.</p> <p>Arteries take blood away from the heart.</p> <p>Veins take blood to the heart.</p> <p>Capillaries connect arteries and veins.</p> <p>The kidneys act as a filter for the body.</p> <p>The lungs are two small organs where oxygen passes into blood and carbon dioxide is released.</p> <p>Liver</p> <p>Stomach</p> <p>Brain</p> <p>Villi link the digestive and circulatory system.</p>	<p>Investigate the career path to working in a hospital in radiography and its many specialties.</p> <p>Graph a comparison of various environmental temperatures versus internal body temperatures. Explain how this illustrates homeostasis.</p> <p>Research whether skin temperature is an accurate measure of internal temperature. Analyze the various devices sold to take temperatures for their value in reporting an accurate measure.</p> <p>What role do ligaments and tendons play in movement of bones or muscles?</p> <p><u>Effects of Smoking</u></p> <p><u>Advertisements About Smoking</u></p>	<p>http://science.education.nih.gov "LifeWorks" -health and medical science career exploration web site</p>

NC Science SCS	Content Elaboration	Ideas for exploration	Web Resources
<p>and development of the human organism.</p> <p>4.07 Explain the effects of environmental influences on human embryo development and human health including:</p> <ul style="list-style-type: none"> • Smoking. • Alcohol. • Drugs. <p>4.08 Explain how understanding human body systems can help make informed decisions regarding health.</p>	<p>Muscles grow and heal.</p> <p>All the systems of the body work together to maintain homeostasis.</p> <p>Homeostasis is the process by which the internal environment is kept stable.</p> <p>The food people eat contains nutrients that provide energy, help them grow, make body repairs, and help their bodies work properly.</p> <p>The body develops, maintains itself, and changes over time.</p>	<p>Using an almanac, students can research changes in human male and female life expectancy over the last 100 years. How has life expectancy changed? Have gender differences remained constant? Ask students to hypothesize why these changes have occurred over time,</p> <p>Debate the pros and cons of a lengthier life expectancy.</p> <p>Interview senior citizens to get their take on the subject.</p> <p>Cite 10 things from modern brain research. How do these things differ from what was once thought about the brain?</p>	<p>http://www.innerbody.com/tutorial2/tutorial.html tutorial</p> <p>http://www.rainbowraccoons.com/acs.htm information on costs of smoking; graphic pictures of lungs</p>

Interaction of Body Systems

Design a graphic organizer to specifically show how each body system functions to help the body maintain homeostasis.





7th Grade

Middle School Support Document
Human Body Systems

Bitter Tastes

You may not like the taste of some foods which are good for you. Everyone's tongue has sensitive areas called papillae but the number of papillae varies from individual to individual.

Materials

Small cup, cotton swabs, paper towel, paper reinforcement rings, white paper

Explore

Use a paper towel to pat the tongue dry.

Put a small amount of food coloring into the cup.

Use the cotton swab to "paint" the very end of the tongue. (about 3 cm)

Press a sheet of white paper to the tongue. Don't rub it—press firm only.

Isolate an area on the transferred imprint of your tongue with a paper reinforcement ring.

There should be circles apparent as you observe inside the ring.

Count the number of circles.

Record.

Compile as a class.

Get a class average, range, and median.

See if you can identify a pattern for the relationship between the number of papillae and the taste of foods.

If you have a large, small number of papillae, then you will, will not like the taste of bitter foods. (Such as collards, turnip greens, broccoli)

Models of Body Systems

Materials

Assorted sizes/colors craft paper, markers, internet access, determination of scale to use for models

Procedure

Research the system of the body that you have been assigned.

What is this system responsible for?

What are the major organs that make up this system?

What is the function of each part of the system?

Sketch each part of the system. Pay attention to scale.

Create a model of your system.

Trace your body on a large piece of paper.

Make a final sketch of each part of the system.

Label and explain the function of each part.

Check location of the organ and system with your research notes.

Plan how to tell the story of your system.

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 Middle School Support Document
 Human Body Systems

Rubric for Body System Model	Completely	Mostly	Partially	Poorly
Research on the body system provides level of detail needed to complete this project.				
Notes are clear and detailed.				
Sources are cited.				
Sources are scientific.				
Model is well planned.				
Model is to scale.				
Model puts system in proper location.				
Presentation tells the story of the system.				
Presentation details what was learned from the project.				

As a class, discuss the interactions of the systems. Compile the systems into one model.

Body Basics-NERVES©

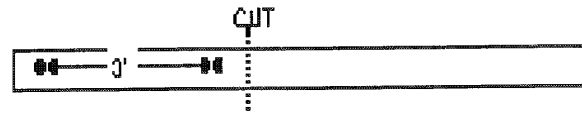
Which is more sensitive, your arm or your finger tip?

Materials(Per group of 3) 1 piece of paper, 1 push pin, 1 ruler, 1 pair of safety goggles,
2 straws, tape, 6 toothpicks.

Procedure

Make your test probes.

Starting near one end of the straw, make a pair of holes with the push pin that are 3" apart.
The holes must both go through the straw in the same direction.



Cut off the piece of straw with the holes in it.

Repeat this making pairs of holes that are 2", 1", 1/2" and 1/4" apart.

Break the toothpicks in half.

Stick one half through each hole so that:

- the pointed ends go in the same direction
- the pointed ends stick out of the side of the straw an equal amount
- the pointed ends stick out about 1/4"



Body Basics-NERVES©

Make your control probe. Poke a single hole in a small piece of the remaining straw. Put a single piece of toothpick in the hole.

Tape paper over your safety goggles. You will use these as a blindfold.

There will be three people involved: the subject whose arm is being tested, the tester, and the recorder who will write down the observations. The test can be repeated three times so that everyone gets a chance to do each job. To be able to measure the response of the nerves and not that of the conscious brain, this will be a blind test. This means that the subject will be blindfolded.

The subject should put on the blindfold and place their arm on the desk.

The tester will select a probe and gently poke the subject's arm.

Poke hard enough so that you can see the skin pushed down.

Be sure that both points touch with the test probes.

The subject must call out **one** or **two** depending on if they felt one poke or two.

The recorder will record which probe was used and the subject's response.

During the test, you should use each test probe at least three times. The control probe will be used more often.

The order in which you use the probes should be random so the subject does not try to "guess" the correct response.

Body Basics-NERVES©

Subject:						
Location: Arm	Control	3 inches	2 inches	1 inch	1/2 inch	1/4 inch
Felt 1 poke						
Felt 2 pokes						

After each person has had a turn at each job, repeat the same test on the subject's finger tip instead of their arm. Since the larger probes obviously won't fit on the finger tip, draw an "X" through the boxes of the probes you don't use.

Subject:						
Location: Finger Tip	Control	3 inches	2 inches	1 inch	1/2 inch	1/4 inch
Felt 1 poke						
Felt 2 pokes						

Write a conclusion which is supported by the evidence you have gathered in the exploration.

Adapted from D.M.Candelora's website <http://www.galaxy.net/~k12/body/nerves.shtml>. Reproduction for educational use is encouraged as long as this copyright notice is included.

Body Facts

Fun Fact	Organ	System	Function
Louis Pasteur had a stroke and had mild paralysis on one side of his body. His thinking was unaffected and he went on to do some of his best work. When he eventually died, half of this organ was found to have been destroyed by the stroke!			
This organ beats 60-80 times a minute or about 40 million times a year.			
The contents of this organ are so acidic that vomit can burn a hole in a carpet. Why doesn't this organ digest itself? The lining of mucus protects it.			
This organ helps you breathe the 282 cubic feet of air that your need every day!			
The liquid waste produced by this organ is 96% water; the other 4% is made up of salts, vitamins, and urea.			

Body Facts

Fun Fact	Organ	System	Function
This is one of the largest organs of the body and one of the only organs that can regenerate even if you lose up to 80% of it.			
The smaller this organ is, the faster it beats. This means mice have a faster beat, and so do children.			
Some animals, like rabbits, eat their waste to extract all the nutrients. The solid waste comes out of this organ.			
In this organ, you can store only two cups of the 4-8 cups of the liquid waste that you produce every day.			
Loss of this organ is survivable but you have to eat small, frequent meals.			

Effects of Smoking

Materials

Regular drinking straws (one per student), thin coffee stirrers (one per student), newsprint and markers, colored balloons, timer, internet access and Be sure to let them know they can stop the activity if breathing becomes very difficult or if they feel dizzy.

Place the regular drinking straws in their mouths, hold your breath, and breathe only through the straw for 30 seconds. Write a description of how easy or difficult it was to breathe. Repeat with small coffee stirrer.

Ask students if they know what these activities illustrate. The first one simulates breathing for a smoker, and it affects people in different ways. The second simulates what it feels like to breathe with chronic lung disease.

Explain that chronic lung disease is one of several dangerous, long-term effects of smoking. Others include heart disease, lung cancer, and other cancers.

- *Chronic bronchitis.* There are many bronchial tubes in the lungs that branch out like an upside-down tree. In a smoker's lungs, the chemicals from tobacco build up in these tubes, blocking or thinning the airways. This makes it difficult to breathe and get oxygen into the lungs.
- *Emphysema.* At the end of these tubes are alveoli, or tiny air sacs, that look like bundles of grapes. When you breathe, air fills these sacs and releases oxygen into your blood. The same dangerous tobacco chemicals that block the bronchial tubes can also destroy the alveoli. With fewer sacs to fill, your lungs do not get enough oxygen.

Build a model to demonstrate the mechanics of emphysema, tie together a bunch of balloons to represent the alveoli? What do they think happens to the air sacs of a smoker?: The alveoli are destroyed; indicate this by popping the balloons one by one.

Brainstorm the short term effects of smoking, such as, smelly hair and clothes, bad breath, stained teeth, difficulty breathing, faster heart rate, wrinkles near the eyes and mouth, stained fingers, getting winded after walking or exercising, negative reaction from friends and family, and waste of money spent on cigarettes.

