Water Across Curriculum

A Curriculum Guide for Teachers
Haggerty Museum of Art at Marquette University

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What is water?

It is a colorless, odorless, and tasteless substance, when pure. It can be found in you, around you, and in your food.

It can be used for recreation, meditation, transportation, and inspiration.

It is treasured by some because of the difficulty in acquiring it, yet is squandered by others because of its abundance.

It is the source of all life. It has the power to sustain life, and also the power to end life.

It is used by every living being on Earth every single day.

Water is constantly changing form while replenishing its supply, connecting all life on Earth in its complex web, just as it has for eons.
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1. Introduction

Water is an interesting substance. It is all around us yet we rarely think about it. *Water Across Curriculum* helps answer some basic questions and explain some fundamental facts about our water supply. Using artworks from the Haggerty Museum of Art at Marquette University as inspiration, water facts, discussion questions, and activities are provided for you to use in your classroom in all basic curriculum areas.

Embrace the cross-curricular opportunities presented here. Try something new, or just teach a familiar topic in a different way. By integrating water into different curriculum areas, you will free yourself from the confines of your textbooks and teach your students to think about things in a different way—stepping out of the box.

Discover how to study water in Math through charts and graphs that show water usage; Science through pH testing; Language Arts through literature, poetry, and writing; Technology through the use of online research and webquests; Social Studies and Geography through maps and studies of how other cultures use water; and, of course, Art, Music, and Theater through creative activities.

Don’t be afraid, jump right in. Try some of the activities. If you need extra help or would like to have a museum specialist come to your school, contact Lynne Shumow (414-288-5915) at the Haggerty Museum to request a classroom visit.

2. The Basics

Water is a necessity for all life on Earth. It is present in the atmosphere and is even present inside our bodies. We use it every day in everything we do. Without it, we would die.

Water moves in an endless cycle—changing form continuously through *evaporation*, *condensation*, and *precipitation*—known as the *water cycle*.

Although water covers 70% of the earth’s surface, 97% of that is saltwater and undrinkable. Less than half a percent of all the fresh water on Earth is available to supply Earth’s life-forms with the water they need.


As the population of Earth continues to grow, so does the demand for that limited amount of fresh water. It is our responsibility to keep the water supply clean and available for future generations.
3. What is Water?

Water is such a common substance that we barely notice it. It is around us every day, all the time. We use it for drinking, washing (ourselves, our clothes, and even our homes), recreation, and waste disposal, yet we take it for granted. Many of the products we use every day either contain water or were manufactured using water.

There are many qualities of water which sometimes contradict one another. Water is unique and magical—even a little mysterious. It can be life-giving or destructive, soothing or frightening, powerful or peaceful. It affects everyone every day by its presence, and sometimes by its absence.

Water is a chemical substance known scientifically as dihydrogen monoxide. The formula for water is H$_2$O, which means that two hydrogen (H) atoms and one oxygen (O) atom combine to form one molecule of water.

Water exists in three different states on Earth—solid (ice), liquid (water), and gas (water vapor/steam) all at the same time.

Let’s look at some of the unique characteristics of water.

- Water is a natural resource that is important to all cultures and societies.
- Water flows—water naturally flows downward due to Earth’s gravitational pull, but it can be made to move upward if enough energy is applied.
- Water clings to itself—water molecules are attracted to one another through cohesion.
- Surface tension, or the way water molecules are attracted to each other and form a bond, creates a skinlike barrier between air and the water molecules below.
- Water behaves differently on different surfaces. It is more strongly attracted to some materials than others. For instance, water will form beads or droplets on waxed paper, but will be attracted to and absorbed into paper towel material.
- Water takes up space. Liquid water takes on the shape of its container—it may look different in a tall thin vase, as compared to the same water spilled in a flat puddle, but the volume of the liquid stays the same.
- In nature water is never totally pure.
- Water has weight, and the weight of water is responsible for water pressure (the force that water exerts on other things).
- Water has a density of about 1 gram/ml, so objects which are less dense float in water and objects which are denser will sink in water.
- Some things mix with water and others don’t.
- Water is called a **polar** (like +/- poles of a magnet) compound because it contains oxygen, which holds electrons within a molecule tighter than most other elements.

  ![Water molecule diagram]

  In a water molecule, negative electrons spend more time near the oxygen than the hydrogen. This makes the part of the molecule near the oxygen slightly negative as compared to the rest of the water molecule which is slightly positive. Imagine the water molecule like a little magnet with a one positive end and one negative end. This quality is what makes it easy for water to stick to itself and to other polar substances.


- Solids respond differently when mixed with liquid water. Sugar and salt (which are polar) will dissolve in water. Other substances—such as sand or butter—will not. When substances combine together to form a uniform mixture, they are called a **solution**. Some substances do not stay mixed and will eventually separate after mixing (e.g. vinegar and oil, sand and water). This is called a **suspension**.

- Because water is less dense in its solid state than in its liquid state, ice floats on water. When water solidifies, it forms an open crystalline lattice causing it to take up more volume than the same number of water molecules that randomly tumble together when water is in its liquid form. This is a very unique property because for most other pure substances solids are heavier than liquids.

  ![Solid water-ice diagram]


**Where did water come from?**

According to the **Big Bang Theory**, ten to twenty million years ago the universe was so small, hot, and dense that it exploded. After the explosion, the universe slowly expanded and cooled, during which time galaxies and stars were formed, as well as the basic components of atoms: **protons, electrons, and neutrons**.

**Hydrogen**, the simplest element, was made during the Big Bang, but **oxygen** and most other elements were formed during the star stage when the universe was expanding and cooling. An abundance of hydrogen and oxygen still exist in the universe today suggesting the possibility of liquid water in other areas of the universe. As a matter of fact, astronomers recently discovered a cloud containing about 140 trillion times as
much water as we have in all of our oceans on Earth, but that water is just too far away for us to access it for use here on the earth.

http://www.nasa.gov/topics/universe/features/universe20110722.html

4. Water in Our Bodies—Hygiene and Health

Water is important to all life on Earth. As humans, 50-78% of our bodies are made up of water. Sixty percent of our body’s total water content is contained in the cells and fluids inside the body. Every organ in the body needs water to sustain life. In fact, a person can survive only three to five days without water because when the body is deprived of fluids, the cells and organs begin to break down.

**Hydration** increases the body’s ability to exercise and re-energize. In order to keep your body hydrated, it is important to drink plenty of water. Water is essential to our **metabolism** just as water is essential to the processes of **photosynthesis** and **respiration** in plants. Water also helps keep our body temperature constant. It keeps our skin moist, preventing bacteria from entering the body through the mucous membranes.

Because 78% of your brain is water, any **dehydration** weakens your mental abilities. As headaches are often related to dehydration, drinking water increases hydration, thereby lessening the chance of headaches.

Water is used as a **solvent**, a **lubricant**, and a **vehicle** for moving nutrients through our bodies. A dry body cannot absorb or digest foods. Water carries **immune cells** to where they are needed for fighting disease and infection. It also helps carry waste and impurities out of the body.

Without water, our bones become more susceptible to breaks and infection. The lubricating fluids in the cartilage around the ends of your bones are also decreased without sufficient water, causing friction on your joints and resulting in **arthritis** pain. **Gout** can also result when uric acid crystals caused by dehydration form on the joints.

http://www.thewaterpage.com

Plants also need water for life. Most plants contain 90-95% water. Because plants can’t drink or eat like animals do, they get water from **groundwater**, dew, **irrigation**, or rainfall.

http://thewaterproject.org
Significance of Water on Earth and Access to Lifeforms

While there are areas of the earth that have plenty of water, some areas are severely lacking, making proper *hygiene* and hydration impossible for their inhabitants. Consider that in the developing world as much as 80% of all illnesses are linked to poor water and sanitation conditions. In fact, worldwide, nearly one in every five deaths under the age of five is due to a water-related disease. Every day 14,000 people die because the water they use contains dangerous chemicals or is untreated sewage. Diarrhea caused by dirty water and dirty conditions kills more than one million children a year. [http://www.unicef.org/health/index_51412.html](http://www.unicef.org/health/index_51412.html)

Water access has become a question of survival. Lack of accessible clean water affects every part of daily life. Land cannot be irrigated for lack of water so crops cannot be grown, food is not produced, and there is nothing to trade. Health and nutrition are at risk because sanitation is inadequate.

