Newspaper in Education – Teachers Guide for Answers, Additional Resources and References.

Air Pollution

You could go days without food and hours without water, but you would last only a few minutes without air. On average, each of us breathes over 3000 gallons of air each day. You must have air to live. However, breathing polluted air can make you sick.

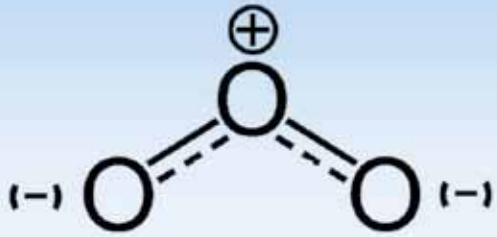
The amount of pollution in the air from all sources – natural and human – defines the quality of the air we breathe. Bad air quality can affect everybody's health. It can have direct effects on the lungs and can worsen an existing condition such as asthma. Some people are more sensitive to air pollution than others are. These include young children who are growing rapidly and older adults who have reduced immune systems.

The Clean Air Act establishes standards to protect the public and the environment from adverse health and welfare effects of air pollution. Air quality standards have been established for six pollutants. They are carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), ozone (O_3), sulfur dioxide (SO_2), and particulate matter (PM).

In Oklahoma, the primary pollutant of concern is ozone.

What is Ozone?

Ozone is a form of oxygen. The molecule is made of three oxygen atoms (O_3). Most oxygen we find in our lower atmosphere is made up of two oxygen atoms (O_2).



Ozone: The Good and the Bad

Good Ozone

The Earth's atmosphere is a mixture of gases that covers the planet; it is divided into distinctive layers.

The ozone layer, as it is called, is really a part of the stratosphere. Stratospheric ozone plays a protective role by absorbing harmful ultraviolet radiation from the sun.

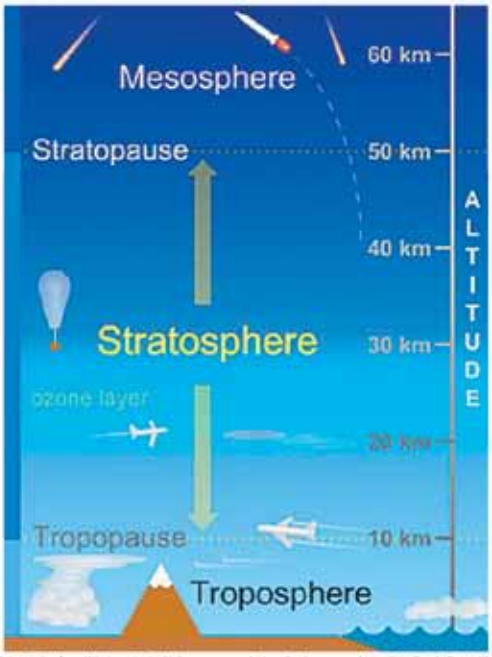


Illustration from Windows to the Universe, www.windows2universe.org Artwork by Randy Russell

Bad Ozone

In the lower portion of Earth's atmosphere, ozone is a harmful pollutant. At the ground level, ozone may also accompany man-made pollutants to form smog, a brownish haze that contaminates the air.

In the troposphere, ozone forms from the chemical reaction of gaseous pollutants. These gaseous pollutants are emitted from natural and man-made sources and require sunlight to chemically react.

Glossary

Air pollution: The presence of contaminants or pollutant substances in the air that interfere with human health or welfare.

Concentration: The amount of ingredients or parts in relation to the other ingredients or parts.

Nitrogen oxides (NOx): A group of gases made up of nitrogen and oxygen that cause environmental problems like smog. Burning fossil fuels, such as coal and gasoline, releases NOx into the atmosphere.

Ozone (O_3): A colorless gas found in the air we breathe. Ozone can be good or bad depending on where it occurs. At ground level, ozone is an air pollutant that can harm human health.

Particulate Matter (PM): A complex mixture of suspended small particles and liquid droplets. Particulate pollution is made of a number of components including chemicals, metals and soil or dust particles.

Smog: The brownish haze that pollutes our air, particularly over cities, in the summertime. The primary component of smog is ozone.

Stratosphere: The second layer of Earth's atmosphere. Approximately 90% of the ozone in Earth's atmosphere is here. Ozone in the stratosphere is good. It absorbs UV light and shields the Earth's surface.

Troposphere: The first layer above Earth's surface that contains one-half of Earth's atmosphere. Most weather occurs in this layer.

Volatile Organic Compounds (VOCs): Compounds emitted as gases from certain solids or liquids. They include a variety of chemicals some of which may have short- and long-term adverse health effects. VOCs are emitted from products we use every day like paints, cleaning supplies, pesticides, adhesives, and permanent markers.

Oklahoma Ozone

Tropospheric Ozone - A Recipe for Ozone

Creating ozone requires the following:

Ingredients:

*Nitrogen Oxides (NOx): gases emitted from cars, refineries, power plants, and industrial facilities.

*Volatile Organic Compounds (VOCs): gases emitted from paints, cleaning supplies, pesticides, glues, and permanent markers.

Preparation

1. Combine the surrounding air with generous amounts of NOx and VOCs. *Sources of NOx and VOCs can be of your choosing. Mix thoroughly.
2. Using ample amounts of sunlight, bake the ingredients on high until they have reacted.

**Cooking time may vary depending on the amount of ingredients used and the amount of available sunlight.*

Okay! You now have a fresh batch of ozone! Serve with fine particles and other atmospheric pollutants to create smog.

Where is Ozone?

Air Quality Monitoring Site #651 located in North Lawton.

The Air Quality Division (AQD) monitors ozone at 17 sites across the state. Each location is equipped with monitors that use ultra-violet absorption techniques to measure ozone concentrations on a continuous basis. Most sites report data hourly so current monitoring data is also posted to the website hourly at *www.deq.state.ok.us/aqdnew/monitoring* (click on) "Current Monitoring Data".

Many of the state's ozone sites are located in and around Oklahoma City and Tulsa. Measured concentrations of ozone in these areas are above the federal standard. Continued high levels this year could put the state into non-attainment which could lead to additional air pollution controls for Oklahoma industry.

Ozone sites are also strategically placed along Oklahoma's borders to measure ozone transported into the state from sources located in other states.

Data from designated monitoring sites are used to calculate the state's Air Quality Index or AQI. The AQI correlates the monitoring data to a number and color that describe the quality of the air. There are six categories. The AQI is issued for Oklahoma City, Tulsa, and Lawton.

How Ozone Can Affect Your Health

Health Risks	Symptoms
1. Irritation of respiratory system	Coughing, sore throat, and tightening of the chest
2. Reduction in lung function	Shallow and rapid breathing
3. Inflammation and lung damage	Swollen and constricted airway passage to lungs
4. Susceptibility to infection	Fever, coughing, and chest pain
5. Aggravation of asthma, emphysema, chronic bronchitis, etc.	Increased sensitivity to allergens, reduced lung function, and airway inflammation
6. Permanent lung damage	Reduced lung function and acceleration of the natural decline in lung function (aging)

Those groups who are more sensitive to ozone and air pollution in general are young children with developing lungs, elderly adults with weakened immune systems, people who frequently exercise or work outdoors, and individuals who suffer from pre-existing respiratory conditions.

Healthy Lung

Inflamed Lung

Photo courtesy of PENTAX Medical Company

Air Quality Index	Numerical Value	Meaning
Good	0 to 50	Air quality is considered satisfactory, and air pollution poses little or no risk
Moderate	51 to 100	Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution
Unhealthy for sensitive groups	101 to 150	Members of sensitive groups may experience health effects. The general public is not likely to be affected
Unhealthy	151 to 200	Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects
Very Unhealthy	201 to 300	Health warnings of emergency conditions. The entire population is more likely to be affected
Hazardous	301 to 500	Health alert: everyone may experience more serious health effects

Air Quality Tools

The following tools are available on the AQD website: *http://www.deq.state.ok.us/aqdnew* and are designed to help Oklahomans better understand Oklahoma's air quality.

1. AQI

The Air Quality Index can be accessed from the upper right hand corner of almost every page of the AQD web site. It is an index for reporting air quality for U.S. cities and is required for cities with populations of 350,000 or more. It predicts today's air quality using yesterday's monitoring data in combination with today's air pollution and weather forecasts. In Oklahoma, the index is calculated every weekday for Oklahoma City, Tulsa and Lawton. The AQI is available to all media and is posted on the weather page of Tulsa World and USA Today and online at sites like Weather Bug.

2. Watch/Alert

An ozone watch is a forecast by DEQ. When monitoring data, ozone models and weather forecasts indicate unhealthy levels of ozone in the state, the division calls an ozone watch so those sensitive to ozone can avoid exposure to high concentrations. An ozone watch can trigger a local ozone alert in Tulsa, Oklahoma City, and/or Lawton. Alerts may also be announced on TV weathercasts and highway signs and are always posted as a banner at the top of the AQD website. You can sign up for ozone alerts in your area on these sites:

Tulsa: www.ozonealert.com/index.htm
Oklahoma City: www.bettertogetherok.org
Lawton: www.enviroflash.info/signup.cfm

3. Advisory

Air Quality Health Advisories are email messages in a graphic format advising subscribers when concentrations of air pollution reach unhealthy levels in their area. These are not forecasts, but near real-time advisories of Oklahoma's air quality. Sign up for these advisories on the Air Quality website.

If Ozone Levels are Unhealthy…

- Avoid unnecessary trips and drive-up windows
- Modify activities that require higher levels of exertion
- Reschedule outdoor events for the morning or evening hours
- Limit or avoid outdoor activity if necessary

What You Can Do!

Take mass transit, share a ride or carpool- Fewer vehicles on the road translate into fewer sources of VOCs and NOx. A reduction in these ozone-forming components may result in an overall improvement of the local air quality.

Trip chain more often- When running errands, it is not only time-efficient to map out your route, but it is also environmentally friendly. When you first start a car after it has been sitting for more than an hour, it pollutes up to five times more than when the engine is warm.

Have fun! Ride your bike- Again, a decrease in the number of vehicles on the road directly translates into better air quality. Twenty-five percent of all the air pollution in the United States is the result of vehicles on the road.

Take things in stride- Instead of driving, try walking or in-line skating. Both are good forms of exercise and cut back on emissions.

Maintain your vehicle- Vehicle emissions could be drastically reduced if regular maintenance were performed. When vehicles have been properly cared for, their gas mileage and emissions rate will improve.

Get fuel when it's cool- Refueling during cooler periods of the day or in the evening can prevent gas vapors from heating up and creating ozone.

Don't top off the tank- Cars are now equipped with control devices that reduce escaping vapors during refueling, so don't override the pump!

Telecommute- A reduction in vehicular pollution can be further accomplished by working at home when possible.

Know before you go- Before commuting to your destination, stay informed of travel and transit information. Traffic reports can help you to avoid congested roadways that are ozone hotspots.

Spread the word- If everyone took just a few of these simple, easy steps, it could make a big difference because it all adds up to cleaner air

Teacher's Column

Teacher Tools:

The Teacher's Guide to OK Air Pollution

- Resource Information
- Lesson Plans
- Student Worksheet Downloads
- Answer Key

The following lessons are posted on our website:

Lesson 1: What is Ozone?