Effects of Smoking

Smoking Facts- Statistics (from the Centers for Disease Control and the American Cancer Society)

- Cigarette smoking is the single most preventable cause of premature death in the United States. Each year, more than 400,000 Americans die from the effects of cigarette smoking. In fact, one in every five deaths in the United States is smoking related.
- Cigarettes are responsible for more deaths in America than alcohol, car accidents, suicide, AIDS, homicide, and illegal drugs put together.
- On average, someone who smokes a pack or more of cigarettes each day lives seven years less than someone who never smokes.
- In a survey of U.S. teens, 65 percent said they strongly disliked being around smokers; 86 percent said they'd rather date people who don't smoke.
- Although only 5 percent of daily smokers surveyed in high school said they would definitely be smoking five years later, close to 75 percent were smoking seven to nine years later.
- Of the almost 3,000 young people who become regular smokers each day, nearly a thousand of them will have their lives shortened from tobacco-related diseases.
- The likelihood of smoking-related cancers increases the longer a person has been smoking.
- Inhaling cigarette smoke reduces the amount of oxygen in the bloodstream.
- Smoking increases your heart rate because your heart must work harder to get oxygen to the rest of your body.
- Nicotine, a chemical found in tobacco, makes your blood vessels smaller so your heart must work harder to pump blood throughout the body.
- The tar found in tobacco sticks to the insides of your lungs.
- Cigarette smoke contains more than 40 carcinogens, or chemicals that cause cancer.
- Cigarette smoke contains more than 40 carcinogens, or chemicals that cause cancer

Write a persuasive argument against smoking as a journal entry to yourself or a letter to a friend or sibling.

Write a response--Given all the dangers of smoking, what are some reasons people still smoke?

Effects of Smoking

Use the following three-point rubric to evaluate how well students participate in the class experiment, discuss issues with the class, understand effects of smoking, and use facts they've learned to complete the writing assignment:

- **Three points:** participated actively in class experiment and discussion; has good understanding of effects of smoking; demonstrated strong writing and research skills; developed a complete, thoughtful writing assignment that demonstrated a thorough understanding of the dangers and physical effects of smoking.
- **Two points:** participated in class experiment and discussion; has on-grade-level understanding of effects of smoking; demonstrated average writing and research skills; wrote an argument that showed some thought and included only it can cause cancer.
- **One point:** participated little in class experiment and discussion; has below-average understanding of effects of smoking; demonstrated weak writing and research skills; wrote an incomplete argument that did not demonstrate a thorough understanding of the dangers and physical effects of smoking



7th Grade

Middle School Support Document Human Body Systems

Advertisements about Smoking

Engage

Read the following statements to the class. After each statement, have students decide whether they agree or disagree. If they agree, they should raise their hand with a balled fist; if they disagree, they should raise their open hand with their fingers spread apart. Before reading the next question, have one student who agrees with the statement give a reason for his or her opinion. Likewise, have one student give a reason for disagreeing with the statement. Here are the statements:

- Local governments have the right to ban smoking in public places.
- Tobacco companies target young people with their advertising.
- It should be illegal for anyone under the age of 18 to purchase, use, or possess tobacco products.
- Quitting tobacco use is the same process for everyone.

Tobacco companies are ultimately responsible for an individual's smoking.

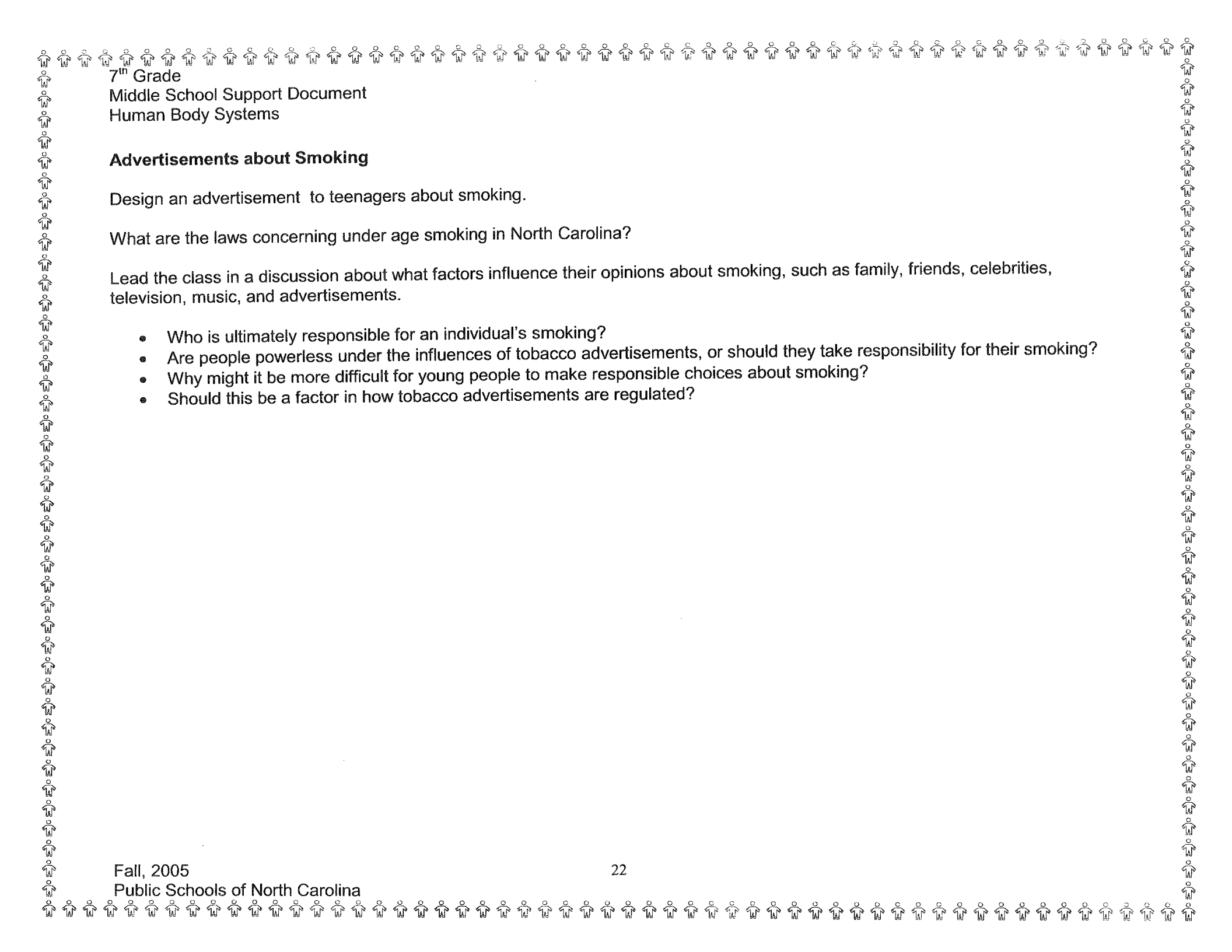
The tobacco industry is reported to spend about 34 million dollars PER DAY advertising its products. Check out some of the ads at: <http://www.tobaccofreekids.org/adgallery/>

Look in magazines and newspapers for additional ads. You could also look at the use of smoking as part of a television show or a movie.

How do these advertisements try to sway others to use their products?

Try to identify and list the different strategies companies use in their advertising. Some strategies might be these: bandwagon, fact versus opinion, fantasy, humor, sensory appeal, statistics, or testimonial. Is the ad targeted at a specific group (e.g., women, teens, a specific cultural group)?

- Does the ad give a good reason for using the product? What is the reason?
- Does the ad make unbelievable claims?
- Does the ad give useful information about the long- or short-term effect of tobacco use?



7th Grade
Middle School Support Document
Human Body Systems

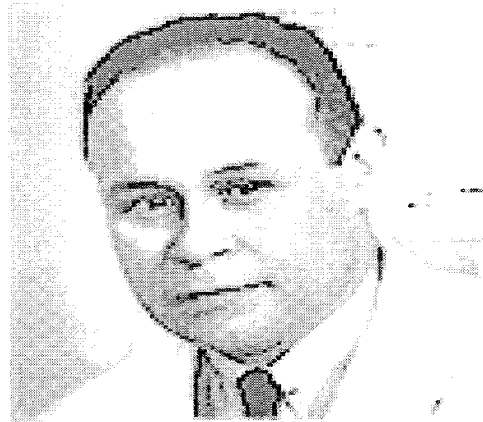
Advertisements about Smoking

Design an advertisement to teenagers about smoking.

What are the laws concerning under age smoking in North Carolina?

Lead the class in a discussion about what factors influence their opinions about smoking, such as family, friends, celebrities, television, music, and advertisements.

- Who is ultimately responsible for an individual's smoking?
- Are people powerless under the influences of tobacco advertisements, or should they take responsibility for their smoking?
- Why might it be more difficult for young people to make responsible choices about smoking?
- Should this be a factor in how tobacco advertisements are regulated?



Charles Richard Drew
Inventor of the Blood Bank in the 1940s

Dr. Charles Richard Drew (1904-1950) was the first person to develop the blood bank. His introduction of a system for the storing of blood plasma revolutionized the medical profession. Drew first utilized his system on the battlefields of Europe and the Pacific during World War II. He later organized the world's first blood bank project - Blood for Britain. He also established the American Red Cross Blood Bank, of which he was the first director.

Drew was born on June 3, 1904, in Washington, D.C. A star athlete, Drew acquired, many athletic honors and was the all-American half-back and captain of his Amherst College football team. After graduating in 1926, he spent two years as a biology and chemistry instructor and director of athletics at Morgan State University in Baltimore, Maryland. In 1928, Drew enrolled at McGill University in Montreal, Canada, where he studied medicine and witnessed a man's life being saved via a blood transfusion. He recalled this as triggering his interest in blood plasma preservation. In 1933 Drew earned his Master of Surgery and Doctor of Medicine degrees from McGill and served a medical internship at the Royal Victoria Hospital in Montreal.

Charles Drew died on April 1, 1950 when the automobile he was driving went out of control and turned over. Drew suffered extensive massive injuries but contrary to popular legend was not denied a blood transfusion. He received a transfusion but was beyond the help of the experienced physicians attending to him. His family later wrote letters to those physicians thanking them for the care they provided. Over the years, Drew has been considered one of the most honored and respected figures in the medical field and his development of the blood plasma bank has given a second chance of life to millions.