Water is a commodity. Although enough rainwater falls every day to cover the land in a layer that is thirty-one inches deep, more rain falls in some areas than in others. Sometimes there is just not enough rain. People living in deserts must walk miles every day to get water for themselves, their animals, and their crops. Conversely, when there is too much water there is flooding. Floods can destroy towns and cause the water supply to become dirty, making it easier for diseases to spread. [http://www.watereducation.org/doc.asp?id=1022](http://www.watereducation.org/doc.asp?id=1022)

When water is not available in the home, where do people get their water? Who is responsible for fetching and carrying the water to the home?
Almost two-thirds (64%) of households rely on women (including more girls than boys under the age of fifteen) to get the family’s water when there is no water source in the home. Over half of the developing world’s primary schools do not have access to water or sanitation facilities, and without toilets, girls typically drop out of school at puberty.  
http://www.who.int/water_sanitation?health/whs0404/en

Water usage is higher in the United States than in any other country in the world, but even within America there are some states and regions that don’t have access to enough water for their populations. For example, some coastal regions of Florida are rich in saltwater, but they must have fresh water piped in from inland areas, a problem which can lead to political disputes over control of the water supply.  
http://science.howstuffworks.com/environmental/earth/geophysics/h2o.htm

5. Making a Personal Connection with Water

Water is vital to our physical life, but it also sustains our mental and spiritual lives. Humans respond to water through religion, art, and science to better understand its meaning in our lives and in the life of our Earth. Water connects us all.

Water of sufficient quality and quantity is essential for all living beings on the earth. Managing our water resources is key to providing the future population with social and economic stability in a healthy and sustainable environment.

Because water replenishes all living things and connects us all worldwide, it is the obligation of each individual to accept a personal responsibility for our water resources and make a commitment to conserve and protect our water supply.
Settling near water
Throughout time people have chosen to settle near bodies of water. The first great civilizations appeared alongside water, including the great river cultures of the Nile, the Tigris and Euphrates, the Indus, and the Yangtze. These civilizations owed their success in part to their easy access to water and the expansion of trade that resulted from that access. Islands with safe water ports have also thrived for the same reason.

Access
In areas where water is scarce, access to clean drinking water is a major factor in human development. There are some communities that have been able to find creative ways to cope with their water access problems. Rich countries like Saudi Arabia, for instance, have spent billions of dollars developing plants that convert salt water to fresh water. In Peru where money and water are more scarce, people stretch tarps between the trees to catch the morning dew.

Religion
Long before scientists began to examine its properties, water was already established as the mysterious and sacred source of life, and its importance and symbolism was firmly established in the framework of the world’s religions.

Water, considered a purifier in most religions, is used to physically clean the body as well as to metaphorically wash away impurities and sins. Most major faiths incorporate ritual washing into their ceremonies. Baptism, ablution, and washing before praying are common practices, as are pure water baths for the dead.

Water is often referred to in religious holy books including the Bible and the Qur’an. According to the Bible, “the earth was formed out of water and by water” (2 Peter 3:5). Similarly the Qur’an states that living things are made of water, and in fact, water is used when describing paradise.

Philosophy
The ancient Greeks believed that water was one of the four classical elements: fire, air, earth, and water. Water was regarded as the ylem, or basic substance of the universe.

In the traditional Chinese philosophy of Taoism, water was also one of the five elements: earth, fire, wood, metal, and water. For Taoist philosophers, there is nothing in the world more soft and weak than water, and yet there is nothing better for attacking things that are firm and strong.

Literature
Water is used in literature to symbolize purification. For instance, note the critical importance of the river in William Faulkner’s novel As I Lay Dying and the drowning of Ophelia in Hamlet. Even Sherlock Holmes stated that “from a drop of water, a logician could infer the possibility of an Atlantic or a Niagara without having seen or heard of one or the other.”

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Art
The myriad and sometimes contradictory qualities of water: both life-giving and destructive, powerful and serene, a barrier and a bond between people, make it a fertile subject for fine art.
http://witcombe.sbc.edu/water

6. Water and Food

Irrigation
At least 70% of the water that humans use is for irrigation and agriculture. Irrigation (the artificial watering of farmland) has allowed mankind the ability to have more stable and secure sources of food. Increased production of food and greater diversification of crops resulting from irrigation have improved people’s health and helped to stabilize farm economies. Irrigation continues to be important, especially as the population of the world grows and the demand for food to reliably feed more people grows accordingly.

The more effective methods of irrigation deliver smaller amounts of water directly to, or very close to, the roots of plants through underground or drip irrigation systems. In these well-designed irrigation systems, the water not only helps the plants grow, but much of the water is either evaporated back into the air or returns to the aquifer from which it was pumped. When irrigation systems are not well designed, they can cause oversaturation of the soil.

Although contaminated water should not be used in irrigation systems, it is okay to use slightly used water, or greywater. For many kinds of irrigation applications, this is another way to efficiently reuse nonpotable water.

Sometimes when water is used for irrigation, it is taken away from other purposes, causing changes and even harm to the environment. When water is diverted from rivers and streams upriver, the rivers may eventually run dry before they reach their final destination; for example, the Colorado River does not flow all the way to the sea any longer. With a lower water level in a river the water quality also goes down because there is less water to dilute the contaminates. In some coastal areas where pumping fresh groundwater has lowered the water table, saltwater has crept in to replace the fresh water.
http://www.lenntech.com/water-food-agriculture.htm
When growing plants in your house or garden, how do you know when to water them and how much water they need? What happens to plants that get either too much water or not enough water?

The Food Industry
A large amount of water is used in the food industry—much of it in obvious ways such as a component of food or in cleaning and cooking the food, but much of the water is used in ways we never see or think about.

We can’t talk about water usage in the food industry without discussing the term water footprint. The water footprint of any product is the volume of fresh water used to produce that product, and it usually breaks down into three parts.

1. The blue water footprint is the volume of fresh water that is evaporated from the global surface and groundwater.
2. The green water footprint is the volume of water that evaporates from the global rainwater stored in the soil.
3. The gray water footprint is the volume of polluted water—the volume of water required to dilute pollutants to such an extent that the quality of the surrounding water remains above-agreed water quality standards.
4. The water footprint of any animal product is larger than the water footprint of a wisely chosen agricultural product with equivalent nutritional value.


Consider that the supply chain of an animal product starts with the cultivation of the feed crop and ends with the consumer. In each step of the chain, there is a direct water footprint, which refers to the water consumption in that step, but also an indirect water footprint, which refers to the water consumption in the previous steps. In the production of meat for human consumption, six to twenty times more water is required than for the production of cereals. Although food and drink are big factors in this figure, the water needed to produce feed is the major factor behind the water footprint of animal products; in fact, about 98% of the water footprint of animal products relates to water used to grow feed.

The dairy industry, which uses water in flushing operations; cooling of the product and equipment; washing/rinsing/hosing during processing; and in refrigeration systems and boilers, is one of the most polluting of the food industries in regard to its large water consumption.


Aquaponics
There are some special indoor urban farms with their own built-in irrigation system called aquaponics. The term aquaponics is a combination of the terms aquaculture and hydroponic. There are two main parts to aquaponics: raising aquatic animals and growing plants. In the aquaponics system, fish and other aquatic animals live in a closed tank system where waste from uneaten food or animal fecal matter accumulates in the water. The effluent (waste)-rich water can become toxic to the aquatic animals in
high concentrations, but these effluents are essential nutrients for plant growth. The effluent-rich water trickles down onto the plants, fertilizing them. The plants then clean and filter the water which is returned to the fish environment and the cycle starts over. Aquaponics uses much less space than gardening in dirt. You can set up your system almost anywhere like in your backyard or on your patio, balcony, and even indoors. With aquaponics, you can grow fish and plants at the same time, and you need only feed the fish.
http://en.wikipedia.org/wiki/Aquaponics
http://aquaponicsassociation.org

Aquaponics in Milwaukee
Growing Power is a national nonprofit organization based in Milwaukee that promotes sustainable food systems. Their Milwaukee headquarters includes two aquaponic hoop houses running through the area with fish tanks that provide water and fish waste to help grow a variety of plants. The fish are sold to local restaurants and in ethnic food markets.
http://www.growingpower.org

Sweet Water Organics is an urban fish and vegetable farm located in a former crane factory in Bay View. The building has been converted into an indoor wetland that contains about 80,000 fish that are being raised as a food source in tanks topped by beds of lettuce and other crops.
http://sweetwater-organic.com

7. Water from the Lake to Your Home and Back

Turn on the faucet in your home and water flows out when you need it. You use it, and it goes down the drain—end of story . . . but is it? When you turn on the faucet in your home and water flows out, you are seeing just a small part of the fantastic journey that community water takes in its regular cycle of use. Do you ever wonder where water comes from? Does everyone get water from the same place and in the same way? Why or why not?
Where do we get our water?

