Acknowledgements

Appreciation is extended to:

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RECIPE FOR A FIRE

SUBJECTS: Science, Mathematics, Health, Physical Education

GRADES: 4-8

DURATION: One class period of 30-45 minutes

GROUP SIZE: One class of 25-30 students (or less)

SETTING: Outdoors or in a gymnasium

KEY VOCABULARY: Heat, fuel, oxygen, fire triangle, firefighters

ANTICIPATORY SET: Can anyone tell me what is needed to build a fire? Today we are going to discuss the recipe for a successful fire

OBJECTIVES: The students will be able to define what makes up the Fire Triangle.

MATERIALS: Necklace Cards (provided in lesson) and string

BACKGROUND: Fire! Whether it is a cozy warm fireplace or towering flames 200 feet tall and a mile wide consuming a forest, all fire is essentially the same. Fire is a chemical reaction.

A more technical explanation is that fire is the naturally occurring companion of energy release in the form of heat and light when oxygen combines with a combustible, or burnable, material at a suitably high temperature. For simplicity's sake, you can call the combustible material fuel, and suitably high temperature heat. Oxygen of course is one of the ingredients in the air we breathe.

Fuel, heat and oxygen are all needed in the right combination to produce fire. These three in combination are called the fire triangle. We all know that a triangle has three sides and if one side is taken away the triangle cannot support itself. The same is true of fire. Take away any one of these three – fuel, heat or oxygen – and the fire is extinguished. Firefighters have studied the chemistry of fire and know if they remove just one of these components a fire cannot burn. The goal of a firefighter is to do just that – remove one the three main ingredients in the recipe of fire. For example, when a line is dug around a fire, fuel is removed. When water is sprayed on a building or dropped on a forest fire, it reduces the heat. Fire retardant (that bright, orange-red, soupy substance dropped from planes that we see on the news during fire season) coats fuels and blocks them from oxygen. If we think of fighting fire as a means of breaking the fire triangle, then it is easier to understand why firefighters do what they do.

Fire needs at least 16% oxygen (our atmosphere has 21%) to survive. If there is a steady supply of oxygen, fuel and temperature become critical in sustaining a fire once it is ignited. (The majority of our western wildland fires begin with a lightning strike. Did you know that on a typical day the Earth receives approximately 8 million lightning strikes?) The connection of fuel and temperature is unmistakable – the more fuel, the more intense the heat. The more intense the heat, the faster the fire spreads. When there is an abundance of heat and fuel, fires begin to take on a life of their own. If a fire is large enough it is capable of creating its own weather. Winds can increase to as much as 120 miles per hour, thus supplying more oxygen. High temperatures in a large fire heat whatever lies in its path and prepare these fuels to
Recipe for a Fire

burn more rapidly. When a fire reaches this stage there is little that man can do. Nature is the dominating force in such fires and only rain or snow can extinguish a blaze of this magnitude.

We have all seen the nightly news showing fire jumping from one tree to another. Did you know that technically these trees are not really on fire? It is not the forest that is burning. The fuel is actually turning into a gas. It is the gas that burns. The next time you light a fire in your fireplace look at the logs. If you look closely you can see a space between the log and the flame. There is little oxygen on the surface of the log. The gases made by the chemical reaction when heat is applied to the fuel need to rise slightly to mix with oxygen in order to burn. The same process is taking place when fireballs of flame explode several feet above a tree.

Understanding the fire triangle is critical in understanding why certain actions are taken, especially in a wildland fire. Backfires and prescribed fires (situations where fire is deliberately set to control fuel loads) are methods used by firefighters and are sometimes misunderstood by the general public.

Fire, as it moves, involves a changing situation. Fire itself changes its environment. In essence, in their attempt to suppress a fire the professionals are mixing a recipe in which the ingredients are known but the quantities going in and out of the recipe are constantly changing.

Procedure:

1. Before the activity begins, the teacher will need to make the "necklace" cards found in this lesson. These cards have pictures and are labeled Fire, Heat, Fuel and Oxygen. Glue the cards on a 5"X 8" index card and laminate if possible. With a hole punch or scissors make a small hole on both ends of the card. Pull string through the holes and tie the ends together to make a necklace. The string should be long enough to slip easily over the students' heads.