- Good Ozone (ozone layer)
- Bad Ozone (surface-level ozone)
- How Do We Know When There Is Bad Ozone? (air quality monitoring network)
- Activity- Vocabulary Crossword Puzzle

Lesson 2: How Does Ground-Level Ozone Form?

- Components of Ozone Formation
- VOCs and NOx
- Activity- Ozone Formation Poster

Lesson 3: Why is Ground-Level Ozone Monitored?

- Importance of Air Pollution Monitoring (health and economic reasons)
- How Ozone Affects Health
- Activity- Air Quality Comparison Tables

Lesson 4: How is Ground Level Ozone Monitored?

- Monitoring Sites
- Monitoring Equipment
- Air Quality Data
- Activity- *Combined with lesson 5 content. See below*

Lesson 5: 3 Tools for Understanding Air Quality

- AQI
- Ozone Watches/Alerts
- Air Quality Health Advisories
- Activity- Monitoring Site Identification and Data Analysis

Lesson 6: Steps to Improving Air Quality

- Ozone Overview
- Ways You Can Help
- What Else Is Being Done?
- Activity- Alternative Fuel Vehicles Research

Oklahoma Ozone

A Case Study in Air Quality

Air pollution levels can vary greatly on a monthly, weekly, and even daily basis. Air quality can also vary from region to region as well. There are several factors that can be attributed to such variations.

For example, population density, geography, and weather-related events are a few determining factors that can affect air pollution levels. Variables such as temperature, solar radiation, wind speed and direction, and sky coverage can further affect the rate of ozone formation.

In order to understand why ozone episodes tend to be seasonal occurrences in Oklahoma, it is helpful to consider these factors in relation to actual events.

The following case study uses actual ozone data collected from Oklahoma City on January 17th, May 22nd, July 1st, and August 6th of 2012. The selected dates do not have any relation to one another; however, the data collected on those dates allow for an effective evaluation of factors that can affect ozone concentrations.

Air quality health advisory maps are provided for May 22nd and August 6th to display Oklahoma County and the surrounding areas affected by ozone.

*Note: there are no health advisory maps for January 17th and July 1st due to the low ozone levels reported on those days. Health advisories are issued when ozone levels are unhealthy for sensitive groups.

www.deq.state.ok.us/aqdrew/advisory/index20120506.html

www.deq.state.ok.us/aqdrew/advisory/index20120522.html

In addition to the health advisory maps, corresponding AQI values and weather data for Oklahoma City have been supplied for each day. The weather data include total solar radiation, average temperature, sky coverage conditions, and average wind speed and direction.

1. Using the maps and accompanying data, create four separate bar graphs — one for each factor being considered: one graph to display the AQI values, another graph to display the total solar radiation, another graph to display the average temperature, and the last graph to display the average wind speed.

The horizontal axis of each bar graph should represent the four dates being analyzed in the study, while the label on the vertical axis will differ depending on the information conveyed by each graph i.e., AQI values (number—no units), total solar radiation (MJ/m^2), average temperature (˚F), and average wind speed (mph).

When creating multiple bar graphs, it is easier to evaluate the data by assigning a different color for each graph.

2. Be sure to select appropriate increments to best represent the data for each graph. Also, title the graphs and label the axes.

Case Study Fact Sheet

- Solar radiation is energy emitted by the sun.
- Ozone formation often occurs hours or days after the emissions of VOCs and NOx pollutants and can occur hundreds of miles downwind.
- Chemical reactions between VOCs and NOx occur in the presence of solar radiation.
- When clear sky conditions are present, a greater proportion of solar radiation is able to reach the Earth's surface. Clouds reflect or scatter solar radiation.
- Widespread heavy rain typically cleans the air of pollutants.
- Thermal inversions are important because they trap pollutants beneath them. Temperature inversions occur when there are warmer temperatures aloft and cooler temperatures below.
- If wind speeds are calm for an extended period, air can become stagnant and does not mix well.

Weather Data Chart

Date		1/17/12	5/22/12	7/01/12	8/06/12
AQI Value (O_3)		21	80	39	132
Total Solar Radiation (MJ/m^2)		13.04	27.21	28.94	23.88
Avg. Temperature (Degrees F.)		33.5	73.4	83.4	90.6
Wind	Avg. Speed (mph)	N	SSE	S	ES
	Direction	12.3	7.7	8.3	4.1
Sky Coverage		Mostly Clear	Partly Cloudy	Few Clouds	Scattered Clouds

Case Study Questions

1. Using a color-coded AQI chart and the data tables corresponding with each day, describe what the reported AQI value means in terms of air quality.
2. Why are high AQI values associated with high temperatures and high solar radiation?
3. Based on the comparison provided by the graphed data, what time of the year are ozone episodes more likely to occur? Why?
4. Describe the wind speeds on the days with lower AQI values and the wind speeds on the days with higher AQI values. What is the relationship between wind speed and AQI values?
5. Based on the Air Quality Health Advisory maps and the average wind directions provided for May 22nd and August 6th, which areas could have been affected by ozone on the following days (assuming the wind remained steady and continued to blow out of that direction)?
6. What factors may have led to a lower ozone concentration on July 1, 2012, despite the high amounts of solar radiation?

Teacher's Guide:

Air Quality Division (pages 2 -7)

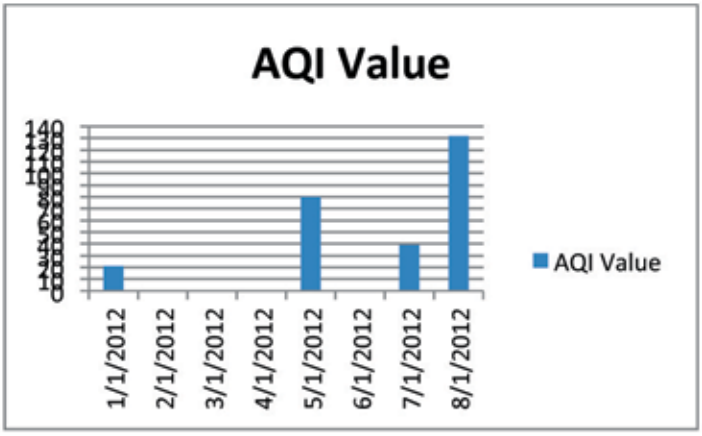
Oklahoma Department of Environmental Quality

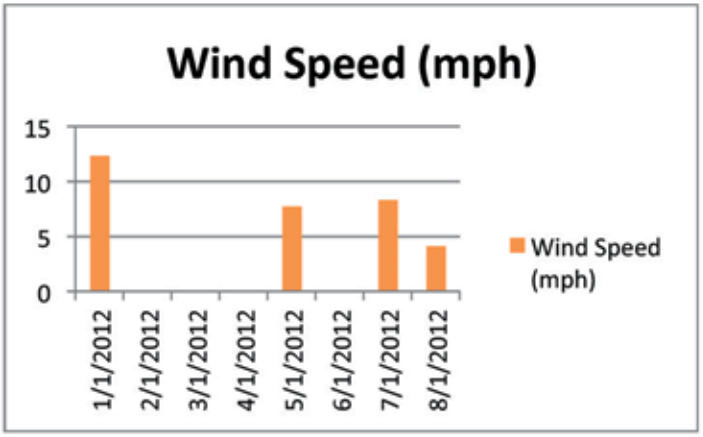
OBJECTIVE: The student workbook provides an overview of the air quality in Oklahoma, specifically in terms of ozone pollution. In addition to the student workbook, six lesson plans have been developed to supplement the information presented in the workbook. These lesson plans are available in a .pdf on both the DEQ website and Newspaper in Education website.

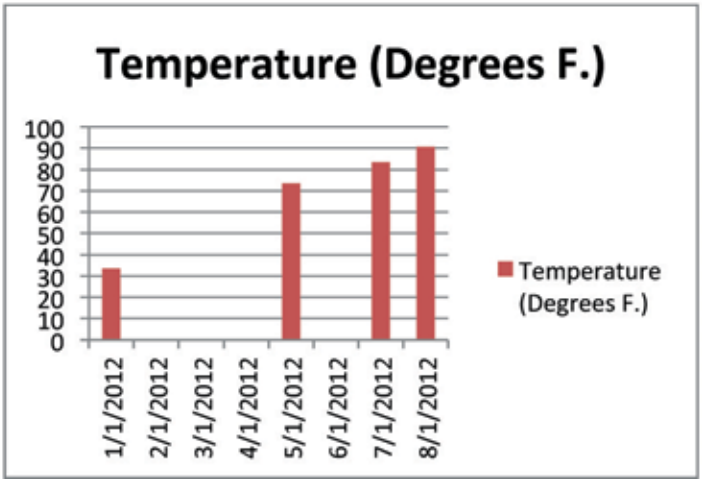
Each lesson plan includes an activity with accompanying student worksheets designed to reinforce the content. *The purpose of the workbook and the lesson plans is to inform students about ground-level ozone, more specifically, how ozone forms, how and why air pollution is monitored, how monitoring data is disseminated to the public, and what everyday choices can be made to reduce ozone emissions.*

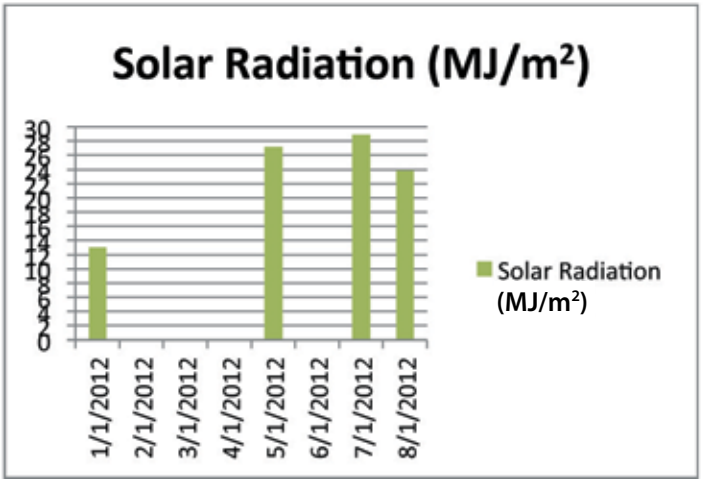
REAL-WORLD APPLICATION: A case study has also been provided in the student workbook and was designed to give students practice interpreting actual scientific data from indexes, tables, and maps. Students are also given practice displaying data in a graphic format and analyzing the information it represents.

CASE STUDY ANSWER KEY









1. Using a color-coded AQI chart and the data tables corresponding with each day, describe what the reported AQI value means in terms of air quality.

   ANSWER: The AQI score for 1/17/12 was 21, meaning the air quality was considered satisfactory, and air pollution posed little or no risk (Good = green). On 5/22/12 the AQI score was 80 which means the air quality was moderate (yellow) and acceptable; however, for some pollutants there may have been a moderate health concern for a very small number of people who are unusually sensitive to air pollution. The air quality for 07/01/12 was good and had an AQI value of 39, meaning air pollution posed little or no risk. The AQI score for 08/06/12 was 132, indicating that the air quality was unhealthy for sensitive groups (orange). Members of sensitive groups may have experienced some health effects.

2. Why are high AQI values associated with high temperatures and high solar radiation?

   ANSWER: For ground-level ozone to form there needs to be high solar radiation in addition to ample sources of NOx and VOCs. Solar radiation enables chemical reactions between NOx and VOCs to occur, which is how ground-level ozone is formed. Typically, high solar radiation correlates to high temperatures.