**Charles Richard Drew
Inventor of the Blood Bank in the 1940s**

The table below shows the percentage of blood types found in the US population. Display the information in a graph which will enable you to answer the questions related to blood types.

Blood Type Distribution

Blood Type	Rh Factor	Percentage of US Population
AB	-	1%
AB	+	3%
B	-	2%
B	+	9%
A	-	6%
A	+	34%
O	-	7%
O	+	38%

Rank blood types from the most common to the least common.

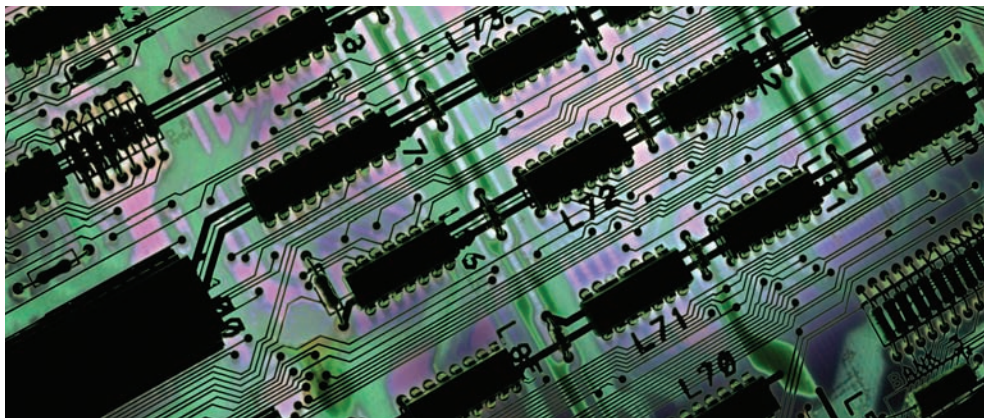
What percentage of the population is Rh- and Rh+?

Create a chart to show which type blood can be donated to each category.

Middle Grades Science

7th Grade Support Document

Goals 1, 2, and Heredity and Genetics



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PUBLIC SCHOOLS OF
NORTH CAROLINA
Department of Public
Instruction

7th GRADE COMPETENCY GOAL 5

The learner will conduct investigations and utilize appropriate technologies and information systems to build an understanding of heredity and genetics.

BIG Ideas

Heredity & Genetics

There is enormous variety among living organisms in the world. In the context of heredity, the focus is on the origin of variation. Differences between individuals within the same species, and even within the same family, result from the recombination of parents' genes or mutations of genes in reproductive cells.

The basis for the diversity of life lies in the DNA molecule. Deoxyribonucleic acid (DNA) contains the genetic code for each species. This molecule contains 4 smaller compounds that mix and match to make millions of proteins like the letters of our alphabet mix and match to make millions of words. The different proteins are responsible for the differences among species and within the same species. Each protein code is a gene (trait). Genes connect to make up the DNA molecule (chromosome). Chromosomes come in pairs and thus genes are paired. Each individual gene of the pair can have a little different information about that trait. These individual differences result in dominance, recessiveness, and incomplete dominance and are exhibited through characteristics of the organism.

Analysis of the patterns of genetic traits enhances the understanding of genetic diseases and allows for predictions to be made by studying pedigrees and probability diagrams. Either one or many genes determine an inherited trait of an individual, and a single gene can influence more than one trait. Some traits are inherited and others result from interactions with the environment. life style choices, and environment influence human characteristics that may or may not be passed on to future generations.

Technological advances have allowed us to better understand how heredity and genetics are interrelated. As scientists learn more about the human genome, we are able to better understand how genetic differences affect the human body and allow us to make informed choices.

National Science Education Standards	AAAS Benchmarks
<p data-bbox="235 297 520 326">Heredity & Genetics</p> <ul data-bbox="235 362 1010 1343" style="list-style-type: none"><li data-bbox="235 362 911 431">• Every organism requires a set of instructions for specifying its traits.<li data-bbox="235 467 989 537">• Heredity is the passage of these instructions from one generation to another.<li data-bbox="235 573 978 643">• A new individual receives genetic information from its mother (via the egg) and its father (via the sperm).<li data-bbox="235 678 1003 769">• Hereditary information is contained in genes, located in the chromosomes of each cell. Each gene carries a single unit of information.<li data-bbox="235 805 1010 896">• An inherited trait of an individual can be determined by one or by many genes, and a single gene can influence more than one trait.<li data-bbox="235 932 951 1002">• A human cell contains many thousands of different genes.<li data-bbox="235 1037 1003 1170">• The characteristics of an organism can be described in terms of a combination of traits. Some traits are inherited and others result from interactions with the environment.<li data-bbox="235 1206 999 1343">• Concerning heredity, younger middle-school students tend to focus on observable traits, and older students have some understanding that genetic material carries information.	<p data-bbox="1087 289 1402 318">Human Body Systems</p> <ul data-bbox="1087 354 1913 1198" style="list-style-type: none"><li data-bbox="1087 354 1913 646">• Heredity - In sexual reproduction, a single specialized cell from a female merges with a specialized cell from a male. In some kinds of organism, all the genes come from a single parent. In organisms that have two sexes, typically half of the genes come from each parent. The fertilized egg cell, carrying genetic information from each parent, multiplies to form the complete organism.<li data-bbox="1087 682 1913 867">• Behavior – Some animal species are limited to a repertoire of genetically determined behaviors; others have more complex brains and can learn and modify a wide variety of behaviors. All behavior is affected by both inheritance and experience.<li data-bbox="1087 902 1913 1198">• Physical Health – The length and quality of human life are influenced by many factors, including sanitation, diet, medical care, sex, genes, environmental conditions, and personal health behaviors. Faulty genes can cause body parts or systems to work poorly. Some genetic diseases appear only when an individual has inherited a certain faulty gene from both parents.

7th Grade
 Middle School Support Document
 Heredity and Genetics

NC Science SCS	Content Elaboration	Ideas for exploration	Web Resources
<p>5.01 Explain the significance of genes to inherited characteristics:</p> <ul style="list-style-type: none"> • Genes are the units of information. • Parents transmit genes to their offspring. • Some medical conditions and diseases are genetic. 	<p>Heredity is the transmission of genetic material from one generation to another.</p> <p>A gene contains one set of instructions for an inherited trait.</p> <p>Normal human body cells have 23 pairs of chromosomes containing genetic information.</p> <p>The female's egg cell combines with the male's sperm cell during reproduction.</p> <p>Scientists are studying how to determine specific chromosome locations of diseases.</p> <p>Traits are inherited physical characteristics.</p> <p>Genetically transmitted diseases include cystic fibrosis, sickle cell anemia, Marfan syndrome, Huntington's disease.</p> <p>A widespread misconception is that traits due to dominant alleles are the most common in the population. While this is sometimes true, it is not always the case. For example, the allele for Huntington's Disease is dominant, while the allele for not developing this disorder is recessive. At most, only 1 in 20,000 people will get Huntington's; most people have two recessive, normal alleles.</p>	<p><u>Trading Traits</u></p> <p>Complete Tree of Traits Activity http://gslc.genetics.utah.edu/teachers/tindex/overview.cfm?id=traittree</p> <p>Complete Plastic Eggs Genetics Activity http://www.middleschoolscience.com/geneticplasticegggs.pdf</p> <p>Complete the ReeBobs Activity http://www.wisc.edu/cbe/cbe_publications/reebops.pdf</p> <p>Complete the Traits Bingo Activity http://gslc.genetics.utah.edu/teachers/units/traits_bingo.pdf#search='traits%20bingo'</p> <p><u>Breaking the Code</u></p>	<p>http://www.kumc.edu/gec/lessons.html links to various sites</p> <p>http://gslc.genetics.utah.edu specific information related to genetics and disease</p> <p>http://student.biology.arizona.edu/sciconn/heredity/worksheet_heredity.html subdivision of Biology Project</p> <p>http://www.pbs.org/wgbh/nova/genome/heredity.html information about cracking the genetic code</p> <p>http://gslc.genetics.utah.edu/teachers/tindex/overview.cfm?id=traittree pictorial of common traits</p> <p>http://library.thinkquest.org/19037/heredity.html</p> <p>http://www.dnafb.org/dnafb/1/concept/ tutorial</p>

NC Science SCS	Content Elaboration	Ideas for exploration	Web Resources
<p>5.02 Explain the significance of reproduction:</p> <ul style="list-style-type: none"> • Sorting and recombination of parents' genetic material. • Potential variation among offspring. 	<p>Physical traits are observable characteristics.</p> <p>While each of us shares some of our traits with many other people, our own individual combination of traits is what makes each of us look unique. Some combinations of traits are more common than others.</p> <p>Physical traits are determined by specific segments of DNA called genes. Multiple genes are grouped together to form chromosomes, which reside in the nucleus of the cell. Every cell (except eggs and sperm) in an individual's body contains two copies of each gene. This is due to the fact that both mother and father contribute a copy at the time of conception. This original genetic material is copied each time a cell divides so that all cells contain the same DNA.</p> <p>Genes store the information needed for the cell to assemble proteins, which eventually yield specific physical traits. Most genes have two or more variations, called alleles. For example, the gene for hairline shape has two alleles – widow's peak or straight. An individual may inherit two identical or two different alleles from their parents.</p>	<p>Research specific chromosome locations associated with genetic conditions such as Chromosome 17 for breast cancer, colo-rectal cancer, and neurofibromatosis (elephant man disease).</p>	<p>http://pbs.org/wgbh/aso/tryit/dna virtual DNA replication</p> <p>http://library.thinkquest.org/28599/experiment_making_a_candy_model.htm directions for making a DNA model with candy</p> <p>http://student.biology.arizona.edu/sciconn/heredity/worksheets/heredity.html models for various traits are illustrated –select traits you wish to survey the class for</p>