All of our water, whether it comes out of a well, a lake, a river, or the sky, has been recycled many times through the water cycle. When precipitation hits the ground, it may stay on the surface and form surface water, such as a lake, river, or stream. The water that soaks into the ground sustains plant and animal life in the soil. Some seeps into underground aquifers (a geologic formation that stores large quantities of groundwater).

The water table is the boundary between where the ground is saturated with water and where the ground is filled with water and air. Groundwater is any water at or below the water table. Most groundwater is held in spaces within sand and gravel deposits. Groundwater is the largest single supply of fresh water available for use.

Water’s Journey

The water in your home has already been on a long, complicated journey before it ever flows out of your faucet, and after the water comes out the journey continues in a never-ending cycle until it ends up right back at your faucet. Let’s explore that journey.

Water is moved to a variety of places where people need to use it. Firemen pump it from fire hydrants, people keep it in their swimming pools in summer, when we turn on the faucet or shower water flows out, it pours into our washing machines and dishwashers, and spurts up out of drinking fountains. It is also pumped through pipes in manufacturing plants where it is used for all sorts of things.

Water gets to these places by first being collected from wells, rivers, cisterns, and lakes. It passes through municipal waterworks operations where it is treated and purified, and then pumped up to a water tower for storage and distribution. After we have finished using the water, it returns to the environment, but not until after again passing through tanks, pipes, pumps, and purifiers at wastewater treatment facilities. So, why do we need to move it to so many places? Because water is used for so many different purposes.

Out of the Faucet and Into (and out of) the Body

When you are thirsty you turn on the faucet. Water flows out into a glass and you drink it. Where does it go? It enters the mouth, goes down the esophagus and into the stomach where it mixes with food that is there. Water then leaves the stomach entering into the first part of the bowel where most of it is absorbed into the bloodstream. The water that is not absorbed into the bloodstream travels through the rest of the bowel until it is finally absorbed into the bloodstream through the bowel wall and becomes the body’s solid waste.

Water then leaves the bloodstream and returns to the cells where it collects cell “waste.” This waste is returned into the bloodstream that goes to the heart. The water circulates through the body until enough “disposal” water in the blood is collected that can be released into the kidneys. The tainted water makes a last stop at the kidneys on the way to the heart to be filtered. Then it goes to the blood filtration section of the kidney, where blood elements remain in the bloodstream and water with impurities are ejected from the bloodstream. That “waste water” collects in the bladder until a sufficient
amount is collected to be efficiently released from the body as urine, and down the toilet it goes.

**Waste Treatment**
After leaving your home, water is directed through sewer pipes (different from those pipes that bring drinking water into your home) to a wastewater treatment plant where it is cleaned by mechanical, biological, and chemical processes and then sent back into the groundwater or surface water. During water's visit to the wastewater treatment plant, microscopic organisms are introduced into the water to help clean it up. These tiny organisms are nature's own way of purifying water. They literally “eat up” and digest organic waste that is in the wastewater. The better the job the microorganisms do, the cleaner the water and the fewer man-made purifiers are needed. It is important to remember that when using toxic cleaners and hazardous wastes in your home you should not put them down the sink drain as these chemicals kill the microorganisms used in cleaning your water and cause the systems to malfunction. From the wastewater treatment plant, Milwaukee water travels through pipes back into Lake Michigan where it is “recycled” back into the natural water cycle.

**Nature and Back to the Tap**
Where does water come from before it gets to the faucet in our homes? In Milwaukee we are lucky to have Lake Michigan as a huge, natural water source. In effect, water is simply detoured from the natural water cycle for our personal use and then returned back to the environment to be used again at a later date. Because Lake Michigan is used for so many purposes other than drinking water, there are impurities and contaminants in “raw” lake water that must be eliminated before it is safe to drink. That’s why there are water treatment facilities. The water is pumped from Lake Michigan, treated and disinfected (if necessary), and then delivered to homes through pipes in a distribution system. It is important to know that clean drinking water comes into our homes through one set of pipes and the dirty wastewater leaves through a different set of pipes.

The chart above and the information that follows describe the basic steps used to make the water from our lakes, streams, rivers, and reservoirs safe to drink. Having an
adequate, clean supply of water in our community ensures that everyone has safe water to drink, businesses have the water necessary for commerce, and that the community has water available for fire protection. 

http://city.milwaukee.gov/water

Source: It is important that the sources we use for our water supply are good and clean and are readily available in an adequate amount.

Treatment: Treatment techniques remove soil and dirt, bacteria, viruses, parasites, and chemical impurities. The steps include coagulation, flocculation, sedimentation, filtration, and disinfection.

- **Coagulation and Flocculation**: Gentle mixing of the water and treatment chemicals causes the impurities and particles to form larger floc particles.
- **Sedimentation**: The particles that are formed through coagulation and flocculation become increasingly larger and eventually settle out of the water in large sedimentation basins.
- **Filtration**: After sedimentation, the clarified water is passed through filters to remove particles of dirt, algae, harmful bacteria, and parasites. Filters can be made from sand, gravel, coal, or granular activated carbon.
- **Disinfection**: Disease-causing bacteria, viruses, and parasites are destroyed by disinfection. Chlorine and compounds containing chlorine are typically used for disinfection purposes. New disinfection technologies may also use ultraviolet light and ozone.
- **Solids Removal**: Solids that settle out of the water are removed to drying lagoons or sludge presses for dewatering.

8. Water: Science and Technology

We use water in many different ways because it has special properties. We never really run out of water, we just make it unusable for reuse before cleaning.

Water is used in industry for power generation (*hydroelectricity*). Hydroelectric power is low cost, non-polluting, and renewable. Energy is supplied by the motion of water. Typically a *dam* is constructed on a river, creating an artificial lake behind it. Water flowing out of the lake is forced through turbines that turn generators creating hydroelectric power.

In industry, water blasting and water jet cutters use pressurized water. Very high-pressure guns are used for precise cutting. This is relatively safe and does not harm the environment. When water absorbs heat, it evaporates and expands as it forms steam that can push steam turbines to produce mechanical or electrical energy.

Water is good at absorbing and transporting heat. In a heat exchanger like a radiator, water can absorb heat from a machine that is working hard and getting hot. Then the water can be pumped away, moving the heat to another spot where it might be used, or where the heat might just radiate out to the environment. If the water absorbs enough heat it can evaporate and carry the heat away without having to be pumped.
Water acts as a **solvent** for many kinds of substances. That is how water helps in cleaning. Dirt, grime, stains, and other things that we want cleaned out of our clothes, or dishes, or off of surfaces, dissolve in water. Once dissolved, we can rinse the water away. The dirt, grime, and stains don’t disappear; they are just carried away with the water. Sometimes we use other chemicals like soap to help make the dirt dissolve better in water.

Water can help transport things from one place to another. For instance, painters use water as a solvent to help transport pigment onto paper, walls, or furniture; then the water can evaporate and leave the pigment where it was painted.

Industry requires clean water for many applications and utilizes a variety of purification techniques both in water supply and discharge. Note that it takes energy to clean water.

### 9. Water and Pollution

**The Source of Water Pollution is us.**

When we think of sources of water pollution, we think of pollution that comes from factories or other industrial sources known as “point source pollution.” Because of laws...
passed in the 1970s, most of those pollution sources have cleaned up their practices and sites. You may be surprised to know that today the biggest source of pollution is us—you and me. Known as “nonpoint source pollution,” this type of pollution can’t be traced to any one source; we don’t know how much pollution is coming from any one source.

Nonpoint pollution that ends up in our waterways includes used oil poured into storm drains, soil washed from construction sites, grease from restaurants, paintbrushes cleaned in the street, or fertilizer and pesticides washed off farm fields and city lawns. Because we are the source, it is important for us to learn how to prevent such pollution. [http://www.watereducation.org/store/itemdetail.asp?id=82](http://www.watereducation.org/store/itemdetail.asp?id=82)

Rivers are constantly threatened by pollution from chemicals used in lawn treatments to farm fertilizers that are washed through the soil by rain and end up in the rivers. Industrial waste is often dumped into our rivers. In the developing world, 90% of all wastewater still goes untreated into local rivers and streams making them natural sewers.

**Water Conservation**
Distribution of the world’s water supply has everything to do with political boundaries, economic development, and wealth. Most of the world’s fresh water is contained in underground aquifers. The rest comes from rainfall, man-made reservoirs, lakes, and rivers.