   When ozone forms and the concentrations are high enough, the AQI scores will usually be high as well. AQI scores are measures of how good or poor the air quality is for certain areas and when the numbers are high, so too are the concentration levels.

3. Based on the comparison provided by the graphed data, what time of the year are ozone episodes more likely to occur? Why?

   ANSWER: The highest AQI score reported in the case study occurred on August 6th followed by May 22nd. Based on those AQI values and the data displayed by the bar graphs, it can be concluded that ozone episodes typically occur in warmer months, such as spring and summer, when there is more solar radiation. The amount of solar radiation increases during the warmer months because the angle of the sun changes and it is more overhead. This conclusion can further be supported by the fact that the lowest AQI score reported in the case study occurred on January 17th when the sunlight (solar radiation) is less intense.

4. Describe the wind speeds on days with lower AQI values and the wind speeds on days with higher AQI values. What is the relationship between wind speed and AQI scores?

   ANSWER: The lowest AQI score reported in the case study occurred on January 17th and the corresponding average wind speed for that day was 12.3 miles per hour; the highest reported average out of the selected dates. Conversely, the highest AQI score reported in the case study occurred on August 6th and the corresponding average wind speed for that day was 4.1 miles per hour; the lowest reported average out of the selected dates. This being the case, higher average wind speeds typically correspond to lower AQI scores and lower average wind speeds typically correspond to higher AQI scores.

   ***Note: In the case study fact sheet it mentions that air can become stagnant when wind speeds are calm. If wind speeds are low, very little mixing occurs and the air does not circulate. As a result, pollutants are able to accumulate and settle over a particular area. If there are sufficient amounts of solar radiation and sources of NOx and VOCs, ozone is able to form. This being the case, the days with high ozone concentrations are typically associated with calm wind conditions.**

   On the other hand, higher wind speeds are indicative of lower AQI scores or lower ozone concentrations because the winds help to disperse the pollutants.

5. Based on the Air Quality Health Advisory maps and the average wind directions provided for May 22nd and August 6th, which counties or areas could have also been affected by ozone (assuming the wind continued to blow out of that direction)?

ANSWER: On May 22nd the average wind direction was out of the south/southeast meaning the areas most likely to be affected were those north and northwest of Love, Carter, Jefferson, Garvin, Murray, Johnston, and Marshall Counties (near the Texas and Oklahoma border). The southerly winds were, more than likely, transporting ozone pollution from Dallas and Houston into Oklahoma. Air pollution transport from Texas is a common occurrence since the winds in Oklahoma are predominantly out of the south.

On August 6th the average wind direction was out of the east/southeast, as a result the areas most likely to be affected were those along the northwestern border of Oklahoma. Also, the counties in southwestern Kansas could have been affected.

6. What factors may have led to a lower ozone concentration on July 1st, 2012, despite the high amounts of solar radiation?

The wind speeds were slightly higher than they were on May 22nd and could have caused more vertical mixing of the air. Climatic data indicates there was no widespread heavy rain for Oklahoma towards the end of June 2012. However, northwestern and north central Texas could have received significant rainfall during that time period that would have cleansed their air of pollutants. Therefore, any transport that may have occurred would have consisted of relatively cleaner air.

Also, there may have been an airmass change that occurred over Oklahoma during that time, which means that the pollutants in the air were transported to a different area such as Missouri, Arkansas, Kansas, etc.

This Land is Our Land

When you throw something away…where is away?

• In Oklahoma, when you throw something in the trash it will likely end up in a landfill and will no longer be a useful item. If, however, that item is recyclable, and you choose to recycle it, then the item can be given a new purpose. It can become something totally new! Plus this leaves more room in the landfill for items that cannot be recycled.

- Raw materials must be mined or harvested from the environment, and the extraction process and energy required are very costly. Recycled materials simply have to be melted down or processed to be used again.
- There are also financial benefits for recycling. Recyclers of aluminum and various metals pay by the pound for materials. Some organizations collect cans as a fundraising opportunity. Manufacturers use recycled materials because they are cheaper.
- Recycling has become easier to do. Many cities have curbside recycling or drop-off stations that make the recycling process simple for citizens.

Reduce, Reuse and then Recycle

Reduce

The key to cutting down waste is to reduce how much you produce in the first place. The easiest way to do this is to look at a product's packaging. Here are some tips:

- Compare the packaging of similar items and opt for the one that has less.
- Single-serve items have lots of packaging! Instead, buy in bulk or concentrated products when possible. Then use smaller reusable containers to divide the bulk item, which can save money and resources!

Recycling just one plastic bottle saves enough energy to power a 60 watt light bulb for 6 hours. The average American consumes 167 bottles of water each year. If you stopped buying bottled water and used a refillable bottle instead, in a year's time how many watts of energy would you have saved?

- Look for containers that can be reused or recycled, like aluminum, plastic and glass, or those that can be composted, like paper.
- Avoid items that are made to be thrown away after only one or a few uses like disposable razors or disposable batteries.
- Look for products that can be used again and again, like thermos jars, cloth towels and napkins, glass plates, a reusable water bottle, etc.
- Use cloth bags when shopping.
- Write e-mails or letters to companies asking them to use less packaging.
- Write to companies that send unwanted junk mail and request to be taken off their list. Or opt out by signing up with the National Do Not Mail List.
- Print or copy on both sides of the paper.

Reuse

Reusing an item is the best way to keep it out of the waste stream. Try to find a new purpose for an old item, or find someone who can! Here's how:

- Save plastic and paper bags for reuse instead of throwing them away.
- Store leftovers in glass or plastic containers.
- Take hangers back to the cleaners.
- Use the back side of paper for scratch pads.
- Start a backyard compost bin for kitchen and yard scraps.
- Encourage your school to start a program composting cafeteria food waste.
- Share newspapers, books and magazines.
- Reuse Styrofoam peanuts or newspaper as packing material.
- Look for some great finds at garage sales or re-sale and thrift stores.
- When finished with something, consider loaning it, giving it away or donating it to someone else rather than sending it to the landfill.

Recycle

When you can't reduce or reuse, the next step is to recycle!

- Buy recycled content products. To complete the full recycling cycle, choose to buy items with recycled content. Look for items that are made from recycled content that can be recycled again.
- Start a paper recycling program at work or school.
- Separate plastics, steel, aluminum, glass and paper waste at home and work for recycling.
- Take time to learn about how to prepare recyclable items.

The Oklahoma Department of Environmental Quality has lots of recycling resources available.

Visit the DEQ recycling page for more information *http://www.deq.state.ok.us/lpdnew/Recyclingindex.htm.*

By recycling 1 ton (2,000 lbs.) of paper you save:

A) 500 lbs. of air pollution
B) 17 trees
C) 7,000 gallons of water
D) 3.3 cubic yards of landfill space
E) Enough energy to power the average home for six months
F) All of the above

Want an excuse to party? Celebrate America Recycles Day every November 15th!

Answers:

Recycling just one plastic bottle saves enough energy to power a 60 watt light bulb for 6 hours. The average American consumes 167 bottles of water each year. If you stopped buying bottled water and used a refillable bottle instead, in a year's time how many watts of energy would you have saved?

A 60 watt bulb uses 60 watts of energy in one hour.
1 bottle can power a 60 watt bulb for 6 hours,
*so 60 watts * 6 = 360 watts per bottle.*
*167 (bottles per year) * 360 (watts per bottle) =*
60,120 watts per year

By recycling 1 ton (2,000 lbs.) of paper you save:

A) 500 lbs. of air pollution
B) 17 trees
C) 7,000 gallons of water
D) 3.3 cubic yards of landfill space
E) Enough energy to power the average home for six months
F.) All of the above

Additional Teacher Resources Available

- **Would you like DEQ to come to your school and do a presentation on a land topic?**
  We have people available who would be happy to talk about recycling, landfills, composting, litter and more. We could also tailor a presentation to your individual needs. Please call or email Sara Ivey at 405-702-7122 or *sara.ivey@deq.ok.gov* to schedule a visit.
- **Is your school ready to start recycling?**
  Use the DEQ Recycling Implementation Plan to make sure you have everything in place before you start. *http://www.deq.state.ok.us/pubs/lpd/schlrecfm.pdf*
- **A great Oklahoma resource for recycling information is the Oklahoma Recycling Association.**
  Visit their website at: *http://www.recycleok.org/okra/*
- **For some great recycling and litter activities to try with your students** visit the Solid Waste Institute of Northeast Oklahoma at *www.swino.org* and click on Education.
- **Celebrate America Recycles Day every November 15th.** Resources are available on the DEQ website: *http://www.deq.state.ok.us/mainlinks/eepage.htm* or at *http://americarecyclesday.org/*

Reference Sources

Reduce, Reuse, Recycle

Oklahoma Department of Environmental Quality. “59 Ways You can make a difference to keep Oklahoma beautiful”. February, 2001. *http://www.deq.state.ok.us/pubs/lpd/59ways00.pdf*

Recycling 1 Ton of Paper

US EPA, OSWER. “Basic Information Details | Paper Recycling.” Overviews & Factsheets. Accessed March 7, 2013. *http://www.epa.gov/osw/conserve/materials/paper/basics/.*

Recycling 1 plastic bottle energy

“Water Bottle Pollution — National Geographic Kids.” Accessed March 7, 2013. *http://kids.nationalgeographic.com/kids/stories/spacescience/water-bottle-pollution/.*

60 watt bulb uses 60 watts per hour

“Power - Are Watts Usually Measured in Watt-hours? - Electrical Engineering.” Accessed March 11, 2013. *http://electronics.stackexchange.com/questions/4611/are-watts-usually-measured-in-watt-hours.*

167 Bottles of water per year

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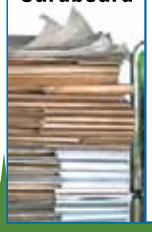
Time to Recycle!