2. The teacher will designate the appropriate number of students as Fire, Heat, Fuel and Oxygen. Example: A class of 25 students would need two students designated as Fire, five students as Heat, eight students as Fuel and 10 students as oxygen. A larger number of students are designated as oxygen because a fire needs at least 16% oxygen to ignite. The oxygen "necklace cards" are labeled with varying percentages of oxygen.

3. The teacher will need to set boundaries and establish two "home bases" for the students designated as Fire to bring Heat, Fuel, and Oxygen back to.

4. The students designated as Fire need to collect sufficient Fuel, Heat and Oxygen to survive. They do this by tagging a student wearing one of the element cards. Tagged students are led back to "home base" prior to Fire tagging the next required element. Reminder: A fire needs 16% Oxygen to survive.

5. If the students designated as Fire are able to capture sufficient amounts of the Fire Triangle (heat, fuel and oxygen) and bring them back to their home base, the fire survives. If not, the triangle topples and the fire is extinguished.

6. The teacher can repeat the steps as many times as he/she feels is necessary.
Fire

Oxygen - 6%

Fuel
Fuel

Fuel

Fuel
Oxygen - 20%

Oxygen - 10%

Oxygen - 8%
RECIPE FOR A FIRE

CLOSURE: Fire is an element that has been used and feared by man from the beginning. The recipe – Heat, Fuel and Oxygen – is one of the few things in nature that never changes. Fire can be friend, heating our homes in the dead of winter, or foe, destroying what man and nature hold dear.

EVALUATION: The teacher is able to evaluate the students by observing how well they put together the elements to build the Fire Triangle.

EXTENSIONS:

1. The students could invite a guest speaker from a local fire department to discuss the danger of fire and how to prevent fires around or in their homes.

2. Students could bring in newspaper articles about fires that have affected their community.
STOPPING THE FLAMES

SUBJECTS: English/Language Arts, Science, Health, Physical Education, Vocational Studies, Careers

GRADES: 4-8

DURATION: one class period

GROUP SIZE: one class of 25-30 students

SETTING: Outdoors or Indoors

KEY VOCABULARY: Grid, fire, flame, spot fires, firefighter, strategy

ANTICIPATORY SET: When firefighters attempt to contain a wildland fire they use strategies which will help them eliminate fuels and thus stop the spreading flames. Today you will play a version of the oriental game "GO". This game has similar strategies. As you play the game, will your decisions stop the spread of fire or will the fire overtake your area?

OBJECTIVES: To understand the strategy involved in fighting fires and to practice making sound decisions.

MATERIALS:
- For outdoor activity: chalk or flagging tape to mark a grid on the ground; red ribbons (bandanas, lengths of material, etc.) to designate "fire"
- For indoor activity: Checkerboard and 64 small markers (32 red and 32 black paper circles, checkers, small cubes, or colored rocks)

BACKGROUND: Fire can be unpredictable. When fighting fires in wilderness areas, a team of men and women works behind the scenes to watch for changing weather conditions, to procure the best equipment available, and to provide the safest working conditions possible for firefighters. Firefighters themselves must always be on their guard to ensure that they are not trapped by flames. While trying to save natural resources, the first priority of any firefighting team is always the safety of people. Protection of property is the second priority. This was not always the case. During the turn of the century, firefighters made saving trees their first priority, sometimes with disastrous results. One fire changed public opinion and brought about new rules and methods of safety.

It has been estimated that long before the western half of the United States was settled, cyclic fires burned as much as 13 million acres per year. Some of these fires were set by native Indians who wished to maintain prairie and savanna lands for game. Most of these fires were naturally occurring, usually started by lightning strikes on dry fuels.

By the 1850's, early settlers were beginning to populate these western lands. As many of these pioneers were of European descent, they brought with them an attitude of fire suppression. In Europe, fires could destroy already depleted forests, and fires were always put out. However, Europe had a much wetter climate then that found in the western United States, so fires in Europe weren't really a problem. The situation was very different in the drier American west. Settlement and fire suppression eventually resulted in a build-up of forest fuels in the western states.

The summer of 1910 was hot and dry. The newly formed Forest Service had hired thousands of men to fight these lightning strike fires as they were started. By the end of the summer there were more fires than firefighters. Then, on August 20th, hurricane-force winds in Idaho and Montana pushed the previously moderate intensity fires towards each other. The result was a fire so large and so hot that it altered regional weather patterns. A weather forecaster in Denver, Colorado (800 miles away) reported that in only 10 minutes, winds in Denver increased to 42 mph, the temperature changed by 19 degrees and the winds encased his town in smoke from the distant fires!
It was later estimated that the fire burned 4,700 square miles in only two days! The fire was stopped by a very welcomed rain/snow storm.