NC Science SCS	Content Elaboration	Ideas for exploration	Web Resources
<p>5.03 Identify examples and patterns of human genetic traits:</p> <ul style="list-style-type: none"> • Dominant and recessive. • Incomplete dominance. 	<p>When two different alleles are present they interact in specific ways. Some alleles interact in what is called a dominant or a recessive manner. The traits due to dominant alleles are always observed, even when a recessive allele is present. Traits due to recessive alleles are only observed when two recessive alleles are present</p> <p>Most human genetic traits are the product of interactions between several genes.</p> <p>Because the genes of the parents are sorted and recombined randomly in the offspring, the offspring is different from the parents. If the same parents have other offspring, the sorting and recombination of genes will take place again with the off spring being different from each other and different from the parents.</p> <p>The process of meiosis produces sex cells which have half the number of chromosomes. These two halves combine during reproduction.</p> <p>In organisms that reproduce sexually, every trait has genes from two parents. Inheritance occurs in patterns that can be predicted by the laws of probability.</p> <p>It is sometimes possible to predict the most probable outcome in any randomly ordered event, but the expected outcome may not match the actual results.</p>	<p>Construct Punnett Squares for complete and incomplete dominance patterns.</p> <p>Display the gene combinations from some of Gregor Mendel's experiments in Punnett Squares and explain orally.</p> <p><u>Beans and Genes</u></p> <p>Apply the laws of probability to inheritance patterns.</p> <p>Research how scientists are conducting studies of identical and fraternal twins to try to understand how genes determine personality.</p>	<p>http://www.dnafb.org/dnafb/animations of DNA, timelines, code exploration, Genome Project, Manipulation simulations, image gallery, video interviews, biographies, and links</p> <p>http://school.discovery.com/lessonplans/programs/the mysteryoftwins site for twins studies</p> <p>http://ology.amnh.org/genetics/naturewalk/index.html virtual "tour" of A Nature and Nurture Walk in Mendel Park-simulates Mendel's pea plant experiments</p>

7th Grade
 Middle School Support Document
 Heredity and Genetics

NC Science SCS	Content Elaboration	Ideas for exploration	Web Resources
<p>5.04 Analyze the role of probability in the study of heredity:</p> <ul style="list-style-type: none"> • Role of each parent in transfer of genetic traits. • Analysis of pedigrees. <p>5.05 Summarize the genetic transmittance of disease.</p>	<p>Probability=number of events of choice/number of possible events A pedigree is a diagram that shows the occurrence of a genetic trait in several generations of a family.</p> <p>A Punnett square is a chart used to show possible gene combinations.</p> <p>Some birth defects are caused by abnormal numbers or types of chromosomes such as Down syndrome.</p> <p>Genetic variation may be determined by mutation.</p> <p>Some genetic disorders occur more often in males than females. Examples are hemophilia and color-blindness. Females carry the gene for the disorder and pass it on to their offspring. These types of transmission are known as sex-linked disorders (x-linked or y-linked).</p> <p>Not all genes are completely dominant or recessive. In cases of incomplete dominance, genes combine and a mixture of both traits shows up.</p>	<p>Determine which genetically transmitted diseases are being researched. Debate whether research dollars should go to prevention or treatment.</p> <p>Write a response to the statement "All things considered, you are more like every other person on earth than you are different from them".</p>	<p>http://www.eurekascience.com/ICanDoThat/ interesting facts about DNA, RNA, cells, protein, and cloning.</p> <p>http://library.thinkquest.org/28599/experiment_probability_heredity.htm simulation of Mendel's work with coins</p> <p>http://kidshealth.org/kid/health_problems/birth_defect/down_syndrome.html information about Down Syndrome</p>

7th Grade
 Middle School Support Document
 Heredity and Genetics

NC Science SCS	Content Elaboration	Ideas for exploration	Web Resources
<p>5.06 Evaluate evidence that human characteristics are a product of:</p> <ul style="list-style-type: none"> • Inheritance. • Environmental factors • Lifestyle choices. 	<p>By the early 1900s, it was firmly established that both parents contribute equally to the child's traits.</p> <p>Most human traits are determined by multiple genes and are influenced by environmental factors.</p> <p>Most human traits such as height, weight, intelligence, skin color, and eye color do not occur in an either/or condition.</p>	<p>Investigate one common disorders multifactorial disorders.</p> <p>Examples include heart disease, high blood pressure, Alzheimer's disease, arthritis, diabetes, cancer, and obesity.</p> <p>Multifactorial inheritance also is associated with heritable traits such as fingerprint patterns, height, eye color, and skin color.</p>	<p>http://library.thinkquest.org/28599/interviews.htm interviews with geneticists</p> <p>http://www.kidshealth.org/kid/health_problems/heart/cystic_fibrosis.html cystic fibrosis information</p>

Trading Traits

Engage

Observe your classmates to determine who has each of these traits. Ask each person to sign his/her name next to the trait that he/she has. Try to get each person to sign the sheet only once.

Traits	Signature of classmate
Brown eyes	
Blue eyes	
Green eyes	
Brown hair	
Blond hair	
Red hair	
Black hair	
Freckles	
No freckles	
Curly hair	
Straight hair	
Dimpled cheeks	
No dimples in cheeks	
Dimpled chin	

Trading Traits

Traits	Signature
Left handed	
Right handed	
Ambidextrous	
Second toe is longer than big toe	
Second toe is shorter than big toe	
Ring finger is longer than index finger	
Index finger is longer than ring finger	
Little finger is bent in toward ring finger	
Hair on second segment of fingers	
With hands clasped together, left thumb is over right thumb	
With hands clasped together, right thumb is over left thumb	

Breaking the Code

Engage

Recite the alphabet. Discuss how the letters are grouped to make words and then “decode” to make meaning.

Code (DNA)	English (RNA)
A	↵
B	↵↵
C	↵↵
D	↵↵
E	↵↵
F	↵↵
G	↵↵
H	↵↵
I	↵↵
J	↵↵
K	↵↵
L	↵↵
M	↵↵
N	↵↵
O	↵↵
P	↵↵
Q	↵↵
R	↵↵
S	↵↵
T	↵↵
U	↵↵
V	↵↵
W	↵↵
X	↵↵
Y	↵↵
Z	↵↵

Break the Code

Use the code to transcribe this sentence.

You are going to build a shelter according to the directions you have been given. Follow them carefully.

Go to a computer and type in the sentence above and change the font to Arial.

Explain the use of the computer to do this task versus you doing it by hand.

Create an example of your own.

Explore

Use the manual method or the computer to break the code for the directions. Build according to the directions you have been given. Not every structure will be the same.

Explain

When structures are complete, provide the students the translations. Determine how the directions were different. Have the class discuss how this is similar to DNA-carries the code, RNA copies and then translates the message. Discuss what happens if you copy or decode incorrectly (for whatever reason).

Elaborate

Have students to determine where the fault lies in the structures that are not complete and how this is similar to genetic mutations.

Break the Code

Materials
Popsicle sticks, glue, clay of different colors. Computer access

Procedure

Direction Card #2

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Break the Code

Materials

Popsicle sticks, glue, clay of different colors. Computer access

Procedure

Direction Card #3

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Break the Code-English

Directions Card #1

Glue 4 popsicle sticks in a square shape.
Fill the square with other Popsicle sticks. Glue into place.
Make four large clay balls of the same color.
Stick a Popsicle stick into each of the clay balls.
Make four smaller balls of clay of the same color.
Slightly flatten each of the four smaller clay balls.
Place the smaller, flattened balls onto the top of the Popsicle sticks with the large clay balls.
Place the 4 "barbells" at the four corners of a square slightly smaller than the solid square you built.
Place the solid square on top of the flattened clay balls.

Directions Card #2

Glue 4 popsicle sticks in a square shape. Glue into place.
Make four large clay balls of the same color.
Stick a Popsicle stick into each of the clay balls.
Make four smaller balls of clay of the same color.
Slightly flatten each of the four smaller clay balls.
Place the smaller, flattened balls onto the top of the Popsicle sticks with the large clay balls.
Place the 4 "barbells" at the four corners of a square slightly smaller than the solid square you built.
Place the solid square on top of the flattened clay balls.

Direction Card #3

Glue 4 popsicle sticks in a square shape.
Fill the square with other Popsicle sticks. Glue into place.
Make four large clay balls of the different colors.
Stick a Popsicle stick into each of the clay balls.
Make four smaller balls of clay of the same color.
Slightly flatten each of the four smaller clay balls.
Place the smaller, flattened balls onto the top of the Popsicle sticks with the large clay balls.
Place the 4 "barbells" at the four corners of a square slightly smaller than the solid square you built.
Place the solid square on top of the flattened clay balls.

Beans and Genes

Materials

(per team) 3 boxes, 150 red beans, 150 white beans (any objects of same size/different color can be used)

Procedure

Part I

Put 100 red beans in a box, 100 white beans in a box, 50 red + 50 white in a box. Each box will represent a parent organism. Red (R=red) represents a dominant gene and White (w=recessive).

For one minute, each student pair pulls 2 beans at a time (one from each box). Arrange the pairs in rows. At the end of one minute, calculate the ratio for each group.

Compile group data into a class chart. Calculate class ratios.

Complete Punnett squares for the cross to calculate expected ratios.

Compare the expected ratios with the observed team ratios and observed class ratios.

Which are closer and why?

PART II

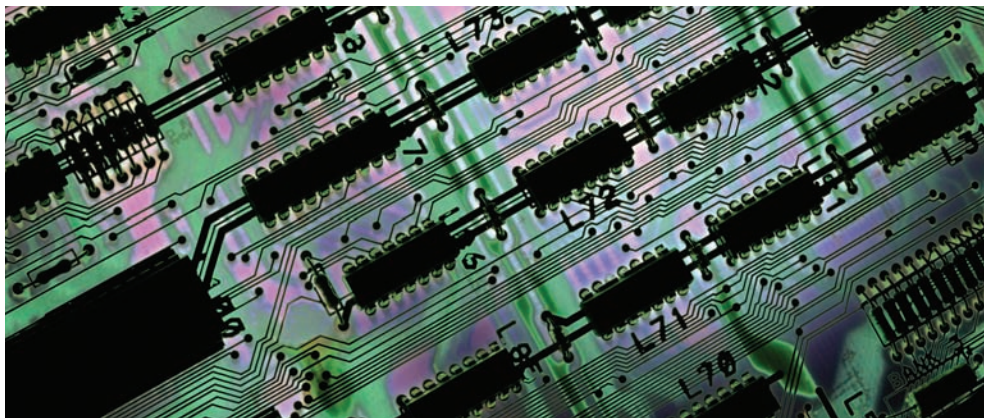
Each team creates a cross, determines expected ratios on paper, and creates parent genotypes with bean boxes.