Material	What products are recyclable?	Recycling Process	Fascinating Facts	Tips
Plastic 	• Bottles such as milk, juice, water, shampoo, detergent, etc. • Containers such as yogurt, sour cream, margarine, etc. • Garden pots • Plastic cups or plates • Plastic bags	Plastic is labeled with numbers 1 through 7. The numbers tell the type of resin that was used to produce the plastic, and this determines if the plastic can be recycled. At the recycling facility, each type of plastic is sorted, then goes through a grinder that turns the container into plastic flakes. Plastics are cleaned and can be reused or melted and formed into new containers, t-shirts, carpet or many other products	Recycling 1 ton of plastic saves 7.4 cubic yards of landfill space and requires only 10% as much energy to produce as producing a new container from raw materials.	• Not all plastics are accepted in curbside recycling programs, so be sure to check with your recycling hauler to see what they will take. • Most communities will not accept Styrofoam regardless of a recycling symbol. • Return plastic bags to recycling bins at retail stores that have plastic collection containers.
Glass 	Any color glass bottle or jar	Glass is one of the few items that can be recycled indefinitely. Recycled glass has the same quality and strength as new glass.	Recycling just 1 glass bottle rather than producing it from raw materials can save enough energy to power a computer for 30 minutes! 80% of recycled glass is used to make new glass containers.	Many recyclers will take any colored glass bottles or jars, but always check to make sure your hauler does. Also, some curbside programs worry about handling glass and do not accept it at all. Broken glass, mirrors, window glass, and ceramics are never accepted. Check with your recycler to see what is accepted.
Aluminum 	• Aluminum cans • Foil • Foil Trays	Aluminum is another product that can be recycled over and over again without any loss of quality.	The aluminum recycling industry has become so efficient that a recycled can is usually back on the store shelf full of new product in about 60 days.	Aluminum recycling can be a money making opportunity. Aluminum recyclers pay up to two cents per can. Check with your local aluminum recycler to see the current price per pound of aluminum.
Steel or Tin 	Steel or tin cans	Steel can also be recycled forever because it is simply melted down and reformed into a new product.	Modern furnaces can melt recycled steel into new steel in less than one hour.	Steel can be taken to a scrap metal recycler, even if your community does not have a central recycling program. Scrap metal collectors are always looking for new materials! Containers that held hazardous materials such as oil, paint, pesticides, or insecticides are not accepted. Your local Household Hazardous Waste Facility or collection event may accept these items.
Paper 	• Office paper • Newspaper • Junk mail • Magazines, phonebooks and catalogs • Paper sacks • Shredded paper • Paperback books	To recycle paper, it must be shredded, pounded, soaked and heated to get the fibers ready for new paper. Because of this process, the fibers can be recycled approximately 5-7 times before the fibers are too short and poor quality to make more paper.	The paper you recycle today could be a new newspaper in about 2 weeks!	• Tissue and toilet paper are not accepted • There are many locations that will take paper. Schools, churches and other organizations sometimes have drop-off bins that make recycling paper easy to do!
Cardboard 	• Corrugated cardboard (boxes) • Paperboard (such as cereal boxes, shoe boxes and tissue boxes)	The cardboard recycling process is similar to paper recycling. The cardboard is soaked with water and made into a fiber slurry. Contaminants such as tape, rope, and plastic are removed and the slurry is pressed (draining the water in the process) and made into paper rolls that can be used for many purposes such as new paper products or boxes.	Cardboard is used to ship 90% of all products in the U.S. In 2009, it was estimated that 81.3% of that cardboard was recycled.	Many curbside programs cannot collect cardboard because it is so bulky. But it is typically accepted at drop-off recycling facilities. Avoid recycling the following cardboard: • Containers with a plastic or wax lining such as milk cartons and juice boxes. • Pizza boxes (grease contamination) • Boxes that have not been flattened and emptied out Many large retailers will also accept your flattened cardboard boxes. Check with your local retailers for their policy on accepting cardboard.

Time to Recycle Reference Sources

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Protect It!

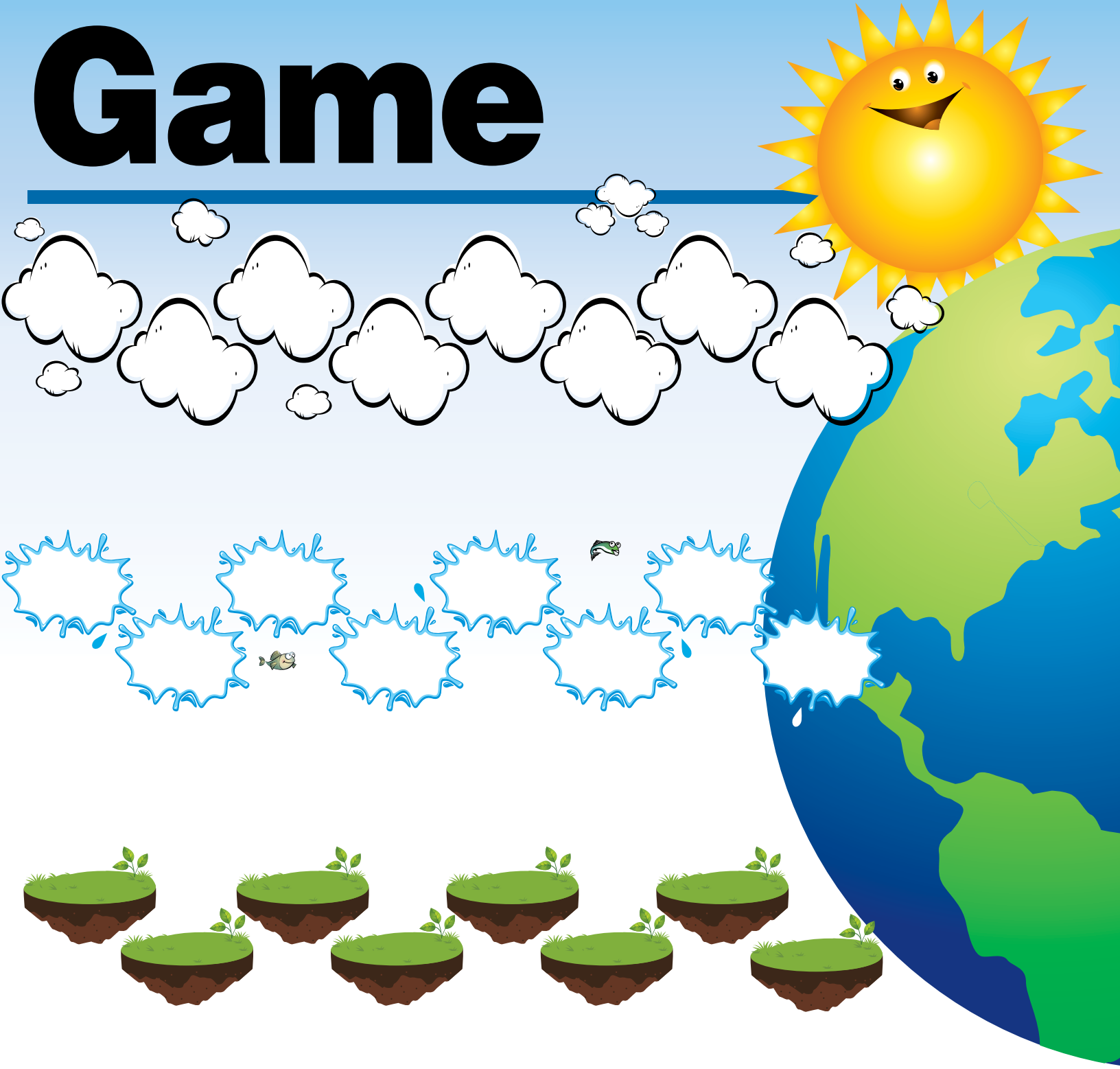
Protect It: The Game of Earth

Instructions:

You will need 2-3 players, a single dice and a game piece (i.e. coins, rocks, buttons) for each player. Your goal is to be the first player to make it to Earth by correctly answering questions along the way.

There are three paths to make it to Earth (air, land and water). Each player will then take a turn and follow their path to Earth, observing the instructions, or answering the question that corresponds to the space square they land on.

Game



The first player to make it to Earth (you must roll the exact number to get to Earth, FYI) and correctly answer 1 question from each of the three categories (air, land and water – the teacher will select the question to ask from each of the categories.) WINS!

Note: Throughout play, if a player incorrectly answers a question, it is then the next player's turn.

Teachers, feel free to add additional questions as needed.

Air Spaces: (the number corresponds to the space on the game board)

1: You put gas in your car during the heat of the day, go back to start.

2: Instead of going through the drive thru to pick up dinner, you go inside. Move ahead 3 spaces.

3: Ozone season in Oklahoma typically lasts from March – November.

4: Ozone Alert Day, lose a turn.

5: Walking and bicycling are great for your health and reduce air pollution.

6: You mow the yard early in the morning. Move ahead 2 spaces.

7: You ride the bus on an Ozone Alert Day, move ahead 3 spaces.

8: Long term exposure to air pollution can cause permanent lung damage and lead to many health conditions.

9: You set some old tires on fire, go back to Start!

10: Particulate matter is divided into two categories based on particle size (PM2.5 and PM10).

11: You walk to a friend's house nearby instead of getting a ride. Move ahead 3 spaces

12: You burn your trash. Go back 3 spaces.

13: The average adult breathes over 3,000 gallons of air every day.

14: You carpool with your friends on an Ozone Alert Day, choose a player and send them back to Start.

15: You could go days without food but only a few minutes without air.

16: You start a clean air awareness campaign at school, move on to Earth.

Land Spaces: (the number corresponds to the space on the game board)

1: On America Recycles Day, you volunteer to organize a school wide recycling effort. Go again.

2: It's Earth Day, move ahead 3 spaces.

3: You only use Styrofoam cups at home, go back to Start.

4: A Styrofoam cup will never decompose.

5: Recycling one aluminum can saves enough energy to keep your tv running for three hours!

6: It takes 80-100 years for an aluminum can to decompose.

7: You leave the light on in your bedroom when you go to school. Go back three spaces.

8: The average American throws away an average of 5 pounds of garbage every day.

9: You don't recycle your water bottle, go back to Start.

10: Glass can be recycled and infinite number of times.

11: Your school recycles a ton of paper and saves 17 trees. Move ahead one space.

12: The average American spends 8 months of their life opening junk mail.

13: Earth Day is April 22.

14: The average aluminum can is made up of 50% recycled aluminum.

15: You throw trash out of your car window. Go back to start.

16: You educate your parents on what you can and can't recycle. Go to Earth.

Water Spaces: (the number corresponds to the space on the game board)

1: 97% of water on Earth is salt water.

2: Approximately 400 billion gallons of water are used in the US per day.

3: You throw tissues into the toilet instead of the trash can. Go back to start.

4: You build a rain barrel and give it to your neighbor. Move ahead 3 spaces.

5: You leave the water running while you brush your teeth. Lose a turn.

6: A five minute shower uses 10-25 gallons of water.

7: Water makes up between 55-78% of a human's body.

8: You fall asleep at school and miss a lesson on water conservation. Lose a turn.

9: It takes 39,090 gallons of water to manufacture a car.

10: You water your lawn after sunset, move ahead 3 spaces.

11: You forget to turn off your bath and flood your house. Lose 2 turns.

12: A running toilet can waste up to 200 gallons of water per day.

13: You collect rain water and use it to water your yard. Select a player and send them back to start.

14: 68.7% of fresh water on Earth is trapped in glaciers.

15: You fix a leaky faucet. Go to Earth.

16: 400 billion gallons of water are used in the US per day.

Questions to be asked when students reach Earth

Air Questions:

Q: Recycling 2,000 pounds of paper eliminates how many pounds of air pollution?
A: 500 lbs

Q: The average adult breathes approximately how many gallons of air per day?
A: 3,000

Q: There are air quality standards for how many criteria pollutants?
A: 6

Q: Name three of the pollutants for which there are air quality standards?
A: Any combination of carbon monoxide, lead, nitrogen dioxide, ozone, sulfur dioxide and particulate matter

Q: What is the primary air pollutant of concern in Oklahoma?
A: Ozone

Q: True or False? Air pollution can lead to diseases like emphysema and cancer.
A: True

Q: The brownish haze that pollutes air, particularly in summer, is called what?
A: Smog

Q: How long can a person go without air?
A: A few minutes

Q: True or false? Carpooling is an ineffective way to reduce air pollution?
A: False

Q: What is the purpose of an air quality health advisory?
A: To notify the public when air pollution reaches unhealthy levels.