When the winds came, men were scattered throughout the forests of Idaho and Montana. These men found themselves trapped by flames no matter which direction they rode. The only places they could run for safety were either in mineshafts or by soaking themselves and laying down in streams or rivers. Citizens of small towns lit backfires or fled by train.

Edward Pulaski, who was in charge of 150 firefighters, told one dramatic story. He wrote: "On August 20, a terrific hurricane broke over the mountains... The wind was so strong it lifted men out of their saddles. The smoke and heat became so intense that it was difficult to breathe. Under such conditions, it would have been worse than foolhardy to attempt to fight the fire. I got on my horse and went where I could, gathering my men."

He managed to gather and lead 45 of his men into a mine shaft. Once inside, however, Pulaski was forced to use his six-shooters (guns) to keep his frightened men there! Pulaski stayed up all night keeping the timbers that held the mine up from burning and preventing his men from leaving. Because Pulaski was there to direct and organize his men, they were not among the 78 firefighters who died.

Pulaski later invented a tool that still carries his name. It has an axe on one end and a grubhoe (for digging) on the other. The Pulaski is still used in modern fire line construction!

The fires of 1910 caused drastic changes in Forest Service policy. Because everything had burned and so many people had lost their lives, new policy demanded complete suppression. Every single fire was to be put out by 10:00 AM the next morning. This "10 o'clock rule" remained in effect until forest managers began to realize that fire was an integral part of the forest cycle. Small fires kept fuel levels under control and assisted with reproduction of many plant species. Fires also indirectly helped animals by improving their habitat conditions and increasing food supplies.

By 1968, a new attitude became prevalent. Prescribed burns were a way to retain fire within the wilderness without the destructive properties of a large, hot, out-of-control inferno. Today we realize that fire is a natural and integral part of the landscape. The trick is to balance the need for fire with the need for safety - of both people and property. This lesson looks at ways firefighters can remain safe while battling a large wildland fire.

PROCEDURE:
This activity follows the rules for the oriental game of "Go". In this game, pieces are played on the intersections of any two lines. Do NOT use the open squares. Teachers may find three Internet sites of assistance: www.sentex.net gives simplified instructions on how to teach the game to students

In the classroom, let students practice at one of these two interactive sites: http://playgo.to/interactive/remove.html teaches the game in a step-by-step format

For outdoor play:

Preparation:
- Choose an open space at least 20' by 20'. Draw a grid on the ground containing 9 lines horizontally by 9 lines vertically. Lines should be 30" apart. Divide students into two teams. Give one team red ribbons to wear. This will designate them as flames. Designate one member of this team to be the "Lead Flame". The second team will be the firefighters. Designate one member of this team to be the "Fire Manager". The "Lead Flame" and the "Fire Manager" will control the movement of members of their respective teams.

The Objective:
- The lead flame begins the play by placing one of his resources (a flame) on any intersection of the playing field. This starts a wildland fire. The fire manager wants to contain the fire by surrounding it with four of his firefighters. But if he is not careful, his firefighters may become surrounded by fire! The team with the greatest number of players at the end of the game is the winner.