There are many easy ways to conserve water like brushing your teeth without letting the water run, taking shorter showers, running the dishwasher only when it is full, and keeping drinking water in the refrigerator rather than letting the tap water run until it is cold. For more tips on water conservation in your home, the Environmental Protection Agency website has some great ideas. [http://www.epa.gov](http://www.epa.gov)

**Water Types**
Water that is safe to drink is called potable water, in contrast to safe water, which can be used for bathing or cleaning. It is the small amount of potable and irrigation water that is scarce rather than the actual amount of water on the earth.

In the United States, the Environmental Protection Agency sets maximum levels for the ninety most commonly occurring water contaminants. If something happens to your water supply, your supplier has to contact you to let you know what precautions you should take. Filtration or distillation can make water potable. Nonpotable forms of wastewater generated by humans may be referred to as greywater which means the water is treatable and can easily be made potable again. Fifty to eighty percent of household wastewater is greywater. Blackwater generally contains sewage and other forms of waste which require more treatment to be made reusable. Toilets generate blackwater.

About 1 billion people around the world currently drink unhealthy water. Approximately 5 million deaths a year are caused by polluted drinking water. The World Health
Organization estimates that safe water could prevent 1.4 million child deaths caused by diarrhea every year.  
http://whqlibdoc.who.int/publications/2008/9789241596435_eng.pdf

**Surface Tension and Oil Pollution in Water Supplies**

Compounds with lots of water bind to *hydrophilic* (water-friendly) surfaces because such surfaces have a slight unevenness in their electrical charges. Water beads up on *hydrophobic* (water-repellant) surfaces because the surfaces have no charge. Water would rather merge with itself than try to merge with something that has no charge. Oil, for instance, is beautifully balanced ionically, so oil and water don’t mix.

Although oil and water don’t mix, crude oil does mix with the skin oils groomed into the fur of sea mammals and the feathers of seabirds. The natural skin oil waterproofs *keratinaceous* (horn-like) outgrowths and allows the animal to trap air with its body which acts as an insulator. Crude oil, however, mixes with the skin oils and mats the hair/feathers down flat, eliminating the air space and the insulation. The affected animals try and lick the oil off so they don’t freeze, and then the oil sits in their stomachs. Exxon Mobil is currently conducting research into these effects in case of oil leaks.

**Hydrofracking**

Hydrofracking is the mining process used to extract natural gas from dense shale. It makes mining for natural gas in dense shale more economically possible but at the same time can be a threat to the environment. Hydrofracking uses significantly more water than conventional drilling. It also uses a “slick water” mixture that is pumped into shale to fracture the rock and release the gas. The impact of this process on the environment can be seen in the loss of forest land, groundwater and surface water contamination, and habitat and species disturbance.

10. The Power of Water/Weather

Asako Narahashi  
Japanese, b. 1959  
*Yunohama*, 2004  
Chromogenic color print  
35 1/2 x 55 1/2 in  
90.17 x 140.97 cm  
2010.4  
Museum purchase with funds from Mrs. Martha W. Smith by exchange  
Collection of the Haggerty Museum of Art, Marquette University
**Water’s Power Changes Things**

Water is all around us, and we often think of it as a rather innocuous substance, but it can be a volatile force in our environment and in our lives. For such a simple compound, water can have enormous impact on its environment both through weather and through simple movement. For example, water expands as it cools. In freezing conditions, water has been known to burst water pipes in the process of freezing into ice.

The force of moving water changes many of the earth’s physical features through a process called **erosion**. Erosion runoff creates river valleys and deltas which in turn provide rich soil. Caverns, some as deep as the Grand Canyon, are caused by erosion from moving water. Groundwater passing through porous rock forms geodes. The earth’s landscapes are constantly changing through erosion as a result of the power of rivers, glaciers, and waves.

**Making Hydropower Safer For Rivers**

Hydropower (power caused by moving water) is one of the oldest and most well-established technologies that provide low-emissions alternatives to **fossil-fuel energy** like gas, coal, and oil. In our nation, hydropower accounts for nearly 8.2% of our total electric generation. Hydropower is an important part of our nation’s energy mix. Hydropower is something that should be taken seriously because, when done wrong, it can have enormous impacts on the environment.

http://www.eia.gov/electricity/monthly/index.cfm
11. Vocabulary

- **Agriculture** – The science, art, or practice of cultivating the soil, producing crops, and raising livestock.

- **Aquaponics** – The are two main parts to aquaponics: raising aquatic animals and growing plants. Wastes from uneaten food or fecal matter from fish and other aquatic animals accumulate in the water because it is a closed system where the same water constantly recirculates. The (waste)-rich water can become toxic to the aquatic animals in high concentrations, but these wastes are actually nutrients essential for plant growth so the cycle continues.

- **Aquifer** – An underground layer of water-bearing porous stone, earth, or gravel.

- **Aqueducts** – An artificial channel or large pipe used for bringing water from a distance, also the structure that supports such a channel or pipe. These were common in ancient Rome.

- **Atmosphere** – The atmosphere is the air surrounding the earth.

- **Big Bang Theory** – Most astronomers believe the universe began inside a bubble that was thousands of times smaller than a pinhead. It was extremely hot and dense—so hot that it suddenly exploded and the universe was born.

- **Blackwater** – Blackwater is water used in a household that should not be reused because it contains toxins and/or sewage, but rather should be sent to the sewerage district for filtration.

- **Cistern** – A cistern is a reservoir or tank for storing water.

- **Cohesion** – The sticking together of particles of the same substance.

- **Condensation** – Condensation occurs when a gas is changed into a liquid. It is the opposite of evaporation.

- **Contamination** – The act of poisoning a substance by adding impure or unclean elements to it.

- **Dam** – A dam is a wall built to hold back flowing water.

- **Dehydration** – The act of removing water from a substance or thing.

- **Distillation** – To distill water is to heat it and condense the vapor given off in the process. The water obtained by distilling dirty water is clean and pure because the steam given off contains no impurities.
• **Drip irrigation** – An irrigation system involving the controlled delivery of water directly to individual plants through a network of tubes or pipes.

• **Drought** – Drought is a prolonged period of time in which there is no rain.

• **Electron** – Electrons are particles that surround the nucleus of an atom. Electrons have negative charges.

• **Erosion** – Erosion is a gradual wearing away of soil by wind, water, glaciers, or waves.

• **Evaporation** – This is the process of a liquid changing into a gas or vapor (i.e., when a puddle disappears, the water is actually evaporating into the air and becoming water vapor).

• **Filtration** – Filtration is the act of running something through a filter to purify it. Water goes through a filtration process before we can drink it.

• **Five elements of Chinese culture** – water, earth, wood, metal, fire

• **Fossil fuel energy** – Energy that results from burning any combustible organic material, such as oil, coal, or natural gas, derived from the remains of former life.

• **Four classical elements of the ancient world** – water, air, fire, earth

• **Fresh water** – Water that is free of pollutants and can be drunk without fear of illness.

• **Glacier** – A glacier is a huge mass of ice formed from snow on the ground wherever winter snowfall exceeds summer melting. It moves slowly down a mountain or in a valley.

• **Greywater** – Greywater is water that is used in a household that can be reused for some purposes, but is not potable/drinkable.

• **Groundwater** – Groundwater is water found under the surface of the ground in the cracks of and between particles of sand, soil, and gravel. It is the water we use for drinking and irrigation.

• **H₂O** – This is the chemical formula for water, also known as *dihydrogen monoxide*.

• **Humidity** – Humidity is the amount of moisture in the air.

• **Hydration** – The act of adding water to a substance or thing.

• **Hydroelectricity** – Hydroelectricity is electricity made from the power of water.
• **Hydrofracking** – A new high-tech way of extracting fossil fuels by blasting vast volumes of water, sand, and chemicals into shale, releasing trapped natural gas.

• **Hydrogen** – Hydrogen is the simplest kind of atom and, in the very earliest days after the Big Bang, hydrogen was the only kind of atom in the new universe.

• **Hydrophilic** – Something that is hydrophilic is literally water loving. It is used to describe chemicals that dissolve in water.

• **Hydrophobic** – Something that is hydrophobic is water fearing. It does not dissolve in, become absorbed by, or mix easily with water.

• **Hydrosphere** – The portion of Earth's surface that is water, including the seas and water in the atmosphere, is known as the hydrosphere.

• **Hygiene** – Hygiene is the science of keeping well. When referring to personal hygiene, it means what a person does to keep him/herself clean and healthy.

• **Immiscible** – Two or more liquid substances that will not mix together to form a single homogeneous substance are immiscible.

• **Immune cells** – Also known as white blood cells, immune cells are part of the body’s immune system that help defend the body against infectious diseases and foreign materials.