Q: What is formed by the chemical reaction of VOCs and nitrogen oxides in the presence of sunlight?
A: Ground-level ozone.

Land Questions:

Q: What percentage of the US population had a cell phone as of June 2012 (round to nearest whole number)?
A: 106%

Q: Which natural resource is not used in the manufacturing of glass? Sand, Dirt, Soda Ash or Limestone?
A: Dirt

Q: The average cell phone is replaced or upgraded how often?
A: Every 18-24 months

Q: Advanced Environmental Recycling Technologies (A.E.R.T.) in Watts, Oklahoma, has a total of what percentage of recycled content in their products?
A: 95%

Q: Orchid Paper Company of Pryor, OK uses recycled paper to make products such as paper towels. The proceeds from which product goes to the Regional Food Bank of Oklahoma?
A: Made in Oklahoma paper towels

Q: Recycling 2,000 pounds of paper saves enough energy to power the average home for how long?
A: Six months.

Q: Recycling one plastic bottle saves enough electricity to power a 60 watt light bulb for how many hours?
A: 6 hours.

Q: You recycle 8 aluminum cans. How many hours of television can you watch with the energy that was saved?
A: 24 hours!

Q: How long does it take the average aluminum can to return to the shelf with new product after it has been recycled?
A: 60 days.

Q: 7.4 cubic yards of landfill space is saved by recycling 2,000 pounds of which material?
A: Plastic

Q: Which of the following items is typically not recyclable?
A. Soup Can B. Pizza Box C. Milk Jug D. Newspaper
A: B. Pizza Box

Q: The following materials can be recycled over and over again without any degradation in quality except for:
A. Paper B. Steel C. Aluminum D. Glass
(Paper can be recycled on average 5-7 times before the quality is too poor)
A: Paper

Q: How many pounds of waste would you prevent from going to the landfill if you compost all of your biodegradable waste for one year? (Round to the nearest pound)
A: 411 lbs.

Q: Compost needs three components for the mix. What are they?
A: Browns for carbons, Greens for nitrogen, and water.

Q: What are the best types of worms to use in vermicomposting?
A: Red Wigglers, Eisenia fetida (common or scientific name is acceptable)

Q: The most littered item in America is what?
A: Confection litter (candy, chocolate and gum) which accounts for 53.7% of all litter.

Q: Name three things you can do to take action against litter.
A: Choose not to litter! Set an example for others by using a trash can or recycling container rather than littering, If you see litter, stop and pick it up. Remind others not to litter and why. Always have a litter bag in your car, and empty it when full. Pick up after your dog when out for a walk. Volunteer to do a litter cleanup in your community. (Answers may vary and other ideas can be acceptable answers as judged by the teacher)

Q: Do items in the landfill decompose at the same rate as items in a compost pile, and why or why not?
NO, the lack of oxygen and moisture in the landfill prevent the breakdown of materials. Decomposition in an landfill takes a VERY LONG TIME, while decomposition in a compost pile can happen in a matter of weeks.

Q: Which gas is produced by items in a landfill?
A: Methane

Q: Plastics are labeled number 1-7. What do these numbers tell you?
A: The type of resin that was used to make the container and whether it is recyclable.

Water Questions:

Q: What percentage of water on Earth is salt water?
A: 97%

Q: Approximately how many gallons of water are used per day in the US?
A: 400 billion gallons

Q: How many gallons of water does it take to make a car?
A: Approximately 39,000

Q: How much water is used during a five minute shower?
A: 10-25 gallons

Q: A running toilet can waste how many gallons of water per day?
A: 200

Q: What is the average annual rainfall in Oklahoma?
A: Approximately 34 inches

Q: A period of drier than normal conditions that results in water related problems is a….?
A: Drought

Q: When was the Dust Bowl?
A: 1930s

Q: Name one factor that contributed to the Dust Bowl?
A: Decade long drought, high temperatures, soil prone to blowing and an increase in soil under cultivation

Q: Approximately how many cities in Oklahoma are reusing treated wastewater?
A: More than 150

Q: How many gallons of water are used to produce one megawatt hour of electricity?
A: 775 gallons

Q: What is the main use for water collected in a rain barrel?
A: Watering a yard

Q: Water makes up what percentage of the human body?
A: 55-78%

Q: What plants require the least maintenance and water and are therefore great to use in landscaping?
A: Native plants

Q: Which uses less water? A 5 minute shower or a bath?
A: A 5 minute shower

Composting

In Oklahoma City, each person generates an average of 4.3 pounds of waste per day. Did you know that 25% of that waste is biodegradable materials such as leaves, yard trimmings and food scraps that can be transformed to compost? Compost is a wonderful fertilizer that can be used in your garden. By composting, you will prevent 25% of your waste stream from taking up space in the landfill!

The Environmental Protection Agency (EPA) says only three percent of food waste in the U.S. is recovered and recycled. One way to help recover food and other organic waste is through composting.

How many pounds of trash would you save from going to the landfill if your family composted all of your biodegradable waste for one year?

Traditional composting can be as easy as starting a pile.

- Simply find a dry, somewhat shady spot near a water source for a pile or bin.
- Then add equal parts of "browns, greens, and water". Browns are dead leaves, branches or twigs.

The browns add carbon to the pile. Greens, which add the nitrogen, are things like grass clippings, fruit and vegetable scraps, and coffee grounds. Water is needed to keep the pile moist so items can decompose properly.

- Some people just leave the pile alone and let nature do the work. To speed up the process, turn the pile (giving it oxygen and mixing the materials) periodically and ensure that it stays moist, and before you know it you will have a rich fertilizer ready for your yard. Plus, you won't have to buy expensive chemical fertilizers!
- Managed properly, a compost pile will not attract pests or rodents and will not have a bad smell.

Tip!

Many hardware and gardening supply stores sell premade compost bins that can get you up and running in no time!

For help with building a compost bin at home, see the DEQ guide "How to Build Compost Bins" at *http://www.deq.state.ok.us/pubs/lpd/compostbins.pdf*

Let worms eat your garbage!

Another composting option is vermicomposting, composting using worms. Worms will happily eat your garbage, and turn it into some of the best fertilizer on earth!

Worms will eat almost anything put in a traditional compost pile. Vermicomposting can work well for people with limited space who want the benefits of composting (it is a great way to compost in the classroom). Only a few things are needed to make good worm compost: worms (red-wigglers, Eisenia fetida are the best), worm bedding (e.g., shredded newspaper, cardboard), and a bin to contain the worms and organic matter (food scraps). For more information on how to begin composting with worms download the DEQ "Worm Composting" Guide at *http://www.deq.state.ok.us/factsheets/local/worms.pdf*

More composting tips can be found in the DEQ "Backyard Composting" publication *http://www.deq.state.ok.us/pubs/lpd/bycompt.pdf*

Answers:

How many pounds of trash would you save from going to the landfill if your family composted all of your biodegradable waste for one year?

*4.3 lbs per person per day * 25% compostable = 1.075 lbs per day per person.*
*# People in your family * 1.075 lbs per day * 365 days per year = x.*

Answers will vary based on the number of family members.

*For example 4 family members would save 4 * 1.075 * 365 =*
1,569.5 lbs. of waste per year.

Additional Teacher Resources Available

- **Many more Environmental Education Resources are available such as grant opportunities, activities, guides and more.** Visit the DEQ Environmental Education Page at: *http://www.deq.state.ok.us/mainlinks/eepage.htm*
- **Looking for a comprehensive guide to help you reduce waste in your school.** EPA's "Tools to Reduce Waste in Schools" guide is just what you need. This 44-page guide gives you step-by-step instructions on what you can do to reduce your waste. *http://www.epa.gov/epawaste/education/pdfs/toolkit/tools.pdf*
- **The Oklahoma Cooperative Extension Service, Waste Management Programs Office,** has many resources available for educators including a media library with many DVD's available for loan such as "The Rotten Truth"; "Tapped"; "No Impact Man"; "Rachel Carson's Silent Spring"; "Growing Greening Schools"; "Auntie Litter's Pollution Patrol"; "Cans: Infinitely Recyclable"; "The Lorax"; "Compost: Truth or Consequences"; "No Time to Waste Oklahoma." They also have resource trunks available for loan on topics such as: Illegal Dumping and Littering; Reduce, Reuse, Recycle; Backyard Composting; and Household Hazardous Waste. Visit the website for more information *http://agecon.okstate.edu/wastenew/#*

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Landfills

In Oklahoma, most trash is taken to a landfill. The garbage trucks deliver the trash to a municipal solid waste landfill where a specifically designed plastic liner, laid over a clay liner, is used to protect ground water from the trash. At the end of each day, the trash is covered with soil, making a barrier from air and rain, and keeping it from polluting the surrounding area. Burying it also discourages animals and birds from scavenging through and scattering the trash.

So what happens to the garbage once it's buried? Since waste needs oxygen and moisture in order to break down, materials that are buried in a landfill take a VERY LONG time to decompose. Old landfills still contain magazines and newspapers that are completely readable.

Why is saving landfill space important? Landfills can generate methane and require long-term monitoring. New landfills are hard to permit, so maximizing existing landfills is the best option. It costs money to dispose of trash and build and maintain landfills. This cost is passed on to all of us.

For a list of the landfills in Oklahoma visit *http://www.deq.state.ok.us/lpdnew/SW/landfill.htm*

Each year Americans throw away 25,000,000,000 Styrofoam cups. Even 500 years from now, the foam coffee cup you used this morning will still be sitting in a landfill.

and Litter

Litter is any material that has been discarded where it is not meant to be. Litter is more than just an eyesore; it is a health and safety hazard as well. Litter can create areas that attract disease-carrying pests, such as rats, skunks and mosquitoes. Litter can also be harmful to wildlife. Animals, birds and fish can be injured by soda cans, cigarette butts, plastic wrappers and other kinds of litter. Litter-strewn roads and highways hurt tourism by creating a negative image for visitors. One of the indirect costs is the potential water pollution often caused by illegal dumping and litter. Litter is also expensive to clean up.

Many of the items that are casually thrown aside don't break down - they last in the environment for a long time. People may think that paper decomposes easily, but a parking ticket, for example, can take up to a month to decompose, depending on where it is.

So, imagine the length of time it takes for a plastic soft drink bottle or a plastic industrial oil container to break down! Plastic litter can remain for hundreds (100-450) of years. Plastic is also lightweight, easily windblown and it floats in water, often travelling long distances via the storm water system to impact our beaches.

The Ocean Conservancy estimates that 59% of all marine litter is from land-based shoreline and recreational activities.

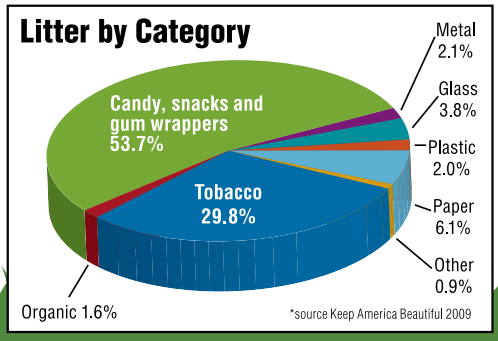
Oklahoma 2012 Trash Poster Contest
6th - 8th Grade, First Place winner Olivia Anderson

A 2009 study from Keep America Beautiful found the most littered item in America is "confection litter" such as candy, chocolate and gum wrappers. The two biggest sources of litter are motorists (52%) and pedestrians (22.8%).