Each team does 4 trials of one minute each. Calculate observed ratios. Discuss differences between single and multiple trial results.

Middle Grades Science

7th Grade Support Document

Goals 1, 2, and Motion and Forces



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PUBLIC SCHOOLS OF
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7th GRADE COMPETENCY GOAL 6

The learner will conduct investigations, use models, simulations, and appropriate technologies and information systems to build an understanding of motion and forces.

BIG Ideas

Motion & Forces

A force is a push or pull on an object that can either cause it to start moving, change direction or slow down until it finally stops. Forces are rarely seen as a single unit, but in combinations of two or more. Balanced forces are opposite in direction and equal in size which causes no change in motion. Objects will either remain at rest or continue to move at a constant velocity, unless acted upon by additional forces. Thus, unbalanced forces cause a change in motion.

An object is said to be in motion if it is changing its position with respect to a frame of reference whose position appears to be stationary. Speed is a comparison of the change in distance over time. Velocity describes speed in a given direction. The constant change in speed is an example of acceleration or deceleration (negative acceleration). If an object is set into motion, it has momentum due to its mass and velocity. An objects' direction of motion is affected by its center of mass. For an object in motion to keep moving at a constant speed, a constant force must be applied. What causes an object to come to a stop is another underlying force (friction) that will oppose that motion. When objects are in contact with each other, friction will act in the direction opposite to the motion and, along with gravity, stop the moving object.

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Motion & Forces

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Gravity is a universal force that causes objects to be attracted to each other. When no other outside force, such as friction or air resistance, acts upon a falling object, its speed increases. An object constantly gains speed for every second it falls until it reaches a maximum speed, which differs depending upon the shape of the object and the friction with the air.

Sir Isaac Newton is credited with describing laws of gravity and motion. His three laws of motion explain objects at rest, constant motion, and acceleration due to balanced or unbalanced forces exerted on objects. The first law describes inertia, the tendency of an object to remain in motion or stay at rest. The second law explains the dynamics of unbalanced forces. The third law notes that for every action (force), there is an equal and opposite reaction. Newton's Laws have been important in describing the motion of falling objects, projectile motion, planetary motion and the gravitational effects of objects upon each other.

People use simple and complex machines to perform "everyday" tasks, which require a force to move objects. The amount of effort saved when using machines is called mechanical advantage. Machines can make work seem to be easier by changing the size or direction of an applied force. Each machine makes work easier by providing some trade-off between the force applied and the distance over which the force is applied. Through a better understanding of forces and motion, scientists and engineers have been able to design more efficient systems related to sports, recreation, transportation and human health.

National Science Education Standards	AAAS Benchmarks
<ul style="list-style-type: none">• The motion of an object can be described by its position, direction of motion, and speed. That motion can be measured and represented on a graph.• If more than one force acts on an object along a straight line, then the forces will reinforce or cancel one another, depending on their direction and magnitude.• Unbalanced forces will cause changes in the speed or direction of an object's motion.	<ul style="list-style-type: none">• The motion of an object is always judged with respect to some other object or point and so the idea of absolute motion or rest is misleading.• Every object exerts gravitational force on every other object. The force depends on how much mass the objects have and on how far apart they are. The force is hard to detect unless at least one of the objects has a lot of mass.• Everything on or anywhere near the earth is pulled toward the earth's center by gravitational force.• An unbalanced force acting on an object changes its speed or direction or motion, or both.

NC Science SCS	Content Elaboration	Ideas for exploration	Web Resources
<p>6.01 Demonstrate ways that simple machines can change force.</p> <p>6.02 Analyze simple machines for mechanical advantage and efficiency.</p>	<p>A machine is a device that make work easier by changing the size or direction of a force.</p> <p>When you use a machine, you do the work on the machine, and the machine does the work on something else.</p> <p>Mechanical advantage is the number of times the machine multiplies force. It compares the input force with the output force. $MA = \text{Output force} / \text{input force}$</p> <p>The work output plus the work done to overcome friction is equal to work input.</p> <p>The less work a machine has to do to overcome friction, the more efficient it is. Mechanical Efficiency (ME) tells what percentage of work input is converted to work output. $ME = \text{work output} / \text{work input} \times 100$.</p> <p>A compound machine is made of more than one simple machine.</p> <p>The MA of compound machines is low because of all the moving parts encountering friction.</p>	<p>Find everyday examples of machines that make work easier.</p> <p><u>Brown Paper Bag Challenge</u></p> <p><u>School Contest for Simple Machines</u></p> <p><u>Dumb Waiter</u></p> <p>Give each group a hardcover book, two unsharpened pencils and scotch tape. Each group has to tape a pencil on the table and the other pencil will be used to lift the book. Have all the groups experience placing the fulcrum at three different locations (front of lever, middle of lever, and back of lever) to better understand the idea of mechanical advantage. Have each group select which of the three appears to be most efficient and attempt to explain why the others are less efficient.</p>	<p>http://www.mikids.com/Smachines.htm illustrations of simple machines</p> <p>http://www.coe.uh.edu/archive/science/lessons/scienceces1/finalhome.htm kids drawings of simple machines and simple experiments</p> <p>http://www.mos.org/sin/Leonardo/InventorsToolbox.html shows makeup of machines</p>

NC Science SCS	Content Elaboration	Ideas for exploration	Web Resources
<p>6.03 Analyze simple machines for mechanical advantage and efficiency.</p>	<p>Ideal Mechanical Advantage (IMA) is what is desired of a machine, where Actual Mechanical Advantage (AMA) is what the machine actually does.</p> <p>A lever is a simple machine that has a bar that pivots at a fixed point called a fulcrum.</p> <p>A pulley is a simple machine that consists of a wheel over which a rope, chain, or wire passes.</p> <p>A simple machine that consists of two circular objects of different sizes is known as a wheel and axle.</p> <p>The MA of a wheel and axle is the radius of the wheel divided by the radius of the axle.</p> <p>A simple machine that is a straight, slanted surface, and facilitates the raising of loads is an inclined plane.</p> <p>The greater the ratio of an inclined plane's length to its height is, the greater the MA.</p> <p>A wedge is made up of two inclined planes that move. A screw is a simple machine that consists of an inclined plane wrapped around a cylinder. The closer together the threads are, the greater the screw's MA.</p>	<p><u>Feeling the Friction</u></p> <p><u>Dream Shoes</u></p> <p>Analyze first, second, and third class levers for MA. Describe the relationship of output force, input force, and distance.</p> <p>Analyze fixed pulleys, movable pulleys, and block and tackles for MA. Illustrate input and output force for each type of pulley.</p> <p><u>How Does An Incline Plane Work</u></p> <p>How would our lives be different without wheels?</p>	<p>http://www.scire.com/sds/Pages/intro.html Shoe Design site</p>

NC Science SCS	Content Elaboration	Ideas for exploration	Web Resources
<p>6.04 Evaluate motion in terms of Newton's Laws.</p> <ul style="list-style-type: none"> • The force of friction retards motion. • For every action there is an equal and opposite reaction. • An object's motion is the result of the combined effect of all forces acting on the object. • A moving object that is not subjected to a force will continue to move at a constant speed in a straight line. • An object at rest will remain rest. 	<p>The amount of friction depends on factors such as the roughness of the surfaces and the force pushing the surfaces together.</p> <p>Newton's law describes the relationship between gravitational force, mass, and distance.</p> <p>An object will not start moving until a force acts upon it.</p> <p>An object will stay in motion forever unless an unbalanced force acts upon it.</p> <p>Inertia is the tendency of objects to resist any change in motion.</p> <p>Likewise, inertia is the reason a moving object stays in motion with the same velocity unless a force changes its speed or direction.</p> <p>Friction is a force that opposes motion between two surfaces that are in contact.</p>	<p>Explain how friction can be both helpful and harmful.</p> <p>Using Newton's laws, explain why it is more difficult to stop a large mass than a small mass.</p> <p><u>Inertia Demonstrations</u></p> <p><u>I Am Floored</u></p> <p>What can't a machine ever be 100% efficient?</p> <p>Break down a compound machine into the simple machines involved in its design.</p> <p><u>Build a Rube Goldberg Device</u></p> <p>Research devices, based on simple and compound machines, that are used to assist the disabled.</p> <p><u>Build A Catapult</u></p>	<p>http://www.physicsclassroom.com/Class/newtlaws/U2L1a.html tutorial on Newton's Laws</p> <p>http://www.rubegoldberg.com/html/gallery.htm gallery of wacky Rube Goldberg devices</p> <p>http://edheads.org/activities/simple-machines/ interesting careers using simple machines and design, catapult lesson plan</p>

NC Science SCS	Content Elaboration	Ideas for exploration	Web Resources
<p>6.05 Analyze that an object's motion is always judged relative to some other object or point.</p> <p>6.06 Describe and measure quantities that characterize moving objects and their interactions within a system:</p> <ul style="list-style-type: none"> • Time. • Distance. • Mass. • Force. • Velocity. • Center of mass. • Acceleration. 	<p>When an object changes position over time relative to a reference point, the object is in motion.</p> <p>You can describe the direction of motion with a reference direction (North, South, East, West, up, down).</p> <p>Mass is a measure of inertia.</p> <p>Acceleration decreases as mass increases.</p> <p>Acceleration increases as mass decreases.</p> <p>Acceleration of an object is always in the same direction as the applied push or pull.</p> <p>Force=Mass X Acceleration</p> <p>All forces act in pairs.</p> <p>The action force and reaction force are a pair. The two forces are equal in size but opposite in direction.</p>	<p><u>Practice Walk</u></p> <p>Describe the relationship between motion and point of reference.</p> <p>Using Newton's laws, explain why it hurts if you bump into a large piece of furniture.</p> <p>Would it be more beneficial to know a storms speed or velocity? Explain.</p> <p>Explain in terms of Newton's laws what will happen if you are on a skateboard and toss a heavy book bag to someone else. What will your motion be? Try it to see.</p>	