The Rules:
- Movement around the field must follow the grid lines. Players are placed on and can only stand on the intersection of two lines.
- Fire Managers and Lead Flames alternately bring in one resource at a time from their reserve-pool area and place this resource on any intersection. Fire always goes first.
- New resources brought into play may be placed on any open intersection. Players placed on the grid lines may not be moved until all "reserve" players have been placed.
- Flames or firefighters can be captured if members of the opposite team occupy the four intersections ahead of, behind, to the right, and to the left of the individual. [NOTE: Students located along any edge of the playing field are assumed to be "surrounded" by the opposite team along the open sides of the grid. Thus, students standing on the intersections along the edge of the grid only need to be surrounded on three sides. Students located on a corner only need to be surrounded on two sides.]
- Groups of flames or groups of firefighters can be captured if all intersections surrounding the group are occupied by members of the opposite team.
- Captured students become members of the capturing team and join their reserve group along the sidelines. For example, if a flame is surrounded by firefighters, the encircled flame leaves the grid, removes their red ribbon, and becomes a reserve firefighter.
- Only after all players have been brought in to play can players already on the grid be moved. Players may only move to the next adjacent, open intersection. Players may not cross open squares.
- After a predetermined time, or when there are no plays left, the team with the most players is declared the winner.
The Play:
- The lead flame always begins the game by placing one of his fire players (flames) on the intersection of two lines anywhere on the playing field. This starts a wildland fire. The fire manager tries to block the spread of the wildfire by placing one of his players anywhere on the field. Play alternates between the two team leaders.
- The fire manager must decide whether to position his players around a single flame or around a larger fire (group of flames). To stop a large fire, all open intersections around the block of flames must contain a firefighter. The fire manager must keep an eye on changing fire conditions and be ready to move his/her resources as necessary.
- The Lead Flame has several options. He/she can have their fire spread like a long chain of flames, thus making it harder for the firefighters to contain. He/she can group their blazes in a large circle, thus making it difficult for the firefighters to encircle. Or they can send out single "spot" fires in an attempt to divide the attention of the fire manager and to spread the firefighter resources as thin as possible.
- Firefighter managers try to surround the flames by placing one firefighter on each intersection surrounding the flame. If the fire is large (several flames grouped together), the firefighter manager would need to station one firefighter on every intersection surrounding the larger blaze. But beware, fire may also surround firefighters!
- Both sides try to surround members of the opposite team thus adding them to their own reserve-pool. New players are positioned onto the field by turns until all resources in the reserve pool have been used up. At this point, resources (firefighters and/or flames) may be moved to new locations on the field. Resources can only move one space and only if there is an open intersection next to them.
- Play continues until one side is able to completely surround and eliminate all players from the opposite side, or until a pre-determined amount of time has passed.

For indoors:
- Use a checkerboard. Play is conducted on the intersections of any two lines. Do NOT use the open spaces. Play will alternate between the red and the black side. Red represents the fire and always goes first. Black represents the firefighters.
- Place one red marker at the intersection of two lines. This is the beginnings of a fire. The opposite team places one black marker on the intersection of two lines. This will be the beginnings of their fireline. Play continues as above, however, once played, markers must remain in the original spot and may not be moved.
- The game ends when one team is captured or until there are no moves left on the board.

CLOSURE: Fire can be unpredictable and firefighters must always be alert to ensure their own safety and the safety of homes and businesses. In this activity, were the firefighters able to anticipate the movements of the flames? Were any firefighters taken out of the game? Could this happen in real life?

EVALUATION: The teacher will be able to evaluate student’s ability to think, to respond to changing conditions, to work together as a team, to react to changing conditions during the game, and to play fairly.

EXTENSIONS:
1. How can firefighters stay safe if they are surrounded by fire in the wilderness? Over the years, scientists have worked hard to produce equipment designed to save lives. The most important item a wildland firefighter can carry with him/her is a fire shelter. A firefighter can get inside this lightweight tent of fiberglass and aluminum when there is a danger of becoming trapped by flames. The fire shelter reflects radiant heat and can reduce the deadly 1,000-degree heat given off by a raging wall of flame to a survivable 120 degrees. This cocoon of safety also provides a temporary pocket of breathable air in a fire-entrapment situation. This can mean the difference between life and death. Wildland firefighters practice deploying their fire shelters on a regular basis. While they hope to never need to use one, firefighters would rather be prepared than in trouble!
Allow your students to examine a practice fire shelter from the Fire Box. Allow students to practice deploying a fire shelter. Can they open their shelter, station themselves safely inside, and be ready for a raging fire in 50-seconds or less? Use a stopwatch to time them. Then simulate a strong fire wind by shaking the top of the shelters. Did the tent “blow away” or stay in place? Did the student “survive”? 

STopping the FLAMES
SUBJECTS: English/Language Arts, Science, Social Studies

GRADES: 4-8

DURATION: One 45-60 minute session

GROUP SIZE: One class of 25 - 30 students

SETTING: Indoors

KEY VOCABULARY: Wildland fire, Native Americans, Europeans, buffalo, prairie, savanna, prescribed burn, journal entry

ANTICIPATORY SET: Fire is a word that can bring a wide range of visions to our imaginations – roasting hot dogs and marshmallows around a bonfire, a cozy campfire with friends or family, a wood burning stove on a cold winter night, or a raging forest or house fire seen on the nightly news. Today we are going to talk about how man has used fire to his benefit.

OBJECTIVES: The students will be able to 1) interpret different cultural viewpoints in regard to fire; 2) describe how man's view of fire has changed over time.