• **Irrigation** – The artificial watering of agricultural plants when rain is lacking or deficient.

• **Lubricant** – A substance used to reduce friction between surfaces.

• **Metabolism** - A collection of chemical reactions that take place in the body’s cells converting the food we eat into the energy needed to power the things we do.

• **Miscible** – Things that can dissolve and exist within water amiably aremiscible substances.

• **Molecule** – Molecules are tiny groups of atoms that make up everything in the universe. They are so small they can only be seen under an electron microscope.

• **Mucous membrane** – Mucous membranes are linings in our bodies that are present in cavities that are exposed to the external environment. For example, mucous membranes can be found at places such as the nostrils, eyelids, mouth, and ears. They help control what substances are absorbed into, and secreted out of, our bodies.
• **Natural resource** – A natural resource is a material that comes from the earth and in its raw or “natural” state is of value for one reason or another. A natural resource is not man made and is already on the earth.

• **Neutron** – A tiny element within the nucleus of an atom with a charge of zero.

• **Nonpotable** – Water that has not been examined, properly treated, or approved by appropriate authorities as being safe for consumption. Although not of drinking water quality, it may still be used for other purposes.

• **Non-renewable resource** – A non-renewable resource is a natural resource which cannot be reproduced, grown, generated, or used on a scale which can sustain its consumption rate; once depleted, there is no more available for future needs.

• **Nutrients** – A chemical that an organism needs to live and grow.

• **Oversaturation** – When a solution is more highly concentrated than is normally possible.

• **Oxygen** – A chemical element with symbol O that is an important part of the atmosphere, and is necessary for life on Earth.

• **Photosynthesis** – Photosynthesis is the process plant cells use to make sugar from carbon dioxide and water in the presence of light and chlorophyll.

• **Pollutants** – Pollutants make other things (water) dirty, unclean, and undrinkable.

• **Polar** - A polar molecule has one end with a positive electrical charge and the other end with a negative electrical charge.

• **Potable** – Potable water is drinkable.

• **Precipitation** – Any form of water that falls from the clouds to the earth’s surface (rain, snow, sleet, hail, etc). When the temperature and atmospheric pressure are right, the small droplets of water in clouds form larger droplets and precipitation occurs.

• **Proton** - A positively charged particle within the nucleus of an atom. The number of protons in the nucleus of an atom determines the atomic number of an element, as outlined in the periodic table of the elements.

• **Putrid** – Putrid means rotten/decomposing/decaying.
- **Rainwater harvesting** – Rainwater harvesting is the accumulation and storage of rainwater (usually in some sort of “rain barrel”) for reuse before it reaches the aquifer. Uses include water for gardens, water for livestock, water for irrigation, etc.

- **Refraction** – In physics refraction is the change in direction that occurs when a wave of energy such as light passes from one medium to another of a different density, e.g., from air to water. When light passes through air into water, it is refracted (it changes direction) causing a pencil dipped into the water to look like it is bent.

- **Reservoir** - A natural or artificial place where water is collected and stored for use.

- **Respiration** – Respiration is the act of breathing (inhaling and exhaling).

- **Runoff** – Much of the water that returns to Earth as precipitation runs off the surface of the land, and flows downhill into streams, rivers, ponds, and lakes. This is known as runoff.

- **Sanitary** – Something that is sanitary is free from dirt and filth and considered to be good for your health and helpful in disease prevention.

- **Sanitation** – The process of making things (water) free from dirt and filth and promoting a healthy environment.

- **Sewage** – Sewage is wastewater that passes through the sewers. It contains animal wastes and toxins.

- **Solution** – When two or more elements are mixed together so that they become evenly distributed throughout, a solution results.

- **Solvent** – A solvent is something used to dissolve other substances.

- **Steam turbines** – An engine or motor in which a wheel with blades is made to revolve by the force of steam.

- **Surface tension** – The bond created by molecules at the surface of a liquid.

- **Surface water** – Water found on the surface of continents and islands is referred to as surface water. This surface water can be found in rivers, streams, lakes, springs, and swamps.

- **Suspension** - A mixture in which fine particles are suspended in a fluid where they are supported by buoyancy.
- **Toxins** – Toxins are poisons.
- **Transpiration** – As plants absorb water from the soil, the water moves from the roots through the stems to the leaves. Once the water reaches the leaves, some of it evaporates from the leaves, adding to the amount of water vapor in the air. This process of evaporation through plant leaves is called transpiration.
- **Universal solvent** – A solvent that dissolves everything put into it. This is a common way of describing water, because so many things dissolve in it.
- **Vehicle** - A medium through which something is transmitted, expressed, or accomplished.
- **Virtual water** – Water used in the production of a good or service is called virtual water.
- **Wastewater** – Water that contains sewage. It usually comes from the toilet or another contaminated water source.
- **Water blasting** – In the process of water blasting, a jet of water (with or without sand) is forced out of a fine nozzle under very high pressure. Water blasting uses a tool called a water jet cutter. The process is essentially the same as water erosion found in nature but greatly accelerated and concentrated. This process is used in industries from mining to aerospace.
- **Waterborne disease** – A waterborne disease is exactly that—a disease that is carried and spread from within the water supply due to bacterial impurities in the water.
- **Water cycle/Hydrologic cycle** – The cycle of water from liquid to gas to solid and back again is known as the hydrologic or water cycle. This cycle explains weather and the replenishing of water on the earth.
- **Water footprint** - The total volume of fresh water used to produce the goods and services consumed by the individual or community, or produced by the business.
- **Water intoxication** – Water intoxication and hyponatremia result when a dehydrated person drinks too much water without the accompanying electrolytes. When too much water enters the body’s cells, the tissues swell with the excess fluid. Your cells maintain a specific concentration, so excess water outside the cells (the serum) draws sodium from within the cells out into the serum in an attempt to reestablish the necessary concentration. As more water accumulates,
the serum sodium concentration drops—a condition known as hyponatremia. Both electrolytes and water move across the cell membrane in an effort to balance concentration. Theoretically, cells could swell to the point of bursting. From the cell’s point of view, water intoxication produces the same effects as drowning in fresh water.

- **Water pressure** – The force that water exerts on other things.
- **Water table** - The level below which the ground is completely saturated with water.
- **Water vapor** – Water vapor is the gas form of water that is found in the atmosphere around us.
- **Watershed** – The land area that drains water into a particular lake, river, or ocean.
# 12. List of Images

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13. Helpful Resources

Useful Websites:

  An excellent water resource site with elementary and high school activity sets, downloadable information sheets about water issues around the world, development issue sheets that describe water problems and solutions around the world, and games.

- [http://www.watereducation.org](http://www.watereducation.org)
  Contains a curriculum and activity guide with over 90 interdisciplinary activities for students in K-12. Affordable water products, resource books and games are available for purchase from this site. There is also a Kids Page with activities and information directed to kids of all ages.

- [http://water.usgs.gov/education.html](http://water.usgs.gov/education.html)
  Basic information about water. Site includes an interactive center for schools where you can give opinions and test your water knowledge. Posters, coloring pages, and a glossary of terms are available. Lists of pamphlets, booklets, and other multimedia resources are available for your use simply by request.

- [www.teachengineering.org](http://www.teachengineering.org)
  The Teach Engineering digital library provides teacher-tested, standards-based engineering content for K-12 teachers to use in science and math classrooms. Engineering lessons connect real-world experiences with curricular content already taught in K-12 classrooms. Hands-on, inexpensive, relevant materials and information are available for your use. (675 searchable lessons exist)

- [www.projectwet.org](http://www.projectwet.org)
  Project Wet is a good resource for teachers – training workshops, community water event organizing, worldwide network of educators, water resource professionals, and scientists. Their main concepts are: water connects us all, water for all water users, managing water sustainability, and personal responsibility for water resources.

  As the name suggests – water lesson plans are available on this site.

- [http://www.uwex.edu/erc/eypaw](http://www.uwex.edu/erc/eypaw)
  Educating Young People About Water – Guides and a water curricula database provide assistance for developing a community-based, youth water-education
program. These resources target youth and link educators to key community members to build partnerships to meet common water-education goals.

- **http://www.wetcity.org/resources.htm**
  WET in the City – The WET in the City curricula includes water activities, teacher guides and activities in English and Spanish, and water-testing kits.

  This San Francisco-based site is designed to teach middle school students about water resources in San Francisco and the importance of conservation. It is interdisciplinary and flexible. Fifty-minute presentations are available on different water issues in San Francisco, which can be applied to other geographical locations. Activity sheets, fact sheets, and lesson plans are available.