NC Science SCS	Content Elaboration	Ideas for exploration	Web Resources
<p>6.07 Describe and measure quantities that characterize moving objects and their interactions within a system:</p> <ul style="list-style-type: none"> • Time. • Distance. • Mass. • Force. • Velocity. • Center of mass. • Acceleration. 	<p>A force never acts by itself.</p> <p>The center of mass is the point at which all the mass of an object can be considered concentrated.</p> <p>Average speed= total distance/total time</p> <p>Velocity is the speed of an object in a particular direction. Velocity must include a reference point.</p> <p>Acceleration is the rate at which velocity changes over time. An object accelerates if its speed, direction, or both change. The faster the velocity changes, the greater the acceleration. Acceleration can be expressed in both negative and positive terms.</p> <p>Average acceleration=final velocity-starting velocity/time it takes to change velocity.</p> <p>A force is a push or pull.</p>	<p><u>The Lift Box</u></p> <p>Build a mobile that displays an unusual center of gravity.</p> <p><u>Center of Mass Challenge</u></p> <p><u>Where Does It Balance?</u></p> <p><u>Match Car Mania</u></p> <p><u>Observing Acceleration</u></p>	

NC Science SCS	Content Elaboration	Ideas for exploration	Web Resources
<p>6.08 Describe and measure quantities that characterize moving objects and their interactions within a system:</p> <ul style="list-style-type: none"> • Time. • Distance. • Mass. • Force. • Velocity. • Center of mass. • Acceleration. 	<p>Force can change the acceleration of an object.</p> <p>Force is expressed in Newton's (N).</p> <p>Usually, more than one force is acting on an object. Net force is the combination of all forces acting on an object.</p> <p>When forces act in the same direction, you add to determine the net force. The net force will be in the same direction as the individual forces.</p> <p>When two forces act in opposite directions, you subtract the smaller force from the larger force to determine the net force. The net force will be in the same direction as the larger force.</p> <p>If you know the net force on an object, you can determine the effect of the net force on the object's motion.</p>	<p>Use motion detectors to examine constant speed or acceleration/deceleration. Give students examples of graphs and have them match their motion to the graph. Explore equations for the lines.</p>	<p>http://www.eduref.org/Virtual/Lessons/Science/Physics/PHS0206d.pdf scenario where students are to design a transportation system</p> <p>http://www.aip.org/success/drivesprogress/ website that discusses research and development of the car industry</p>

NC Science SCS	Content Elaboration	Ideas for exploration	Web Resources
<p>6.09 Investigate and analyze the real world interactions of balanced and unbalanced forces:</p> <ul style="list-style-type: none"> • Sports and recreation. • Transportation. • The human body. 	<p>The net force tells you whether forces on the object are balanced or unbalanced.</p> <p>When the forces on an object produce a net force of 0 Newtons, the forces are balanced.</p> <p>Balanced forces will not cause a change in the motion of a moving object and balanced forces do not cause a motion that is not moving to start moving.</p> <p>Unbalanced forces produce a change in motion and are necessary to cause an object not in motion to start moving.</p> <p>Unbalanced forces are necessary to change the motion of a moving object.</p> <p>An object can continue to move when the unbalanced force is removed.</p> <p>Balanced and unbalanced forces are their interactions are important in many aspects of life.</p>	<p><u>Car Bashing</u></p> <p>Illustrate force pairs in sports, the human body, and in transportation.</p> <p><u>Amusement Park Physics</u></p> <p><u>Build Your Own Roller Coaster</u></p>	<p>http://home.nc.rr.com/enloephysics/sports.htm Describes physics principles applied to various sports</p> <p>http://www.powermasters.com/Physics/AllChapts/all_chapters.html physics of NASCAR</p> <p>http://www.grc.nasa.gov/WWW/K-12/airplane/newton.html NASA site that applies Newton's Laws to flight</p>

Brown Paper Bag Simple Machines

Sample Materials Brown paper grocery bags (or lunch for smaller items), Can opener, Armed corkscrew, Scissors, Tweezers, Picture of a bicycle, Clamp, Ruler and rock (or something to use as a fulcrum for a lever), unusual tools that the students may not know.

Put each object in a brown bag.

Students are not to look until signal is given.

Students have 60 seconds to write what the machine consists of.

Give a 10 second warning, to place object back in the bag.

Rotate bags or move through stations.

School Contest for Simple/Complex Machines

Simple machines may be identified in the following school sites only. Identify as many as you can.

1. Our lab/classroom
2. Cafeteria
3. Bathroom

For every 10 unique simple machines you list, you will receive 1 extra point on your test, up to 5 extra points. Only things that are found in the room count!

Example
Name:
Date

#	Type of Simple Machine	Example of simple machine	Location: Room number and/or room.
1	Pulley	Window Blind mechanism	Cafeteria

Have students complete the following: I will never look at a _____ the same way ever again. Until we studied simple machines, I had never really thought about what things are made up of. _____ consists of :

Thomas Jefferson's Inventiveness: The Mechanical Advantage of the "Dumb Waiter"

Procedure:

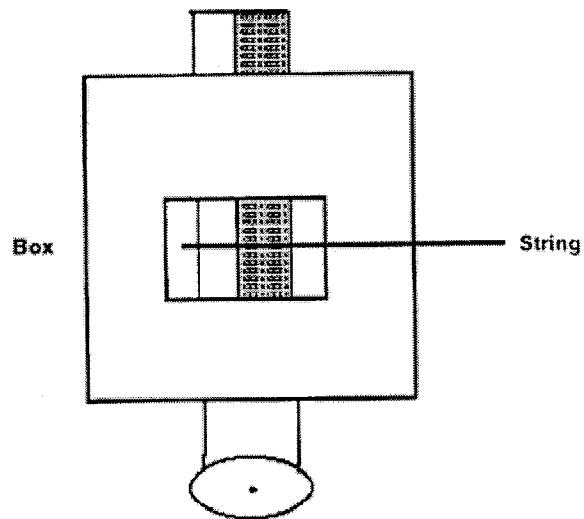
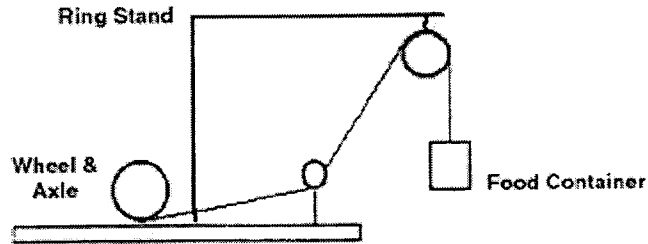
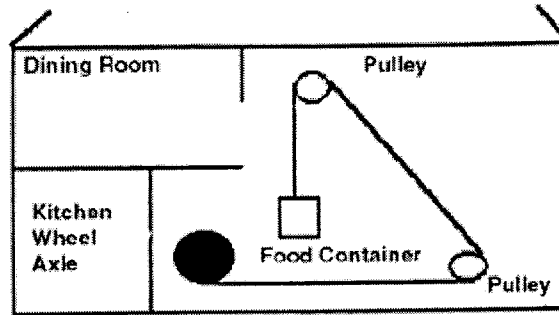
- Examine the illustration of the dumb waiter Jefferson had built at Monticello.
 - The food storage box would carry the contents into the dining room 12' overhead by turning the handle 24 complete turns.
 - The handle moved one foot with each turn.

What is the ideal mechanical advantage of the dumb waiter?

- Build a model of the "dumb waiter" and design a test for MA.

- Identify the ways friction can be reduced on the mechanism and implement each of them to determine their effect of the actual and theoretical mechanical advantage. List the results in the table below.

7th Grade
Middle Grades Support Document
Motion & Forces



Feeling the Friction

Teacher Notes

Friction is a force that opposes motion. Through the years, technological designs have had to build products to accommodate friction and even to use friction in a positive way. Brake pads create friction to slow or stop a vehicle. Friction can also be reduced by changing sliding motion into rolling or fluid friction. Cars use oil (fluid) to reduce the internal friction between moving parts. Ball bearings are used in machines to reduce friction and allow easier movements. By reducing friction, more work and energy can be conserved. Many designs for vehicles are now designed with a “streamline” design which cuts down on the “drag” and uses less fuel.

Materials

Sandpaper, silk fabric, small piece of carpet, a mass weight or something to attach to a scale, spring scale, string.

Procedure

Attach the mass weight or object to the spring scale and hold it up vertically, allowing gravity to pull it down. Measure the values found on the spring scale and record it in the table.

Lay the sandpaper, silk, and carpet down horizontally on the table.

Drag the mass weight slowly across each material and record the values. Be consistent with the force of how you drag the weight.

Graph results.

Data

Surface Material	Frictional Force (N)
Sandpaper	
Silk	
Carpet	

Discuss

Which surface had the greatest frictional force? The least?

What is the independent variable? The dependent variable?

Dream Shoes

Materials

Board, materials to support board as an incline plane, meter stick, graph paper, students' shoes.

Engage

Scenario

A sports company wants to design basketball shoes that have minimal sliding on the court. You are on the design team to create this "dream shoe". What features would you add to the shoe to meet the intent of the new shoe?

Explore

Design a plan of action to test which shoe has the best ability to stay on an incline plane when raised to different heights. Plan, with the idea in mind, that your results must be replicable.

Present your test design to the class and discuss.

Predict which brand will perform best on selected criteria. Test shoes according to test design criteria.

Collect data and graph results. Share results and place the brand names on the board and record the values.

Which had the greatest friction? Justify with supporting evidence.

Which one had the least friction? Justify with supporting evidence.

Is there a difference of the more expensive athletic shoe to the lesser expensive brand?