MATERIALS: The four journal/article entries found in this lesson, paper, pen or pencil

BACKGROUND: Just a few days after seeing the eastern coast of what is now Virginia, colonists saw "great smokes of fire" rising from deep within the forest. The year was 1607 and upon investigation these early Europeans found that Native Americans inhabiting the area were burning the native grasses. The colonists believed, at the very best, these people were clearing the land for their "plantation". The worst case scenario was they were using the smoke from the fire to signal their forces and attempt to do battle.

What is noted from this historical account by ecologists is the type of fuel the Indians were burning – grass. Grassland in Virginia (and Kentucky) will quickly succeed to forest unless grazed, mowed or burned. Today numerous researchers agree that manmade and natural disturbances assisted in shaping the patchwork of early ecosystems known as the primeval forest.

The majority of wildland fires in the eastern part of the United States are started by humans and probably have been for thousands of years. Lightning fires (which cause 80% of natural fires) are uncommon in these regions.

Evidence of a long, ancient, anthropogenic fire history is found in the Mammoth Cave area through artifacts found...
in the caves. These artifacts are thought to be two to four thousand years old. The items (torches, slippers, etc.) were manufactured from plants that are presently scarce within the park. When found today, the plants grow to such a small size they could no longer be used for torches or other implements. Plants such as false foxglove, goldenrod and rattlesnake master are restricted to savanna and prairie communities, ecosystems largely dependent on fire.

In Mammoth Cave National Park, all the plants gathered by early Native Americans for food (lamb's quarters, sunflower, sumpweed, amaranth, panic grass, maygrass) and for torch material and slippers require more light than is currently available in the forest. Most of these plants require an open savanna or prairie community in order to thrive. This indicates the use of fire by these native people is consistent with practices elsewhere in eastern North America.

The three major groups of Native Americans connected to Kentucky, upon arrival of Europeans, were the Cherokee, Chickasaw and Shawnee. The Shawnee, in particular, claimed the area of Kentucky for a hunting ground and guarded it jealously. This tribe raided the early settlements of Kentucky and did not give up their claims until after the War of 1812.

Although the more ancient groups of Native Americans lived in Kentucky for thousands of years very few of the Cherokee, Chickasaw or Shawnee actually inhabited the area when people of European decent arrived. In the mid-1700s land company representatives gave glowing accounts of the paradise in the west. Following a treaty with the Cherokee and Iroquois in which they ceded to Britain their claims to land in the Ohio Valley, groups such as hunters, explorers, surveyors and land speculators began to push across the mountains into Kentucky. The most noted of the early hunters was Daniel Boone. He later described what he saw:

*The buffalo were more frequent than I have ever seen cattle in the settlements, brouzing on the leaves of cane or cropping the herbage of those extensive plains... Sometimes we saw hundreds in droves, and the numbers about the salt springs were amazing. In the forest, the inhabitants of beasts of every kind natural to America, we practiced hunting with great success.*

- *Adventure of Col. Daniel Boone*

Kentucky was admitted to the union as the fifteenth state in 1792 – the first on the western frontier.

Just as in Daniel Boone's journal, the majority of historical descriptions of Kentucky described areas of prairie vegetation. Again, this indicates that vast regions were burned to accommodate the herds of bison and elk. Small towns, such as Elkton and Buffalo Gap, are other reminders. Barren County, with its historical prairie-like landscape, is so named because the Shawnee regularly burned this area to attract large game into the region.

The prairie and oak savanna ecosystems have all but disappeared in Kentucky, along with the bison and elk. Some reports say that 99.99% of these vast regions are gone and are the most threatened ecosystems in the entire state. In order to restore these communities, Mammoth Cave National Park is using fire as a tool. These communities have become overgrown, often by non-native species of plants and shrubs, and fire is the only means of restoration. This type of fire is called a prescribed burn, very similar to the methods once used by Native Americans and by farmers throughout Kentucky and other states.

The following selections are fictional journal entries, stories and newspaper articles from Joseph Madison (a young pioneer/adventurer), Chief White Eagle (Native American), Hannah Comer (a young wife moving west with her husband) and Amanda Greer (firefighter with the National Park Service). These entries reflect four points of view about fire. The four entries are from different times in history and therefore reflect different personal views toward the subject. The purpose of the activity is to reveal how cultures affect and are affected by a controversial subject such as fire.