Changing a habit like littering starts with you! Accept responsibility for your actions and influence the actions of others.

Here are ways to start:

1. Choose not to litter!
2. Set an example for others by using a trash can or recycling container rather than littering.
3. If you see litter, stop and pick it up.
4. Remind others not to litter and why.
5. Always have a litter bag in your car, and empty it when full.
6. Pick up after your dog when out for a walk.
7. Volunteer to do a litter cleanup in your community.



Additional Teacher Resources Available

- **How much waste in generated every day during lunch at your school?** Probably a lot! One way to raise awareness at the wastefulness of the lunch room is to have a Waste Free Lunch Day. Several resources are available. Contact Sara Ivey at 405-702-7122 or *sara.ivey@deq.ok.gov* for help on planning a Waste Free Lunch event.
- **DEQ has a "Litter Lasts" poster that shows how much time it takes for some common items to decompose in the environment.** You may request a copy by calling 405-702-7122 or download the poster at: *http://www.deq.state.ok.us/pubs/lpd/Litter4web.pdf*
- **Do you have an upcoming event you are planning?** Resources are available for making your event litter-free. It can be fun and it promotes environmental awareness by involving everyone at the event in reducing litter. Request a copy by calling 405-702-7122 or download the brochure at: *http://www.deq.state.ok.us/pubs/lpd/litter.pdf*
- **Teachers! The end of the school year is quickly approaching.** Use our guide "How to Make Locker Cleanout an Environmental Event" to promote awareness of conservation and environmental protection by including everyone in the process of reducing waste and recycling. Request a copy by calling 405-702-7122 or download the guide at *http://www.deq.state.ok.us/factsheets/general/lockercl.pdf*

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Oklahoma's Water

Did you know?

Ninety-seven percent of Earth's water is in the oceans; two percent is frozen; only one percent is suitable for drinking water.

A human can survive for about a month without food but can live only about a week without water.

An average residence in the United States uses 107,000 gallons of water per year (indoors and outdoors). You may not think about all the things that require water. For example:

- About 39,090 gallons of water are used to manufacture a new car.
- Approximately 634 gallons of water are required to produce one hamburger.
- More than ten gallons of water are used to produce one slice of bread.
- One gallon of milk requires 1,000 gallons of water.
- More than 713 gallons of water are used in the production of one cotton T-shirt.

Oklahoma is a diverse state, as are our water resources. While many regions of Oklahoma are blessed with abundant water supplies, other areas, particularly in the drier western part of the state, are not.

Times of water shortages and drought are cyclical, as Oklahoma's history has shown. Oklahoma's current prolonged drought and record high temperatures are an ominous reminder of the Dust Bowl that ravaged the Plains States, including Oklahoma, in the 1930s.

These weather conditions should serve as a warning of what could happen again if we fail to act decisively to conserve water.

The Dust Bowl is widely considered the worst sustained environmental crisis in U.S. history. Raging through much of the 1930s, the Dust Bowl was caused by a horrendous decade-long drought, high temperatures, soil already prone to blowing, and a vast increase in soil under cultivation. Topsoil in Texas, Oklahoma, New Mexico, Colorado and Kansas simply blew away, but the Dust Bowl's reach extended far beyond those five states. In May 1934, massive dust storms caked cities as far as New York, Atlanta and Washington, D.C. In Chicago, a two-day storm dumped 12 million pounds of soil on the city.

Over time, much needed soil and water conservation projects markedly changed practices in Oklahoma and led to the construction of massive flood control systems and dams. Hundreds of reservoirs and man-made lakes were constructed to supply water for domestic needs and agricultural irrigation. By the 1960s, Oklahoma had created more than 200 lakes, the most in the nation.

The lessons that we, as Oklahomans, learned as a result of the Dust Bowl, carry with us today. In order to address Oklahoma's current water needs, DEQ, in coordination with the Oklahoma Municipal League, began encouraging water reuse. Water reuse plays an important role in water resources, wastewater and ecosystem management in Oklahoma. When reclaimed water is used to irrigate golf courses and farmland or to provide cooling water to power plants, it eases the demand on traditional, often limited, sources of water suitable for drinking. It is important to note that reclaimed water systems are continually monitored to ensure the health and welfare of the public and the environment are protected.

According to The Economist magazine, the average person in the United States eats 3 hamburgers per week.

The 2012 US Census said the population of Oklahoma was 3,814,820.

Using those figures, how much water does it take to produce the hamburgers eaten by Oklahomans over a one year period?

(Hint: 3 per week * 52 weeks * 3,814,820 * 634 gallons of water = amount of water needed)

Currently, more than 150 cities, towns and rural wastewater districts are reusing their treated wastewater primarily to irrigate pastures and golf courses. To increase water reuse, new rules and regulations have been modified to allow highly treated wastewater to be used to irrigate public access landscapes and public use areas/sports complexes. By reusing water, communities can grow while minimizing or even reducing their impact on the water resources around them.

Answers:

According to The Economist magazine, the average person in the United States eats 3 hamburgers per week.

The 2012 US Census said the population of Oklahoma was 3,814,820.

Using those figures, how much water does it take to produce the hamburgers eaten by Oklahomans over a one year period?

*3 hamburgers per person per week *52 weeks * 3,814,820 people * 634 gallons of water =*

377,300,957,280 gallons of water per year.

Additional Teacher Resources:

- **Would you like DEQ to come to your school and do a presentation on a water topic?** We have people available who would be happy to talk about water conservation, water pollution, the water cycle, and more. We could also tailor a presentation to your individual needs. Please call or email Sara Ivey at 405-702-7122 or *sara.ivey@deq.ok.gov* to schedule a visit.
- **Want a fun activity to teach your students about watersheds, water pollution and stormwater runoff?** Try DEQ's Water Limbo activity, download it at: *http://www.deq.state.ok.us/pubs/wqd/Waterlimbo.pdf*
- **Are you and your students interested in getting your feet wet and helping a local creek or stream?** The Oklahoma Blue Thumb program would love to have you! This program allows your students to learn about water pollution and water quality issues while performing hands-on science in an outdoor setting. They will find a creek or stream near your school where you and your students can conduct periodic water quality testing to monitor the health of the water body. For more information see: *http://bluethumbok.com/*

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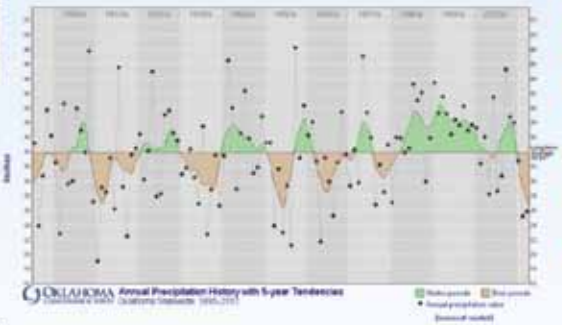
Dry Times

During 2012, most of Oklahoma was categorized as suffering from Extreme Drought by the Oklahoma Climatological Survey.

A drought is a period of drier-than-normal conditions that results in water-related problems. While it is relatively easy to recognize when a hurricane or earthquake happens, determining when a drought is occurring can be more subjective. Droughts do not have the immediate effects of floods, but sustained droughts can cause economic stress throughout an area. The word "drought" has various meanings, depending on a person's perspective. To a water manager, a drought is a deficiency in water supply that affects water availability and water quality.

To a farmer, a drought is a period of moisture deficiency that affects the crops under cultivation; even two weeks without rainfall can stress many crops during certain periods of the growing cycle. To a meteorologist, a drought is a prolonged period when precipitation is less than normal. To a hydrologist, a drought is an extended period of decreased precipitation and streamflow.

Drought is a normal part of Oklahoma's climate cycle. Since modern record keeping began in 1895, Oklahoma has experienced numerous (8) periods of drought, ranging in duration from two-three years to a decade. This graph from the Oklahoma Climatological Survey shows the periods of drought from 1895-2012.



A drought is a period of "drier than normal" conditions. If the brown areas of the drought are considered drier than normal, what is the normal amount of precipitation for Oklahoma?

Drought can have many consequences. These can be environmental, economic or social in nature, but can have devastating effects for those impacted.

Examples of these impacts include:

- Reduced drinking water sources
- Increased costs for food
- Increased cost to farmers who must now irrigate crops, or drill new or deeper wells
- Increased costs to ranchers for feed and water for animals
- Reduced drinking water and food for wildlife
- Loss of habitat; increase in wild animal disease
- Migration of wildlife
- Stress or extinction of endangered species
- Reduced water levels in lakes and ponds
- Increased wildfires
- Erosion of soils by wind and water
- Reduced soil quality
- Monetary losses for farmers who cannot produce crops
- Decrease in business for farming/ranching supply companies
- Decrease in revenue from boating, fishing and other recreational activities
- Increased cost to residential and commercial customers when water utilities have to find new or additional water supplies
- Increased costs to electric companies who utilize hydroelectric power who will have to use other sources
- Decreased water quality
- Timber industry losses related to forest fires
- Increased transportation costs if barge traffic is reduced
- Health problems arising from dust
- Loss of human life
- Threat to public safety from fires
- Human migration to different locations
- Reduced recreational opportunities
- Unemployment due to reduction in business/ supply/etc.
- Stress associated with economic losses

Is your city currently rationing water? Find out at *http://www.deq.state.ok.us/* and click on Drought Report

Additional Teacher Resources:

- **Great Teacher's Water Curriculum is available through the Project WET program.** Project WET is an interdisciplinary water education program intended to supplement a school's existing curriculum. Using water as a theme, Project WET provides hands-on activities to enhance the teaching of science, math, social studies, language arts and many other required subjects.For more information about Project WET in Oklahoma visit *http://www.ok.gov/conservation/Agency_Divisions/Conservation_Programs_Division/Conservation_Education/Project_WET.html Or visit the national site http://projectwet.org/*
- **The Oklahoma Green Schools Program is a great resource to help you find ways to have a healthier and more environmentally friendly school environment, while saving money and resources.** They have information on a variety of topics including Energy, Waste and Recycling, Water, Environmental Quality and School Site. For more information visit the website at *http://www.okgreenschools.org/*
- **Project Learning Tree is a multi-disciplinary environmental education program for educators and students in PreK-grade 12.** The core of the PLT program is an activity guide which contains hands-on, supplemental activities that involve students in the learning process. The guide includes more than 90 cross referenced activities. There are also 7 secondary modules available for students grades 9-12: Biodiversity, Biotechnology, Focus on Forests, Forests of the World, Places We Live, Focus on Risk, and Municipal Solid Waste. A six-hour training workshop is required in order to receive the activity guide. Workshops can be scheduled for staff development. For PLT Oklahoma visit *http://www.forestry.ok.gov/project-learning-tree or visit the national site at www.PLT.org*

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Photo - *http://www.owrb.ok.gov/supply/drought/drought_index.php* Upper right of Page

Photo - *http://photoblog.nbcnews.com/_news/2011/09/30/8064484-from-floating-dock-to-dry-dock-as-drought-continues-in-oklahoma?lite* Bottom left of series of three

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What can you do to help prepare for times of water shortages?

Learn to Conserve Water Now!

Water conservation starts with you. It is as simple as changing habits and making water-wise decisions.