- **http://static.water.org/pdfs/WPElemCurricFULL.pdf**

- **http://www.respectourwaters.com**
  Respect Our Waters is a local cooperative effort of Sweet Water Organics and Root-Pike WIN to educate everyone on the actions they can take to help improve the quality of area rivers and Lake Michigan. There is a blog about keeping our water clean, daily tips, news, and events in our area.

- **http://sweetwater-organic.com**
  A local aquaponics business in Bay View. Encourages urban farming through use of aquaponics.

- **http://www.kathimitchell.com/water.htm**
  Online water games.

- **http://www.liquidsculpture.com**
  This is a site about an exhibition of water drop art.

- **http://www.huffingtonpost.com/2011/06/22/artist-creates-art-by_pai_n_882370.html**
  A site about an unknown artist who practices the ancient Turkish art of Ebru, also known as paper marbling. Using water as pigment, he creates a piece of art. There is a video that shows his process. First, he deposits drops of blue color to form the background. Next, he creates multicolored circles which he manipulates
into the recognizable shapes of flowers and leaves. Last, he transfers the design he has made onto a piece of paper and sets it out to dry.

- [http://www.tomegan.net/l2tf_text.html](http://www.tomegan.net/l2tf_text.html)
  A water art exhibit with some interesting ideas for activities with water including a hands-on waterwheel section.

- [http://shinichimaruyama.com](http://shinichimaruyama.com)
  A website about a water artist who photographs water and creates artforms.

  This site has images that artist Markus Reugels photographed of water droplets at very high speed. Amazing images!

- [http://www.sfgate.com/cgi-bin/article.cgi?f=/c/a/2012/01/06/CMS51LOIIG.DTL](http://www.sfgate.com/cgi-bin/article.cgi?f=/c/a/2012/01/06/CMS51LOIIG.DTL)
  A website about an artist who uses water issues as inspiration for her cross-stitched paintings on silk.

  This website has information about the water cycle, games, songs, experiments, historical information, quizzes, videos, and online games. Also has an interactive vocabulary and activities and video related to water.

- [http://www.weatherwizkids.com](http://www.weatherwizkids.com)
  This is a website especially for kids to allow them to learn more about the fascinating world of weather. It’s a wonderful educational website for teachers and parents that provides the tools to explain the different types of weather to children. Weather information, games, experiments, jokes, optical illusions, flashcards, lore, and weather instruments.

- [http://www.hobart.k12.in.us/jkousen/Biology/freshwater.html](http://www.hobart.k12.in.us/jkousen/Biology/freshwater.html)
  This is a webquest about fresh water, where it comes from, and how it’s treated.

- [http://www.wateruseitwisely.com/kids](http://www.wateruseitwisely.com/kids)
  This website has activities about water that kids can do in the home.

  This site includes information about water for kids, and activities for them to try.
- [http://ethemes.missouri.edu/themes/1440?locale=en](http://ethemes.missouri.edu/themes/1440?locale=en)
  This is a site about the water cycle with activities and website links.

- [http://www.kidzone.ws/water](http://www.kidzone.ws/water)
  This is an excellent site for kids. It is all about the water cycle in words and images kids can understand. There are coloring and information handouts available about the water cycle, evaporation, condensation, precipitation, and collection in English and in Spanish.

**Good Kids’ Books About Water:**

- *Poop Happened!: A History of the World from the Bottom Up* [Paperback] by Sarah Albee, illustrated by Robert Leighton – gr. 4-8
- *Flush!: The Scoop on Poop Throughout the Ages* by Charise Mericle Harper – gr. 2-4
- *Sewers and Gutters* (Horrible Habitats) by Sharon Katz Cooper – ages 7 & up
- *Do You Know Where Your Water Has Been?: The Disgusting Story Behind What You’re Drinking* (Edge Books: Sanitation Investigation) by Kelly Regan Barnhill – ages 8 & up
- *Sewers and the Rats That Love Them: The Disgusting Story Behind Where It All Goes* (Edge Books: Sanitation Investigation) by Kelly Regan Barnhill – ages 8 & up
- *Canals and Aqueducts* (Smart Structures) by Julie Richards – ages 8 & up
- *Garbage, Waste, Dumps, and You: The Disgusting Story Behind What We Leave Behind* (Edge Books: Sanitation Investigation) by Connie C. Miller – ages 8 & up
- *Mud* by Mary Lyn Ray, illustrated by Lauren Stringer – ages 4 & up
- *Mud Puddle* by Robert N. Munsch, illustrated by Sami Suomalainen – ages 4-7
- *A Drop Of Water: A Book of Science and Wonder* by Walter Wick – ages 7 & up
- *Paddle-to-the-Sea* (Sandpiper Books) by Holling C. Holling – gr. 3-5
- *The Water Cycle: Evaporation, Condensation & Erosion* by Rebecca Harman – ages 8 & up
- *A Long Walk to Water: Based on a True Story* by Linda Sue Park – gr. 5-8
- *Why Should I Save Water?* by Jen Green, illustrated by Mike Gordon – ages 4-8
- *One Well: The Story of Water* on Earth (CitizenKid) by Rochelle Strauss, illustrated by Rosemary Woods – gr. 4-6
- *How to Cross a Pond: Poems About Water* by Marilyn Singer, illustrated by Meilo So – ages 8 & up
14. MPS LEARNING TARGETS

ART

GRADE 1
- Participate in class discussions about art.
- Analyze how mood is created in art; for example, they will contrast the mood of dark blue to that of bright yellow.

GRADE 2
- Develop skill in using pencil, paint, crayon, and printmaking tools.
- Identify emotions that we may feel when looking at certain works of art.
- Identify red, orange and yellow as warm colors and blue, purple and green as cool colors.
- Discuss how art is affected by color.

GRADE 3
- Distinguish between realistic art and art that is abstract or not resembling real objects.
- Create an abstract work of art.
- Develop skill in realistic drawing.
- Create a self-portrait and analyze its mood.
- Understand how angles and point of view are used to give a work of art a distorted perspective, particularly in photography.

GRADE 4
- Discuss design in art and architecture; for example, distinguish between modern and classical design in buildings.
- Work with watercolor paints, prints, and clay.
- Begin to understand how to use color to give artwork depth.
- Identify shapes that have no defined form as free-form shapes.
- Identify and discuss the use of contrast in artwork; for example, explain the effect of contrasting colors in a painting or contrasting textures in weaving.
- Understand the use of color and light in Impressionist paintings. Observe that using small areas of color can combine to create illusions of light and dark.

GRADE 5
- Understand how perspective (the angle from which the art is created or viewed) is used in artwork.
- Demonstrate problem-solving skills when working on art projects.

GRADE 6
- Identify elements of art and design, such as color, shape, and texture.
- Identify principles of art and design, such as how light and dark affect color, how texture provides depth, etc.
- Create a portrait that communicates the characteristics of an individual.
- Discuss how artistic works show us life in the past.
- Create the same image in two different mediums; for example, use watercolor and pencil to portray the same scene. Discuss the differences.
- Understand that art begins with an idea.
- Discuss the role of the artist in other societies and cultures, and the type of art created.
GRADE 7
- Identify elements of art and design, such as color, shape, and texture.
- Identify principles of art and design, such as how light and dark affect color, how texture provides depth, etc.
- Create a portrait that communicates the characteristics of an individual.
- Discuss how artistic works show us life in the past.
- Discuss the role of the artist in other societies and cultures, and the type of art created.

GRADE 8
- Identify elements of art and design, such as color, shape, and texture.
- Identify principles of art and design, such as how light and dark affect color, how texture provides depth, etc.
- Create a portrait that communicates the characteristics of an individual.
- Discuss how artistic works show us life in the past.

LANGUAGE ARTS
GRADE 1
- Write basic sentences on a topic for different audiences and purposes.
- Write various drafts on a topic.
- Write sentences using words, capital letters at the beginning of sentences and punctuation marks (., ?, !) to express ideas.
- Verbally express ideas that make sense.
- Be able to find word parts (root words) and use dictionaries/glossaries to increase knowledge of word meanings.
- Ask questions and use resources such as dictionaries and encyclopedias to answer questions, and gather and share information.