**NOTE:** Historically, bison (*Bison bison*) were called buffalo and for these entries the term buffalo will be used. True buffalo, such as cape buffalo or water buffalo, are not native to North America.
PROCEDURE:

1. Divide the class into four groups. Give one journal entry to each group. Ask students in each group to read their entry and summarize, in writing, the information found in the text.

2. Have students research United States and Kentucky history, via the internet or library. Students should investigate the culture of the group represented in their article and determine the views of fire held by that particular group or culture. Ask the students to consider the effect of fire on each group. What effect did the settlers have on the bison and the Native Americans? What was the natural history of the bison and its habitat? How is fire viewed today by someone like the park ranger depicted in the newspaper article or by other people in today's world?

3. Involve the students in a discussion guided by the following questions:
   - What is the main theme of each journal entry? How are they different? What similarities are there in the themes of the four entries?
   - How did each author view the importance of fire? How did the culture of each author influence his or her perceptions? How did fire affect the way of life for each person?
   - Based on your research, do you think the experiences portrayed in the journals/stories/articles accurately portray the people and events of the time? Why or why not? Do you see any biases in their writings?
   - The entries suggest a relationship between the people, the land, sometimes the bison and even the fire. Highlight the sections of the four entries that suggest connections between the four elements. Describe how these elements are interdependent.
   - What lessons about the relationship of people, fire and wildlife could be learned from reading these four journal entries?

CLOSURE: We have looked at a subject that brings out a variety of emotions in people and have seen how man has used something as threatening as fire to actually benefit his life. This lesson has given us an idea of how people lived and worked in the past as well as in current times.

EVALUATION: The teacher will be able to evaluate the students through their participation in class discussions and by reading their written summaries.

EXTENSION: Students could use the same procedures to research a controversial subject that has the potential to affect them and their community.
Entry 1. Excerpts from the journal of Joseph Madison (16 years old)

April 3, 1769. Tomorrow is the big day! I'm so excited I could just bust wide open. I'll be joinin up with Daniel Boone and a few others and finally takin off for the west. I've had enough of Pennsylvania and enough of school. I can read and write and I know all my numbers. My mom died a few months ago and my dad took off. My older brothers and sisters are married and settled down with their own families and have plenty of mouths to feed. So I'm takin off to the wilds of Kentucky!

June 1, 1769. Finally arrived in the wilderness. Sure is different than home. Different in a good way though. As my mom would say it's real pretty. There are huge trees in some places and big areas of open grassland and flowers in others. And the wild game is wonderous to see – elk and buffalo great herds of them. One thing for sure I should never be hungry here like I was sometimes in Pennsylvania.

June 16, 1769. Saw my first Indian today. A group of us were out in the woods huntin and all of a sudden we came upon a group of Indians. I don't know who was more scared us or them. They took off in one direction and we took off in the other. When we got back to camp and told Daniel about this he said we were lucky and not to expect them to always go the other way.

October 15, 1769. It's startin to get a little frosty in the mornins now. When I see the elk and buffalo on these cold mornins you can see their breath when they snort. What a sight. These big animals stompin, snortin, rollin around in the dust. I feel real scrawny when I see how big these animals are close up. Sure are bigger than our old Betsy back home.

October 31, 1769. Woke up this mornin and smelled a strong odor of smoke. Not just the camp fires, something bigger. We all got up and took off from camp to see what was goin on. You wouldn't believe what we saw. A whole group of Indians and they were burnin the grass. What a blaze! Couldn't decide if I should be more scared of the Indians or the fire. Why would they want to burn the grass? Is it a signal to bring in more of their people and attack us? Or are they burnin the grass so they can plant some kind of crop like the farmers back home?

November 13, 1769. I've made a friend of one of the Indians. He's about my age and he has taught me a few of his words and I have taught him some of mine. Daniel said I should be careful. I asked my friend why his people were burnin the grass a few weeks back and he said they do it every few years or I think he meant years. They burn the grass so the trees and other plants don't take over the grassland. If the grass doesn't grow every year then the buffalo and elk will go away and his people will have nothin to eat. He said they only come into the area for a few weeks each year to hunt. Maybe these people are not so dumb after all.

Many years later...