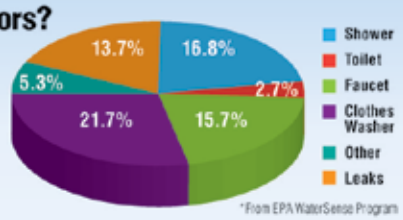
Toilets, Taps, Showers, Laundry, and Dishes

Love baths? Are 20 minute showers your norm? You know who you are!

But did you know...It takes about **70 gallons** of water to fill a bathtub, and a 20 minute shower can **use 50-100 gallons** depending on your showerhead. Make a change! Take a 5 minute shower (with a low flow showerhead) and you will use just 12.5 gallons of water.

If you still have a toilet in your home that was manufactured before 1994, it uses close to **3.5 gallons** with every flush. You can save water and money by retrofitting or filling your tank with something that will displace some of that water, such as a brick, or a 2 liter bottle filled with water. Otherwise, all of those flushes can add up to nearly 20 gallons or more a day down the toilet. Better yet, replace your old toilet for a low flow model which will use a maximum of **1.6 gallons** per flush, with some models using even less! Toilets were designed to flush only toilet paper. Putting other items in the toilet can clog your pipes and waste water. So put your trash in the trash can and save your pipes and your wallet.

How do we use our water indoors?



*From EPA WaterSense Program

Nearly 22% of indoor home water use comes from doing laundry. Save water by adjusting the settings on your machine to the proper load size, or wait to wash until you have a full load. Consider purchasing an ENERGY STAR certified clothes washer which uses approximately 20% less energy and 35% less water than regular washers.

On average, 10 gallons per day of your water footprint (or nearly 14% of your indoor use) is lost to leaks. One of the easiest, most effective ways to reduce your water use is by repairing leaky faucets and toilets.

Yards

30% of residential water use happens outdoors for lawn and garden maintenance during the summer months. Does your lawn really need watering? Probably not. Most lawns require only 1-1.5 inches of water every 5 to 7 days during the growing season. When you do water, the best time of day is during the early morning hours when temperature and wind speed are low. **Tip* raise the cutting height on your lawn mower and use a mulching mower rather than bagging to help hold water in the soil.*

Climate counts—where you live plays a role in how much water you use, especially when it comes to tending to a yard. When selecting new plants, choose native species which will require less watering. Native plants also need less fertilizer and maintenance and have a great resistance to pests, diseases and drought conditions.

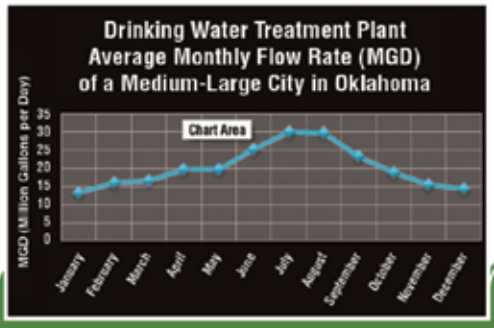
The average swimming pool takes 22,000 gallons of water to fill, and if you don't cover it, hundreds of gallons of water per month can be lost due to evaporation.

The graph below shows a typical drinking water treatment plant's monthly flow rate. Notice the dramatic increase during the summer months; it is more than double. Daily flow can be as much as five times the average. This is primarily due to outdoor water use!

The water industry estimates the average family uses 7,500 gallons per month.

If 30% of your total water use is outdoor watering, how many gallons of water could your household save each month by reducing your outdoor watering by half?

(Hint 7,500 gallons per month x 30% = X. Then, X/2 = savings)**



Answers:

If 30% of your total water use is outdoor watering; how many gallons of water could your household save each month by reducing your outdoor watering by half?

7,500 gallons per month x 30% = 2,250.

2,250/2 = 1,125 gallons saved each month

Additional Teacher Resources:

- **Young visitors can play games, read stories, watch videos, print coloring pages and commit to taking action to improve water resources, while educators and parents can use the site to teach engaging, science-based lessons around water.** Targeting learners aged eight to 12, this website shows children how water affects them—and how they can affect water. Visit: *http://www.discoverwater.org/*
- **Students and teachers can learn about the various instrumentation used by managers of lakes and streams to collect data.** There is a section on Lake Ecology that explains the connections between the physical, chemical and biological components of lakes. The Water Quality tab teaches some of the frequent impacts to water quality and some of the commonly measured indicators to assess water quality. The Stream Ecology section explains the connections between physical, chemical and biological components of streams. The Watershed primer explains the connections between a lake or stream and its watershed, land use impacts, and watershed restoration. And in the Understanding GIS unit, there are tools to view interactive maps of some lakes and streams and their associated watersheds. This would be particularly good for high school students. *http://www.waterontheweb.org/under/index.html*

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What you eat, the devices you use and what you buy take water...

Diet

It takes a lot of water to produce the food and drinks you consume every day. Making small changes in your diet can save thousands of gallons of water per day.

- One apple requires 33 gallons of water to produce.
- It takes 634 gallons of water to produce one hamburger.
- It takes 10 gallons of water to produce one slice of bread.
- The average chocolate bar (1.5 ounces) requires 188 gallons of water to produce.
- A serving of poultry requires about 90 gallons of water to produce.
- Each latte you drink takes 53 gallons of water to produce, mainly from the water used to grow the coffee beans.
- Ironically, it takes 1.85 gallons of water to produce the plastic bottle used for bottled water. Consider using a reusable bottle.

Consider how far your food has to travel, and buy local to cut your water footprint. This will get fresher food (often picked within 24 hours) to your table while stimulating the local economy and helping Oklahoma farmers.

Want to know more about some of the items you consume?

See the "Secret Life of" series including: *The Secret Life of Coffee, The Secret life of Cola,* and *The Secret Life of a Potato*

Electricity and Fuel Economy

Did you know that every time you turn on your TV or plug in your cellphone, you are using water? It takes 775 gallons of water to produce one megawatt-hour of electricity, according to the 2012 Oklahoma Comprehensive Water Plan. The US Department of Energy estimates the average Oklahoma home used 6,300 kilowatt-hours of electricity in 2010. The devices you use can add up to a lot of electricity and therefore a lot of water use. The table to the left shows common electronic devices and how many watts each use.

Electronic Device	Watts Used
Flat Screen Television	120
Laptop Computer	50
Hair dryer	1550
100-W Light Bulb	100
iPhone 5 Charger	5
iPad Charger	10
Xbox 360	145
Wii	18
PlayStation 3	195
DVD Player	25

If the average Oklahoma home uses 6,300 kilowatt-hours of electricity per year, how many gallons of water are used to produce that energy?

- A gallon of gasoline takes nearly 13 gallons of water to produce. Combine your errands, car pool to work, or take public transportation to reduce both your energy and water use.

Consumer Goods

Your indirect water use, the water consumption and pollution associated with the goods you buy, is much larger than the "wet" water that you use on a daily basis.

- One of the best ways to conserve water is to buy recycled goods, and to recycle your stuff when you're done with it.
- A ton of steel takes 62,000 gallons of water to produce, and don't forget, steel can be recycled forever. So recycle your old steel, to help save water, energy, and of course, money! Recycling a pound of paper, less than the weight of your average newspaper, saves about 3.5 gallons of water.
- Buying recycled paper products saves water too, as it takes about six gallons of water to produce a dollar worth of paper. So help protect your planet in multiple ways by recycling and buying recycled content items.

Your Water. Your decision.

The City of Tulsa charges a base charge for each water meter (by size) and then $2.97 for every 1,000 gallons used. That is less than one cent per gallon. What an incredible bargain!

In Oklahoma, we are lucky enough to have clean, abundant, affordable water resources as close as the faucet. We rely on water for drinking, growing our food, keeping us clean, running our businesses, generating power, and countless other uses. Having water so readily available at our fingertips often leads to taking that valuable resource for granted. Conservation is the most effective way you can help to protect our water. The decision to use water wisely is in your hands.

Answers:

If the average Oklahoma home uses 6,300 kilowatt-hours of electricity per year, how many gallons of water are used to produce that energy?

One megawatt is equal to 1,000 kilowatts. http://www.nwcouncil.org/history/megawatt

If it takes 775 gallons of water to produce 1 megawatt of electricity, then 775/1000 = 0.775 gallons of water are needed to produce one kilowatt of electricity.

6,300 kilowatts * 0.775 = 4,882.5 gallons of water needed to produce the energy for the average Oklahoma home for one year.

Additional Teacher Resources:

- **Green Teacher Magazine is a wonderful source for Environmental Education materials.** They have a quarterly magazine, books, articles, webinars and more covering a wide range of topics. They are dedicated to helping educators promote environmental awareness among young people aged 6-19. *http://www.greenteacher.com/*
- **A Water Conservation Checklist for Schools is available at:** *http://infohouse.p2ric.org/ref/23/22009.pdf*

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DEQ Mission Statement

The mission of the Oklahoma Department of Environmental Quality is to enhance the quality of life in Oklahoma and protect the health of its citizens by protecting, preserving and restoring the water, land and air of the state, thus fostering a clean, attractive, healthy, prosperous and sustainable environment.

DEQ Values & Behaviors

The employees of DEQ are public servants whose responsibilities and authorities are derived from the laws of the people of Oklahoma.

As such we value:

- Making decisions based on the impartial application of law and the use of common sense, good science and fiscal responsibility.
- Performing our work ethically in a timely, effective and respectful manner.
- Managing simple and uniform processes to provide courteous, consistent and just service with professionalism and integrity.

DEQ Vision Statement

The vision of the Department of Environmental Quality is to eliminate the effects of unintended consequences of historic development, to prevent new adverse environmental impacts and to provide significant input into national decision making, all the while enhancing both the environment and the economy of Oklahoma.

Contact Information:

Oklahoma Department of Environmental Quality
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Oklahoma City, OK 73101-1677

405-702-0100
www.deq.state.ok.us

DEQ
OKLAHOMA
DEPARTMENT OF ENVIRONMENTAL QUALITY

It's Your Environment: Protect It!

Lesson One: It's Ozone Season

Those warm, sunny days are back and so are the air pollution issues that accompany them.

Last year, Oklahoma had 59 days when concentrations of ozone were unhealthy for sensitive groups and though you may not be one of these sensitive individuals, we're pretty sure you know someone who is.

Sensitive groups include:

- Children because their respiratory systems are just developing
- Older individuals who suffer chronic or acute respiratory illnesses
- Persons with asthma or other respiratory disease

Other individuals who need to know about Oklahoma's air quality:

- Construction workers, road crews, farmers and ranchers – those who work outdoors and are exposed to the air for long periods of time
- Teachers in charge of students who go outside for recess
- Coaches who train young athletes
- Runners whose routes expose them to fuel exhaust from vehicles

The Air Quality Division will monitor ozone at 17 sites in Oklahoma this year. Those sites report ozone concentrations hourly. We use that data to inform the public of both current and anticipated air quality. Here are three tools that let you access that information.

- **AQI** – A daily forecast of air quality for Oklahoma City, Tulsa and Lawton. Located in the upper right hand corner of almost every Air Quality Division web page.
- **Ozone Alerts & Watches** – These are forecasts for the next day's air quality and are posted on our website as a banner or you can receive email notifications by signing up with one of our partners:
  - *Oklahoma City: www.getbettertogetherok.org*
  - *Tulsa: www.ozonealert.com/index.htm*
  - *Lawton: www.enviroflash.info/signup.cfm*
- **Air Quality Health Advisories** – These are near real-time notifications when concentrations of ozone or other air pollutants reach unhealthy levels anywhere in the state. Sign Up at: *www.deq.state.ok.us/aqdnew/AdvisorySignUp.htm*

Everyone is affected by the quality of our air. Which people in particular are likely to be affected by air pollution?