Can you think of ways to change this experiment?

What are some things that need to be controlled for in this set-up?

How do you choose the brand of shoe that you wear?

How Does an Incline Plane Work?

Materials

Board, spring scale, toy car, string, and meter stick

Procedures

Find the weight in N of the toy car by using the spring scale. Record.

Measure the length of the board. Record.

Raise the board 10 cm above the level of the floor.

Using the spring scale, attach the toy car to the end. Pull the car up the length of the board slowly and steadily. Record.

Raise the board to 15 cm, 30 cm, and 40 cm. Using the spring scale, attach the toy car to the end. Pull the car up the length of the board slowly and steadily. Record for each pull.

Data Ideal Mechanical Advantage

Effort Distance (length of ramp) cm	Resistance Distance (height of ramp) cm	Ideal Mechanical Advantage (IMA) (effort distance/resistance difference/height of ramp)
	10	
	15	
	26	
	40	

Data

Actual Mechanical Advantage

Resistance Force (weight of ramp) cm	Effort Force (spring scale value) N	Actual Mechanical Advantage (AMA) (resistance force/effort force/spring scale value)
	10	
	15	
	26	
	40	

How Does an Incline Plane Work?

Reflection questions

What pattern is observed when the height of the incline plane is increased?

What other patterns can be observed from the AMA and IMA?

In a real machine, why is work output always less than the work input?

Why can the mechanical advantage never be less than 1?

Inertia Demonstrations

These demonstrations could be set up in stations for teams to rotate through.

Station 1 Coin in the Cup

Materials

Cup, index card, PPE, and a coin

Procedure

Place the cup on the table.

Lay an index card on top of the cup.

Place a coin in the center of the card over the opening in the cup.

Quickly flick cup causing the index card to move.

Observations

What happened to the coin when you flicked the cup.

What would happen if you slowly moved the card?

What other materials could you use to demonstrate this idea?

Station 2 Bottle and Coin “Sandwich”.

Materials

Milk bottle or baby bottle, sturdy paper ring from a paper towel roll, coin, PPE.

Procedure

Place the bottle on the table.

Place the ring on top of the bottle, resting the ring part in the opening of the bottle.

Lay the coin on top of the ring.

Quickly pull the ring from the bottle and coin “sandwich”.

Observations

What direction did the coin move?

Describe the “trick” to being successful in this activity.

What other materials could you use to demonstrate this idea?

Inertia Demonstrations

Station 3 Show Me the Money!

Materials

Two identical glass soda bottles, a dollar bill, PPE

Procedure

Place one bottle right side up on the table.

Place the second bottle upside down on top of the other bottle. Make sure they are mouth to mouth.

Hold the dollar bill at the end and strike sharply in the middle of the bill with the other hand. Use one finger in a chopping motion.

Observations

How difficult is it to remove the money?

Why is using a chopping motion necessary to do this demonstration?

Station 4 Scrambled Eggs

Materials

Aluminum pie pan, beaker, raw egg, toilet paper tube, straw broom with good spring tension

Procedure

Fill the beaker 2/3 full of water.

Set the pie pan on top of the beaker.

Stand the toilet tube ring upright on the pie plate so it is directly above the beaker of water.

Set the raw egg on the open end of the tube.

Make sure the pie pan hangs over the edge of the table about 2 to 3 inches.

Put your foot on the straw part of the broom to hold it in place.

Slowly move the broom handle away from the pie plate. You don't need to pull back very far. Release causing the broom handle to hit the aluminum pie plate.

Observations

What happened when you released the broomstick? Be specific.

What other variations could you think about to show this demonstration?

I Am Floored

Memo: To 7th grade students
From: Your Principal

The School Board has approved our request for a new floor covering in the hallways. I can choose from 4 different types of floor covering and I am asking for your help in deciding which type of floor covering to use. I am very concerned about safety. The operational definition of safest surface to me is: the surface that students can walk on without slipping easily. Because you are studying motion and forces and have learned about friction, I am asking you to help determine which of the four different floor coverings would be safest. Please conduct a series of tests on the samples of each of the four different floor coverings: wood, carpet, tile, and vinyl. Let me know which you recommend. Thank you for your help in making our building safer for students.

Based on what you know about flooring, predict which surface you think will meet the desired criteria. Why?

Describe a plan for testing the floor samples.

What other factors should be taken into account to make this decision or should the flooring be selected solely on the safety criteria?

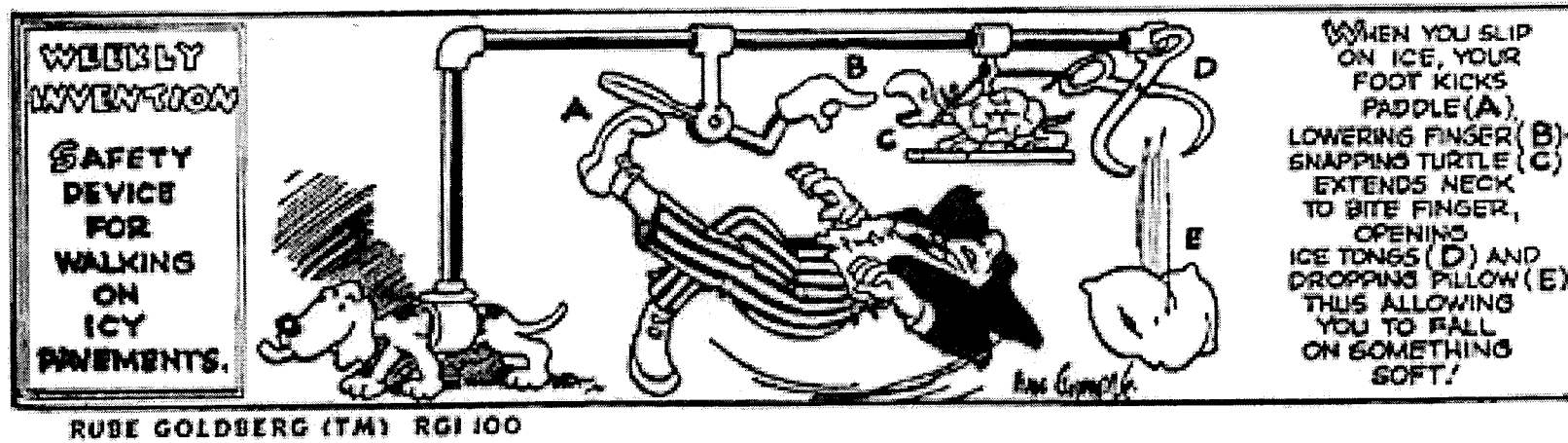
Describe the role of friction in this scenario.

I Am Floored

Indicator of Learning	Score	1 = YES	0 = NO
The student:			
Made a prediction.			
Gave logical reason for prediction.			
Described a plan that included use of materials given.			
Described a plan that included controls for all but 1 variable.			
Described a plan that included logic and reasoning.			
Designed an appropriate data table.			
Based conclusion on data.			
Recommendation was based on data or gave good argument for the need for more data before making a recommendation.			
Described the role of friction.			



For additional ideas, go to: <http://www.rubegoldberg.com>



Safety Device for Walking on Icy Pavement

Rube Goldberg was for his “weekly inventions” in this cartoon series. These devices encompassed many silly devices for solving problems such as turning something on without even touching it. His ideas caught on until now the term “Rube Goldberg” device means anything elaborate machine that transfers actions without actually touching the invention.



Design a method to turn on the TV using the remote control without actually ever touching it.

The following requirements must be met:

- Your device must lower something a vertical distance onto the remote control.
- You are not allowed to touch the device once it has been triggered.
- You must use three different simple machines within the device, but not repeating the same machine.
- Draw a sketch of the device with written explanations of the plan of action. The more action transfers, the more bonus points.
- Build and test the device.

Rubric for Rube Goldberg Device

Criteria	Yes/No	Comments
Uses three different machines		
Includes a sketch of the device		
Explanation included with the sketch		
Device cuts TV on		
Does not touch device once triggered		
Bonus: number of action transfers > 3		

Build A Catapult

Materials

(per group) Popsicle sticks, thick rubber band, 2" X 4" wooden block, PPE, clay, balance, masking tape, meter stick, book for base, protractor, target (for practice and for class "test").

Engage

Have students write explanations to Blackline Master individually and then share in groups.
Analyze suggestions to the problem and have the group reach consensus to share with the class.
Record suggestions for reference throughout the design process.

Explore

Brainstorm and design a catapult that will shoot a clay pancake the longest distance. The challenge is to determine the angle at which one should place the catapult to experience the greatest distance. Lead students to understand that there needs to be a standard design to control for variable in design materials, etc.

Have students collect data and graph results of launching the clay at different angles.

Challenge

Have groups design an investigation to determine the greatest vertical distance the clay pancake is launched.

Challenge

What if I increased or decreased the mass by two? What effect does doubling or halving the mass of the projectile have on the distance traveled?

Challenge

Design an investigation that will yield maximum control by hitting a target.

Complete

When the angle of the catapult is increased, then....
When the mass of the projectile is halved, then....
When the mass of the projectile is doubled, then...

Build A Catapult

- If you wanted to catapult something across the room, at what angle would you need to place the catapult?
- How would you test this idea?
- Consider horizontal distance, vertical distance, and accuracy for aiming at a target.
- Determine a method to hit a target using a homemade catapult.
- Determine materials needed to build the homemade catapult.
- Determine a fair test of the accuracy.
- Record your ideas and make a drawing in your notebook.

Blackline Master

Build a Catapult

Materials

(per group) Popsicle sticks, thick rubber band, 2" X 4" wooden block, PPE, clay, balance, masking tape, meter stick, book for base, protractor, target (for practice and for class "test").

Procedure

Place rubber band around the thickness of the block. Tape the rubber band to the block to keep it in place.

Mark the Popsicle stick with two lines: a rubber band line 2 cm from one end of the stick and the clay line 0.5 cm from the other end.

The top of the rubber band will rest on the rubber band line and the edge of the clay will rest on the clay line.

Place the stick behind the rubber band and tape secure with tape.