April 3, 1819. I woke up this mornin and realized it has been 50 years since I took my trip west with Daniel Boone and his men. I'm gettin to be an old man, 66 my next birthday. I sometimes still think about those days with Daniel and those adventures and how Kentucky was gettin too crowded for Daniel and some of his men. Moving on to Missouri with him hasn't been so bad but that was enough movin for me. Guess Sarah had something to do with that. She's still real pretty and we have a fine family, seven children and 21 grandchildren so far. Wonder whatever happened to that Indian boy I made friends with. I heard that the Shawnee were finally pushed out of Kentucky and their huntin grounds. Guess it got too crowded for them too. Bet those grasslands are all grown up now. No wonder the buffalo and elk left. Kind of sad when you think about it. My life has turned out pretty good but maybe his didn't. I didn't even know his name.
Entry 2. From the stories of Chief White Eagle (Shawnee Chief, 1830)

Note: Native Americans did not keep journals in the traditional way of people of European decent. Their history was passed orally through stories from one generation to another.

My people have always hunted the buffalo. The buffalo provided everything we needed. Their flesh provided food, their skins clothing and shelter. We wasted nothing because the buffalo was sacred to our people.

One of the happy memories from my childhood was when the boys and men would go out and burn the tall grasses. This was a sight that still lingers in my head. We did not do this every year, only about every third year. Because it was an event that did not happen often made it even more special. The boys in our tribe could hardly sleep the night before a big burn. We would arise on a cool spring or autumn morning and after eating we would leave for the prairie.

The young boys were never allowed to set the fires. Only the quick young braves who had already gone through the ceremonies to become a man were allowed to start the fire. I will never forget how the fire started small but quickly spread faster than a man could run. Another memory is the sound of the wind the fires created and if I close my eyes I can still smell the smoke. All of the young boys like myself looked forward to our time as the ones to start the fires that raced across the prairies.

These fires were set so that the grasses would grow back the next year. Without the fires, trees and small shrubs would grow and after a while the grasses would no longer grow. And if the grasses didn’t grow, the buffalo would not return and our people would be hungry and cold.

The days of the great fires have passed. The white man arrived and after a while there were more of them than there were of our people. They brought their cows and built fences. They didn’t like the fires. They were afraid the fires would burn their houses and barns. Soon our people were forced to leave the land that we loved so much, the land where once hundreds of buffalo and elk provided all our needs. I only got to light the fires two times before we were moved to the reservation. The days of the great fires and of the great buffalo and elk hunts continue only in our stories. My sons will never light the fires or hunt the buffalo.
Entry 3. Excerpts from the journal of Hannah Comer

April 30, 1792. My husband John has decided that we are going to leave our home in Virginia and move to Kentucky. John was a young officer in the Revolutionary War and because he was one of the high ranking officers from Virginia he can receive payment for his services in the form of a land grant. Some officers of his rank received as much as 5,000 acres. And all of the stories he has heard about the abundant wild game has him so excited that he’s ready to go claim his land and see what this untamed west is all about. The untamed part is what makes me nervous.

May 10, 1792. Well, we’re going to do it. We’re moving west. I must say I’m excited but also more than a little scared. John thinks about the wild game and I think about the wild Indians. I also think about leaving my family behind — my mother and father, brothers and sister, aunts and uncles. We have all lived in Virginia all our lives. My oldest brother, George and his wife, Carolyn bought our farm. Their oldest son is getting married soon and he and his new wife will be living in our house and sharing the responsibilities of the tobacco plantation.

May 15, 1792. We’re leaving bright and early in the morning. Everything we own is on pack animals and packed in a couple of small wagons. My brother James is going along with us to help with the wagons and animals. James is not married and says if he really likes what he sees he just might stay in Kentucky. I hope he does, at least there will be one other person besides John that I’ll know in this wilderness.

June 17, 1792. Haven’t had much time to write in my diary since we started our journey. We are now officially in Kentucky and John has claimed his land. It has been decided that John, my brother James, and other men from our party will camp on the land until they can finish our cabin and myself and the other women in our group will stay at the fort. John says there is a nice prairie-like area of several hundred acres where our cabin will be built. The buffalo and elk are plentiful in these grassy places so we should always have plenty of meat. Throughout the prairie there are several stands of trees and our cabin will be near one of these so we will have shade in the summer. There’s also a stream nearby, supplied by a spring, so we should always have plenty of water. Most of the 5,000 acres that John has claimed (and will share with my brother if he decides to stay) is wooded. John said that even though most of the land is forested by oak and hickory trees there are several of these large grassy prairie areas throughout the land. The people at the fort say that these are the areas the Indians have burned for hundreds of years to attract the buffalo. Any kind of talk about Indians makes me really nervous.