GRADE 2
- Demonstrate that the spread of disease can be stopped by healthy habits, such as washing hands and using tissues.
- Give an example of how the choices one person makes may affect everyone’s health or safety.
- Describe how decisions people make affect their health; for example, deciding to eat less candy keeps their teeth healthier.
- Create and improve a piece of writing through multiple drafts.
- Write complete sentences that contain subjects and predicates.
- Write in complete sentences organized around a topic. Write for different purposes; for example, to entertain and to provide information.
- Face the audience, maintain eye contact, and speak clearly to express information.
- Participate in class discussions. Show respect for the ideas of others. Ask thoughtful questions.
- Use dictionaries, glossaries, thesauruses, word walls, and literature to develop vocabulary.
- Use resources to create and answer questions. Organize and share research information with others.
- Use computers to find, communicate, and save information.
GRADE 3
- Research topics using computer resources and the Internet.
- Write a variety of well-organized paragraphs that contain main ideas and details.
- Improve writing by revising and editing; for example, choosing specific words and applying the rules of proper grammar, spelling, and punctuation.
- Use standard American English to communicate ideas in writing.
- Face the audience, maintain eye contact, and speak clearly to express information.
- Listen to gain information and connect it to what they already know. Use information to make predictions and draw conclusions.
- Participate in class discussions by asking and answering questions related to the topic.
- Use a dictionary and thesaurus to locate correct definitions, find words with similar meanings, spell words correctly, and apply the rules of standard American English.
- Use a variety of appropriate resources to research a topic; share the information with others orally and in writing.

GRADE 4
- Listen, connect, and compare what is being heard to what is already known.
- Develop words and phrases. Identify and use common figures of speech such as, “It’s raining cats and dogs.”
- Use e-mail and the Internet.
- Research a topic using many sources of information. Organize the information to communicate with others.
- Participate in group discussions by asking questions and responding to others.

GRADE 5
- Present organized oral reports to the class.
- Identify and evaluate key points from a story, report or discussion.
- Participate in class discussions. Ask questions and respond to information respectfully and thoughtfully.
- Be able to inform, explain, and persuade an audience in an oral presentation that uses different sources of information.
- Use a computer to prepare reports using programs that both word process and illustrate. Use e-mail.
- Find and use resources to research a topic. Organize the information to communicate with others. Note the source of information correctly.
- Apply the writing process. Use revision strategies to revise writing.

GRADE 6
- Use effective oral-presentation skills, such as organizing notes, speaking clearly, and restating ideas as a summary.
- Restate a speaker’s ideas by taking notes.
- Support ideas by identifying important points, stating evidence, and giving helpful feedback.
- Use a computer to locate, organize, and share information.
- Write a research paper that includes a summary of the research findings.
- Use a variety of graphs to represent collected data. Summarize the data and graphs using mathematical vocabulary.
- Gather data from experiments. Predict, analyze, and justify outcomes using probability.
- Analyze and describe how two sets of data are related to each other by using tables, graphs, and equations.

GRADE 7
- Use a computer to find specific information.
- Write a research paper giving sources of information, and including graphs and charts.

GRADE 8
- Participate in large- and small-group discussions, respecting the ideas of others and keeping an open mind.
- Use a computer to access information for different purposes.
- Produce a well-written research paper.

MATH
GRADE 1
- Pose questions, collect data, and organize the information to answer questions about themselves and their world.

GRADE 2
- Estimate and measure using a ruler and other measurement tools.
- Make comparisons in size between two objects. Ask questions, collect data, and organize information on a graph or chart.
- Discuss the data and draw conclusions. For example, graph and discuss the number of hours each classmate watches TV in a week.

GRADE 3
- Use, read, and interpret measuring tools in both the metric and the commonly used U.S. system of measurement.
- Discuss the data (range, data groupings), draw conclusions from graphs and charts, and relate this to the data question.
- Discuss probability, meaning the chance that something can happen in everyday life, using terms such as certain, impossible, and equally likely.

GRADE 4
- Use strategies in real-world situations to solve multiplication and division problems that have factors 1 through 9.
- Determine appropriate units of measurement, liquid capacity, volume, time, and temperature in both the U.S. and metric systems, including finding the area and perimeter of an object.
- Make and compare predictions to the results of experiments; for example, the likelihood of a coin landing on heads or a spinner landing on green.

GRADE 5
- Draw and build two- and three-dimensional representations of the same shape.

GRADE 6
- Use a variety of graphs to represent collected data. Summarize the data into graphs using mathematical vocabulary.
- Gather data from experiments. Predict, analyze, and justify outcomes and probability.
- Analyze and describe how two sets of data are related to each other by using tables, graphs, and equations.
GRADE 7
- Enlarge and shrink plane figures using appropriate scale factors in real-world problems; for example, draw a building’s floor plan given a scale factor and summarize data from the drawing.

GRADE 8
- Organize, display, compare, and interpret data in a variety of ways in mathematical and real-world contexts. Use reasoning and logic to formulate questions, pose problems, and make conjectures from organized and displayed data using the mean, median, mode, and range.

READING
GRADE 1
- Recall and state main ideas from nonfiction material.
- Use nonfiction books to research new information. Connect information to what they already know.

GRADE 2
- Analyze and state main ideas from nonfiction material.
- Use nonfiction books to research new information and connect it to what they already know.

GRADE 3
- Analyze and summarize main ideas and key points in works of nonfiction. Read to gain knowledge of the world.
- Use nonfiction books to research new information and connect it to what they already know.

GRADE 4
- Select a variety of reading materials to read for information and enjoyment. Analyze and summarize the main ideas and key points in different types of reading materials, including informational texts. Connect what is learned to their life experience.
- Identify a topic of interest to research using a variety of resources. Summarize key points and connect them to previous knowledge.

GRADE 5
- Use a variety of reading strategies to analyze and interpret what is being read; for example, infer the author’s purpose, point of view or message.
- Read aloud with fluency, accuracy, and expression.
- Select a variety of reading materials to read for information and enjoyment.
- Analyze and paraphrase the main ideas and key points in different types of reading materials, including informational texts. Connect what is learned to their life experience.
- Identify a topic of interest. Use multiple resources to research and gain information. Summarize key points and connect them to previous knowledge.

GRADE 6
- Select a variety of reading materials to read for information and enjoyment.
- Research a variety of topics in informational texts and analyze what is read. Make generalizations about the topic.

GRADE 7
- Select a variety of reading materials to read for information and enjoyment.
- Identify and summarize the main ideas and key points to analyze common themes from a variety of cultures, both oral and written.
- Determine whether research from different sources is valuable and accurate. Summarize, interpret, and make generalizations about the information.

GRADE 8
- Select a variety of reading materials to read for information and enjoyment.
- Identify and discuss the main ideas and key points to analyze common themes from a variety of cultures, both written and oral.
- Using different types of documents, compare and contrast the information found in them to learn about a topic. Analyze the sources of information and make generalizations about the topic.

SCIENCE
GRADE 1
- Conduct simple science investigations using simple tools.
- Identify properties of objects, such as solids dissolving in liquids.

GRADE 2
- Ask and answer questions using scientific methods and vocabulary.
- Explore sound and magnetism.
- Explore motion and how it is linked to the position of objects; for example, observe the distance a ball moves by kicking it gently and hard.
- Explore how science and technology change their lives.

GRADE 3
- Demonstrate how the parts of a system interact to produce change. Construct sketches to explain ideas and models.
- Investigate the properties of objects and materials; for example, observe how putty and clay bend.
- Investigate changes in the position and motion of objects; for example, explain what happens when a bicycle pedal is pushed.
- Describe changes in the environment. Tell how the availability of resources affects populations.

GRADE 4
- Observe order, system, and organization in science. Observe consistency and change.
- Begin interpreting scientific investigations using a variety of methods and tools. Learn to use books and other resources to answer their questions about science.
- Investigate electricity in addition to light, sound, heat, and magnetism.
- Interpret changes in the earth and sky; for example, describe how rain causes soil erosion.
- Investigate interaction between different organisms that share the environment; for example, explain the relationship between predator and prey.
- Explore how science and technology affect our lives.

GRADE 5
- Use a variety of methods to observe and record their scientific work. These include models, graphs, maps, and charts. Be able to interpret investigations.
• Identify different types of scientists. Describe important scientific events. Identify how science has improved society.
• Present scientific questions, and plan and conduct investigations to answer them. Use resources. Record procedures and communicate results.
• Explore how light is absorbed by, reflected by, or bounces off objects. Observe how sound travels through objects or is absorbed by them.
• Identify the features and structure of the earth and how it was formed. Create a model of the solar system and place Earth in it. Tell how fossils are used in scientific study.

GRADE 6
• Describe important scientific events. Identify how science has improved society.
• Conduct scientific investigations. Pose questions and make predictions from results. Record results accurately and write reports.
• Explain how matter changes. Explore concepts of solubility, boiling point, and density. Connect heat energy to the different states of matter—gas, liquid, solid. Know that matter is made up of atoms.
• Describe how forces such as weather and geological movement change the surface of the earth. Distinguish between forces that change things quickly, such as volcanic action; and slowly, such as gravity. Describe the water cycle.
• Discuss the relationship between science and technology. Design a simple technology that solves a problem. Find examples of how technology is used to solve problems.