Make the clay projectile at least the size of a quarter and twice as thick.

Identify a mark on the clay with a pencil. This mark will be used to place the pancake on the stick consistently for all trials.

Align the mark with the clay line before launching it.

Place, DO NOT PRESS, the clay on the stick.

Make sure everyone in your group is involved with the test. Suggested roles are:

Leader/Loader-Sees that all are involved and are doing their work. Loads the catapult.

Shooter/Safety Officer-Brings back arm of the catapult and releases the arm to fire the catapult. Makes sure no one is in the way, that all are wearing PPE before loading for a launch, and checks catapult for safety.

Checker/Data Manager-Sees that the shooter is firing the device the same way each time. Makes sure that the angle is held constant. Records data.

Marker/Returner-Marks landing points of clay projectile. Returns projectile to the leader/loader.

Set the catapult at the desired angle. A minimum of 10 trials without changing the angle is required. Find average distance for 10 shots.

Change the angle and retest. Be prepared to justify the angle your group decides is best with data.

Practice Walk

Materials

1 cm² graph paper, ruler, pencil

Scenario

Two students are trying to raise money for the Relay for Cancer Walk. In order to get in shape for the event, each has plans to practice walking in the neighborhood. Both are using the hospital as their frame of reference.

Student A began the practice walk 5 miles west of the hospital. She walked 3 miles north, then 4 miles east, 1 mile north, 3 miles east, 4 miles south, 1 mile east and 5 miles south.

Student B started the practice walk 6 miles east of the hospital. He walked 5 miles south, then 4 miles west, 3 miles north, 2 miles west, 3 miles north, and 4 miles east.

Plot the information on graph paper. Each cm square = 1 mile. Be sure to mark in the middle of the paper, a building to represent the hospital. Share your results as a team and see if there is class consensus.

If 1 cm square equals one mile, then how far did each student walk?

How far away is student A from the starting point? Student B?

Who ended up farther away from the hospital?

How far apart were the two students at the end of the practice walk?

Develop a “new” set of directions as a group. Switch directions with another group.

7th Grade
Middle Grades Support Document
Motion & Forces

The Liftbox

Materials
Computer access

Procedure
Go to website http://www.msnbc.com/modules/back_pain/lfb.htm

Discuss
Do you agree the information presented in this article? (that force is proportional to velocity and acceleration) Why or why not?

Is the Liftbox a good way to test this information? Why or why not?

Think of other real-life situations where this information could be tested. Other than pickup up a box, what other motion can you think of that includes force, velocity, and acceleration?

Center of Mass Challenge

Materials

wall and straight back chair

Procedure

Place the chair with its back against the wall.

Ladies first. Measure heel to toe two-foot lengths away from the wall.

With back straight, lean head against the wall and lift the chair.

With chair still lifted, try to stand up straight.

Repeat with gentlemen.

Based on the results of this activity, would you say the center of mass for females is lower or higher than that of females?

Where Does It Balance?

Materials

Poster board, mathematical compass, scissors, marker

Procedure

Cut the poster board in a kidney shape.

Place the poster board on the index finger and balance to find its center of gravity. Mark the spot.

With the compass, draw circles around the center of gravity point 1 cm apart.

Repeat on the reverse side but with a point about 3 cm away from the center of gravity.

Trace over the circles with a marker.

Hold the poster board by either end and toss it vertically into the air by using an upward flick action of the wrist.

Make sure to catch it on its way down.

Reverse side of the board and toss it the same way.

Discuss

How did the circles seem to move on the first toss?

How did the circles seem to move on the second toss?

Why did the circles seem to wobble on the second toss and not the first?

Match Car Mania

Materials

Meter stick, Matchbox™ car, stop watch, masking tape, flat, smooth table top

Procedure

On the table top, mark a starting line with masking tape. Mark a time line 0.5 m from the starting line. Mark the finish line 2 m from the starting line. Total track length = 2.5 m. Place car at starting line. Give it a slight push. When the car reaches time line, start timing until car reaches finish line. Record the time on the trial chart. Repeat 3 times.

	Trial 1	Trial 2	Trial 3
Time in seconds			
Average of the 3 trials			

Speed = distance moved / time interval

Find the average speed of the toy car using the formula: Average speed = distance moved / average time interval

Why should this procedure be repeated three times?

How could the experimental design be improved?

Observing Acceleration

Materials

Meter stick, matchbox™ car, board about 2.0 m long and at least 0.5 m wide, books for propping up one end of the board

Procedure

Place the car on one end of the board with its front facing the other end.
Tilt the end of the board with the car on it up until the car just begins to roll.
Prop up the board by putting books under the high end.
Place the car at the high end of the incline and release it. Do not push it.
Do step 4 several times and observe its motion.

What is acceleration?

Is this activity as accurate a measure as one would be that records the times the car would pass certain markers as it rolls down the incline? Why or why not?

Is the car accelerating?

Car Bashing

Materials

Meter stick, board with smooth, flat surface, 4 marbles, 2 books, Matchbox™ car, masking tape

Procedure

Place 2 books flat on top of each other.

Place the board long ways against the books.

Place a piece of double-sided masking tape under the board at its starting point to maintain its position.

The distance from the starting point to the impact point should be exactly 50 cm.

Place the car's rear bumper at the bottom of the board and place one marble at the starting point.

Release the marble.

Measure how far the car moved after being struck by the marble.

Measure from the bottom of the board to the car's bumper; round to nearest 0.1 cm.

Record measurement in the data chart.

Do three more runs using two, three, and four marbles each time.

Number of marbles	Trial 1 (cm)	Trial 2 (cm)	Trial 3 (cm)
1			
2			
3			
4			

How far did the car move in relation to the number of marbles used?

Why would a car hit by a bus moving 50 mph receive more damage than a car hit by a Volkswagen going the same speed?

7th Grade
Middle Grades Support Document
Motion & Forces

Amusement Park Physics

Materials
Computer access

Procedure
Go to website <http://www.learner.org/exhibits/parkphysics/coaster.html>
Read information about roller coasters and their history.

Discuss
As the roller coaster is ascending up the first hill, is the energy potential or kinetic? Explain.
What happened in the early 1900s to slow the development of better roller coasters?
Where was the first steel roller coaster built? What park?
Do roller coasters have engines? Do they need engines? Explain.

Writing
What is your favorite roller coaster? Where is it? Why is it your favorite? Describe what it feels like to ride it?

Build Your Own Roller Coaster

Explore

- You have been hired to design a new roller coaster.
- It is up to your team to make decisions about the height, shape, exit patterns, and loops.
- You have used a computer design program to narrow your choices.
- It is up to the members of the team to select from the choices given.
- You will be given choices for each part of the ride.
- Discuss and reach consensus within your group for each decision.
- There will be no formulas to use in order to reach your goal.
- Your team will be responsible for taking the first test ride on what you design.

Your first decision is in which direction you will have the coaster travel:

- a- forward?
- b- backwards?

Will your ride be :

- a- sitting in cars?
- b- Standing?
- c- seated with feet handing free?

Choose the height of your first hill:

- a- 90 meters
- b- 70 meters
- c- 50 meters

Will your coaster need an electric motor's assistance to pull the cars up to the top of the first hill?

- a-Yes, but this will be the only assistance needed by an outside force until the ride is over.
- b-No, there is no outside force needed for the roller coaster at any time.

Build Your Own Roller Coaster

Choose the shape of your first hill:

- a-obtuse slope
- b-angled slope
- c-normal slope

The choice you make here will determine how fast the roller coaster will travel. Think of the safety of your passengers.

Pick your exit path out of the hill:

- a-medium slope
- b-huge slope
- c-low slope

The path must maintain the coaster's speed while your passengers still enjoy the ride, so choose well.

Choose the height for the second hill:

- a-80 meters
- b-60 meters
- c-40 meters

This hill should continue with the sensation of speed and "weightlessness". Don't forget about the safety of your passengers.

Pick the path from the second hill into the loop:

- a-oval loop
- b-perfect circle loop
- c-no loop

Your choice should give the riders the thrill of going upside down and they should be able to feel the pull of gravity.

Pick the path out of the loop and into the last curve:

- a-60 degree curve
- b-90 degree curve
- c-120 degree curve.

Build Your Own Roller Coaster

Record your Team Consensus and rationales based on what you have learned about motion and forces:

_____ A-Forward B-Backwards (direction)

Rationale-

_____ A-Sitting in Cars; B-Standing; C-Seated with feet hanging free (riders)

Rationale-

_____ A-90 meters; B-70 meters; C-50 meters (height of first hill)

Rationale-

_____ A-Obtuse Slope; B-Angled Slope; C-Normal Slope (Shape of first hill)

Rationale-

_____ A-Medium Slope; B-Huge Slope; C-Low Slope (exit path out of hill)

Rationale-

_____ A-80 meters; B-60 meters; C-40 meters (second hill)

Rationale-

_____ A-Oval slope; B-Perfect circle loop; C-No loop (second hill into the loop)

Rationale-

_____ A-60 degree curve; B-90 degree curve; C-120 degree curve (out of loop into the last curve)

Rationale-

Build Your Own Roller Coaster

The Computer Assisted Design Program Suggestions

_____ A-Forward OR B-Backwards (direction)

_____ A-Sitting in Cars; OR B-Standing; OR C-Seated with feet hanging free (riders)

_____ A-90 meters (height of first hill)
Rationale-allows the greatest potential energy for the rest of the ride

_____ C-Normal Slope (Shape of first hill)
Rationale-allows a gentle lead into the next path

_____ C-Low Slope (exit path out of hill)
Rationale- allows for maximum possible energy for the rest of the ride

_____ A-80 meters (second hill)
Rationale- allows for maximum possible energy for the rest of the ride

_____ A-Oval slope; B-Perfect circle loop; C-No loop (second hill into the loop)
Rationale- greater fun factor plus avoids the danger of a circular loop

_____ C-120 degree curve (out of loop into the last curve)
Rationale-This is the only curve that won't throw passengers from the ride!

How well did your team do in selecting the design for your roller coaster?

Was your test ride a safe one?