A) young children
B) elderly adults
C) people who frequently exercise or work outdoors
D) individuals who suffer from pre-existing respiratory conditions
E) All of the above

Who needs to know about Oklahoma's air quality?

A) Football Coaches
B) Teachers
C) Moms and Dads
D) Little League Coaches
E) All of the above

Where can you find daily air quality information?

A) Weather page
B) News
C) OK DEQ Air Quality Web page
D) Sesame Street

Kids can learn more about Oklahoma's air through DEQ's new Environmental Education Supplement which has just been published by Newspapers in Education. Those materials are also available on our website: *www.deq.state.ok.us/aqdnew/education*

NEWSPAPERS IN EDUCATION
THE OKLAHOMAN

Newspapers for this educational program provided by:

DEQ OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

Lesson 1:

Answers:

Everyone is affected by the quality of our air. Which people in particular are likely to be affected by air pollution?

A) young children
B) elderly adults
C) people who frequently exercise or work outdoors
D) individuals who suffer from pre-existing respiratory conditions
E) *All of the above*

Who needs to know about Oklahoma's air quality?

A) Football Coaches
B) Teachers
C) Moms and Dads
D) Little League Coaches
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Where can you find daily air quality information?

A) Weather page
B) News
C) *OK DEQ Air Quality Web page*
D) Sesame Street

It's Your Environment: Protect It!

Lesson Two: This Land is Our Land

Did You Know?

- In 2010, Americans generated an average of 4.3 pounds of waste per person per day.
- Recycling 2,000 pounds of paper saves 3.3 cubic yards of landfill space, 500 pounds of air pollution, 17 trees, 7,000 gallons of water, and enough energy to power an average home for six months.

Why should you recycle?

There are many reasons including: saving energy, conserving natural resources, limiting pollution, stimulating the economy, and more.

Recycling is vital to several Oklahoma manufacturing companies that use recycled content in their products.

At least 11 Oklahoma companies rely on recycled items for use in their manufacturing process. Recycling is big business that creates jobs and puts money back into the Oklahoma economy. You can help the growing recycling industry in Oklahoma every time you use a recycling bin.

Advanced Environmental Recycling Technologies (A.E.R.T.) in Watts manufactures MoistureShield® and ChoiceDek®, two composite (plastic and wood) decking products available for purchase at retailers throughout Oklahoma, including Lowe's. Their state-of-the-art 70,000 square-foot plastic recycling facility washes, cleans and separates plastic (polyethylene) food packaging and wrapping films for the raw materials in their decking products. A.E.R.T. uses a mixture of recycled wood and plastic materials to produce their composite decking, which has a total of 95% recycled content. No new trees are cut down to manufacture their decking, and using these recycled materials diverts 270 million pounds of trash from entering the landfill every year!

The Verallia North America plant in Sapulpa provides 345 jobs to Oklahoma. Verallia manufactures approximately 3.3 million glass bottles each day. Their bottles are used by companies such as Boulevard Brewing and Anheuser-Busch. Verallia uses an average of 10-60% recycled glass in their products, but may use up to 90% recycled content. Glass is 100% recyclable and can be recycled forever without loss of quality. Verallia needs as much recycled glass as possible, so don't trash that old bottle or jar – recycle it!

The Georgia Pacific (GP) company in Muskogee manufactures tissue products including Brawny®, Quilted Northern®, Vanity Fair®, and Angel Soft®, to name a few. Georgia Pacific is one of the largest employers in Muskogee, with approximately 1,000 employees whose compensation and benefits total approximately $76 million per year. The Muskogee facility is one of two GP Ecosource locations that collect, sort and process recycled books, magazines, rolls and industrial grades of wastepaper, turning it into high-value materials for BP mills or for sale on the open market.

Orchid Paper Company of Pryor produces up to 56,000 tons of paper goods every year from recycled fiber. One of Orchid Paper's products is the Made In Oklahoma (MIO) Paper Towels. These paper towels represent a win-win-win for Oklahoma. Waste is diverted from the landfill and approximately 300 Oklahomans have jobs thanks to Orchid Paper! Additionally, proceeds from the sale of these paper towels support the Regional Food Bank of Oklahoma's Food for Kids Backpack Program. This program provides a backpack full of food to more than 13,500 hungry Oklahoma school children every week, so they will have food to eat over the weekends and school holidays.

1. **Which natural resource is not an ingredient in manufacturing glass bottles?**
   A. Sand. **B.** Dirt. **C.** Soda Ash. **D.** Limestone

2. **How many years does it take a single aluminum can to decompose?**
   A. 0-40 years. **B.** 80-100 years.
   C. 100-200 years. **D.** 200-500 years.

Do you have the latest and greatest cell phone on the market?

What did you do with your old cell phone? Did you know it could be donated to charity or recycled?

Cell Phone Facts:

- Consumers use an average of six wireless products in their day-to-day lives.
- The average cell phone is replaced (or upgraded) every 18 to 24 months.
- Cell phones contain materials such as lead, and their batteries (lithium-ion) can explode if exposed to direct sunlight or high temperatures that occur in landfills.
- Cell phones in working condition can be donated to the elderly, people with disabilities and shelters for use in emergency situations.
- Cell phones are easily recyclable. Take them to your mobile carrier or drop-off locations at chains such as Best Buy, Radio Shack, Lowe's and Staples.

For resources on Recycling in Oklahoma visit the DEQ Recycling page at *http://www.deq.state.ok.us/lpdnew/recyclingindex.htm*

In June 2012, the number of cell phones in use in the United States was 327,577,529.

The US population in the 2012 census was 313,914,040.

Based on these figures, what percentage of the US population had cell phones as of June 2012?

NEWSPAPERS IN EDUCATION THE OKLAHOMAN

Newspapers for this educational program provided by:

DEQ OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

Lesson 2:

Answers:

1. **Which natural resource is not an ingredient in manufacturing glass bottles?**
   A. Sand *B. Dirt* C. Soda Ash D. Limestone

2. **How many years does it take a single aluminum can to decompose?**
   A. 20–40 years B. 80–100 years C. 100–200 years *D. 200–500 years*

In June 2012, the number of cell phones in use in the United States was 327,577,529. The US population in the 2012 census was 313,914,040 .
Based on these figures, what percentage of the US population had cell phones as of June 2012?

To determine the answer, you take the number of cell phones in the US in 2012 (327,577,529) and divide by the US population in 2012 (313,914,040).

327,577,529/313,914,040 = 1.043526211825377 or 104%.

That means that there were more cell phones in use in the United States (as of June 2012) than people. 104% means there were enough cell phones in use for every man, woman and child (including babies) to have one. Obviously not every person in the US has a cell phone, so why do you think this number is so high? Do you know anyone that has more than one active cell phone?

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It's Your Environment: Protect It!

Lesson Three: Oklahoma's Water

Water Facts

- Earth has an abundance of water, but 97% of the water on earth is salt water in the oceans. The remaining 3% is fresh water but 68.7% of the water is trapped in glaciers.
- Approximately **44 BILLION gallons** of water are used for drinking in the United States **EVERY DAY!**
- The human body is 55-78% water.
- A running toilet can waste up to **200 gallons** of water per day.

Do you hear a drip? All those drips add up fast, 10,000 drips = 1 gallon of water. In the average household, 10 gallons per day is lost to leaks!

Conduct a Drip Scavenger Hunt to track down those water wasters!

1. Take a walk through the whole house, looking and listening as you travel from room to room. Use the list to the right to help you keep tabs as you go.
2. Check the box if you find a drip or a leak.
3. If you find a drip, time how many drips happen in one minute using your watch. Record your findings on the chart. If you find a pipe that is wet, but not dripping, make note of that, too.

If a faucet leaks at the rate of one drip per second, how many gallons of water will it waste in one year?

Which of these activities uses the MOST water per day in the average home?

A. Running the tap while washing dishes
B. Using the garbage disposal
C. A leaky toilet
D. Long Showers

Which of these everyday household items is a water-saving tool?

A. A bucket
B. A clock
C. A broom
D. All of the above

✓	Location of Drip	Drips per minute
	Kitchen	
	Faucet	
	Pipes under the sink	
	Bathroom(s)	
	Faucet	
	Shower	
	Bath Tub	
	Outside	
	Hose/Faucet	
	Sprinklers	

Harvesting the rain

Did you know that 600 gallons of water can be captured for every inch of rain that falls in 1,000 square feet of catchment area?

Did you know that storm water runoff is the leading type of residential non-point source pollution?

During the summer months, it is estimated that 30 percent of household water is used for lawn and garden maintenance. A rain barrel collects water and stores it for those times that you need it most – during the dry summer months. Using rain barrels also helps homeowners lower water bills. Rain is naturally soft and devoid of minerals, chlorine, fluoride, and other harmful chemicals. The chemicals and hard water from many of our municipal water systems can add to chemical imbalances in soil and damage sensitive plants. Water collected from the roofs of houses picks up very little contamination, and is very healthy for plant life.

Rain barrels are becoming increasingly available at local home improvement and gardening centers. With some elbow grease and a few materials you can build your own out of a 35-55 gallon trash can. See the instructions (courtesy of the Cleveland County Conservation District) at *http://www.clevelandcountyconservationdistrict.com/trashcanrainbarrels.pdf*

More information about rain barrels can be found in the DEQ brochure "Rain Barrels and Cisterns. Saving Rain for Thirsty Gardens" at: *http://www.deq.state.ok.us/pubs/wqd/RainBarrels.pdf*

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OKLAHOMA
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Lesson 3:

Answers:

Conduct a Drip Scavenger Hunt to track down those water wasters!
http://www.epa.gov/WaterSense/docs/fixaleak_studentworksheet508.pdf

For more Water Activities for Teachers visit:
http://www.epa.gov/WaterSense/our_water/learn_more.html#tabs-6.

If a faucet leaks at the rate of one drip per second, how many gallons of water will it waste in one year?

*1 drip per second = 1 gallon The faucet is leaking at a rate of 1 drip per second. First determine how many seconds there are in a year. If there are 365 days in a year, 24 hours in a day, 60 minutes in an hour, and 60 seconds in a minute. 365(days in a year) * 24 (hours in a day) * 60 (minutes per hour) * 60 (seconds per minute) = 31,536,000. So there are 31,536,000 seconds in one year. And we are told 10,000 drips = 1 gallon of water. So, 31,536,000/10,000 = 3,153.6 gallons* ***So if a faucet leaks at the rate of one drip per second, it will waste 3,153.6 gallons of water in one year's time.***

Which of these activities uses the MOST water per day in the average home?

A. Running the tap while washing dishes
B. Using the garbage disposal
C. *A leaky toilet*
D. Long Showers

http://www.epa.gov/WaterSense/docs/kidsquiz.pdf

Which of these everyday household items is a water-saving tool?

A. A bucket
B. A clock
C. A broom
D. *All of the above*

http://www.epa.gov/WaterSense/docs/kidsquiz.pdf

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