GRADE 7
• Connect scientific themes to the natural and designed world. Use models to represent the rate (slow/quick) and scale (big/small) of processes, such as the acceleration and deceleration of a roller coaster.
• Describe important scientific events. Identify how science has improved society. Give examples of technology and discoveries that changed our lives.
• Pose questions, predict outcomes, and investigate using scientific methods. Record and analyze results. Apply other scientific study to the investigation.
• Compare and contrast different types of energy. Trace the energy of a simple household appliance back to the sun. Examine the source of energy and the hazards of commercial energy production.
• Detail how the earth has changed over millions of years. Describe the parts of the earth’s atmosphere. Investigate weather changes.
• Investigate how an increase or decrease in the population of an organism can affect other organisms and the natural system they share. Discuss theories of extinction.
• Examine scientific topics in the media.
• Design a solution to a local environmental problem. Research how scientific discoveries have been applied to new technology. Research and discuss environmental issues of national and global importance.

GRADE 8
• Connect scientific themes to the natural and designed world. Explore different physical and living systems. Identify cycles and their changes.
• Describe how scientists conduct and record research. Give an example of a scientific study where scientists disagree on the results. Research the contribution of other cultures, both ancient and modern, to science.
• Refine research skills. Record, review, and analyze the results of scientific study.
• Discuss how information on the history of Earth is gathered.
• Explain how the structures and functions of the human body systems work together.
  Examine cellular structure and explain cell specialization.

SOCIAL STUDIES
GRADE 1
• Use words related to a map, map key, and globe to identify major features, such as land
  masses and bodies of water, and the directions of east, west, north, and south. Explore
  how people adapt to the seasons, climate, and natural resources to meet basic needs.
GRADE 2
• Explore and describe the community around them, and how physical and human
  processes affect the land and living things. Use and construct simple maps of the school
  and neighborhood.
• Identify and interpret past and present contributions of people, places, and things within
  their community. Use timelines and graphic organizers to show personal and community
  events in the order in which they happened.
• Recognize how the existence of scarcity versus limited productive resources means
  people must make economic choices. Describe the role of money, credit, banking and
  saving, resources and products, goods and services, and careers.
• Investigate and explain similarities and differences in the ways that cultures meet human
  needs and the contributions made by individuals within each culture.
GRADE 3
• Give examples of how a community’s climate, location, and resources affect the way
  people live and the choices they make as they interact with their environment. Create
  mental maps and use graphs, charts, and other graphic organizers to gather information
  about their city.
• Identify the people, and the historical and cultural events that led to the development of
  Milwaukee and communities around the world. Identify examples of freedom and justice
  in Milwaukee’s history. Predict social changes.
GRADE 4
• Identify latitude, longitude, equator, hemispheres, grid, key, and scale on maps and
  globes. Develop a mental map of Wisconsin and the United States. Describe the
  movement of people, ideas, and goods within Wisconsin and across regions. Explain
  how people adapt to their environment, as well as use natural resources.
• Show how Wisconsin’s historical and cultural events relate to those of the nation. Identify
  what brought people to settle in Wisconsin. Identify events that led to the settlement of
  the nation and state. Explain the history and culture of the American Indian nations in
  Wisconsin.
• Describe a region’s economic specialization, markets, use of productive resources, and
  goods and services. Identify and locate resources and products within the state.
  Understand how supply and demand determine prices and how prices affect personal
  economic decisions.
GRADE 5
- Develop a mental map of the United States and its regions. Describe the reasons for continual movement of people, goods, and ideas. Give examples of ways people interact with and change the environment. Explain the cause and effects of immigration and migration.
- Explain supply and demand and its influence on U.S. exploration, development, and global interdependence. Explain how inventions, innovations, and market systems encourage economic development. Identify and locate resources and products within the United States.
- Describe ways in which various cultures influence the daily lives of people. Cite examples of contributions made by cultural, ethnic, and racial groups. Recognize the importance of multiple viewpoints. Describe the values and beliefs of different groups and institutions. Identify examples of bias and prejudice and how they contribute to conflict in society.

GRADE 6
- Describe how geographic factors influenced historical events, patterns of change, and daily life of various ancient civilizations. Explain where and how cities develop. Use different kinds of maps and geographic resources, such as climate and population maps.
- Make a timeline of important events of an ancient and medieval civilization. Identify how ancient civilizations affect the present. Explain and describe how language, literature, the arts, and artifacts demonstrate beliefs and values, and contribute to cultures.
- Describe how cultures of ancient and medieval civilizations are reflected in their literature, religion, music, art, and architecture. Describe political and social structures. Demonstrate understanding of how issues and behaviors are viewed in different societies.

GRADE 7
- Use and construct maps and other tools to collect, analyze, and interpret data and locate modern geographic sites. Explore global issues, such as resource allocation, pollution, environmental quality, security, and economic development.

GRADE 8
- Identify basic characteristics of a market economy including products, property, competition, profit, voluntary trade, and limited role of government. Explain the economic factors leading to the European settlement of the Americas. Describe how investment in people and equipment improves the quality of life. Describe how personal investing has a personal as well as social benefit.
- Discuss why it is important to examine a number of views on social issues. Give historical examples of how beliefs about how people should live lead to conflict. Make connections and look for patterns that lead to an understanding of the complexity of social issues.

MUSIC
GRADE 1
- Create and sing simple song verses.
- Dramatize songs.
GRADE 2
- Compose music to fit a read passage, such as a poem. Write the music by using pictures, such as a cymbal, to represent an explosion.
- Demonstrate how music can be used to teach and learn.

HEALTH
GRADE 3
- Recognize environmental pollution. Point out an example of pollution and help to clean it up; for example, children may pick up litter outside the school.

GRADE 4
- Describe the different systems of the body, including circulation, respiration, digestion, etc.
- Tell how decisions they make can affect their health; for example, explain how decisions about what they eat affect their overall health.
- Tell how to assist others in an emergency.
- Explain how healthy eating and physical activity affects the body.

GRADE 5
- Describe how pollution affects our natural resources and the health of our community; for example, explain how farm runoff can lead to bacteria in our drinking water.

PHYSICAL EDUCATION
GRADE 5
- Understand the importance of physical activity and healthy food choices in maintaining good health.
15. List of Websites

- http://www.watereducation.org
- http://www.eia.gov/electricity/monthly/index.cfm
- www.teachengineering.org
- www.projectwet.org
- http://www.uwex.edu/erc/eypaw
- http://www.wef.org/PublicInformation/page.aspx?id=143
- http://www.wetcity.org/resources.htm
- http://static.water.org/pdfs/WPElemCurricFULL.pdf
- http://www.respectourwaters.com
- http://www.sweetwater-organic.com
- http://www.kathimitchell.com/water.htm
- http://www.liquidsculpture.com
- http://www.tomegan.net/l2tf_text.html
- http://shinichimaruyama.com
- http://www.sfgate.com/cgi-bin/article.cgi?f=/c/a/2012/01/06/CMS51LOIIG.DTL
- http://www.hobart.k12.in.us/jkousen/Biology/freshwater.html
- http://www.wateruseitwisely.com/kids
- http://ethemes.missouri.edu/themes/1440?locale=en
- http://www.kidzone.ws/water
- http://www.thewaterpage.com
- http://dx.doi.org/10.2527/af.2012-0038
• http://en.wikipedia.org/wiki/Aquaponics
• http://aquaponicsassociation.org
• http://www.facebook.com/tapthatvc
• http://thewaterproject.org/water_stats.asp
• http://www.watereducation.org/store/itemdetail.asp?id=82
• http://science.howstuffworks.com/environmental/earth/geophysics/h2o.htm
• http://www.epa.gov
• http://www.marietta.edu/~mcshaffd/aquatic/sextant/physics.htm
• http://intheworldhistory.blogspot.com
• http://www.watereducation.org/doc.asp?id=1022
• http://www.americanrivers.org/initiatives/dams/hydropower/?gclid=CMzg84r4zLMCFQpgMgodUX4Aow
• http://www.nasa.gov/topics/universe/features/universe20110722.html
• http://www.unicef.org/health/index_51412.html
• www.wssinfo.org
• http://www.who.int/water_sanitation_health/wsh0404/en
• http://witcombe.sbc.edu/water
• http://www.growingpower.org
• http://www.weatherwizkids.com