July 10, 1792. Our cabin is finished and this is moving day. James has decided he is going to stay in Kentucky. He will live with us until his cabin is finished. He and John plan to go back to Virginia next spring and bring back cows and other farm animals. They will use these large cleared prairies to grow corn and other crops. I may still have time to grow a few things in my vegetable garden. Some of the other women in the area said they would give me some seed but because I am getting them out so late I will probably have to water them real often.

August 1, 1792. We had our first Indian attack a few days ago. I can only now write about it. I guess we knew it was only a matter of time. I will have to say I was scared to death but everything happened so fast that I didn’t have time to think about it until it was all over. Now I find it hard to sleep. We were lucky. John and James were
nearby as well as several other men. They were building a barn so that we would have a place to shelter some of our animals and store their food. It was only a small band of Indians but they looked fierce to me. They were probably hunting and were upset that we are here. Two of our men were wounded, but not badly and some of the Indians were injured as well. I'm sure they'll be back.

August 15, 1792. Life here is hard and sometimes lonely. It would be nice to have another woman to talk to. Now that I'm expecting my first child it would really be nice. At least when the baby is born I will have someone to share my time with, not that there's a lot of spare time with all of the chores. I cook, clean, carry water from the stream, wash clothes for myself, John and James.

September 16, 1792. A lot of things have happened since I last had time to write in my diary. One of the scariest things was a large fire. The grass on the prairie is bone dry at this time of year and catches fire very easily. Late one afternoon, it was almost dark, we began to smell a strong odor of smoke. When looking into the distant hills we began to see flames leaping into the air – the grass was burning and burning quickly. It was headed right toward our house and barn. There was little we could do to stop it and we could see the Indians dancing and yelling like they were having the grandest time. They had set the fire! I had been told that these people burned the grass to attract the buffalo. Didn't they know that this was our land, it was given to us by our government. They no longer had a right to do this. They probably thought they could burn us out and burn the land to bring in the buffalo. Kill two birds with one stone. The fire burned right up to our creek, jumped across it and if our land had not been ploughed would have burned everything we owned and we would have died either from the fire or the Indians. I must say this was the most frightening experience of my life. I can still smell the smoke and hear those Indians screaming with delight. A few days later I lost my baby. Life sure is hard here in Kentucky.

June 23, 1802. After I lost my first child I just didn't have the heart to write in my diary any longer. I would still send letters back home to my family, but just lost interest in my diary. I picked it up today and realized that it has been almost ten years since I last wrote in this little book. I guess it's time to start again. I want my children and grandchildren to know what it was like for me and John in those early days of living on the frontier of Kentucky. We now have four children – two of each – and they are the joy of our lives. After the Battle of Fallen Timbers in 1794 the Indians were pretty much gone from Kentucky. There were a few skirmishes every now and then but we rarely see the Indians around our lands anymore. In many places the prairies they created have started to grow up with cedars, but we still burn our fields to prepare them for the crops we need to grow. Even though I was scared to death of those Indians and of the fires they set I guess they knew what they were doing when they burned those great prairies. It still works for us today. Our fields are fenced and because the prairies have started to disappear the buffalo are no longer as plentiful as they once were. It's hard for me to admit but I kind of miss those great beasts that once roamed so freely through our property. The sounds they made, when they all started to run at the same time and their snorts on those cold winter mornings. If things continue as they are my grandchildren may never see these great herds of animals.
Entry 4. Article written for The Greentree Gazette by Amanda Greer, Fire Fighter, National Park Service. The Greentree Gazette is Amanda’s hometown newspaper.

Greentree, Kentucky - November 12, 2001
When I became a park ranger with the National Park Service five years ago I never dreamed I would one day also be a trained firefighter. I have always had a great love for anything connected to the natural world. This is why I have always wanted to work for the National Park Service.

Most wildland firefighters are like myself. They are employed by another state or federal agency and are called out when needed. You can be sent almost anywhere and are usually there for a maximum of 14 days (or two weeks). You may spend several two-week stints during a fire season, especially if the season is extreme. Most people assume that these types of fires are west of the Mississippi River but that is not always true. Florida also has its share of wildland fire and under the right circumstances almost any area is susceptible to these types of fire.

Being a firefighter is a tough, dirty, hot, dangerous job. Some people say it is the closest thing to hand-to-hand combat without firearms or a human opponent. You have to be in excellent physical condition and a minimum requirement is the ability to hike three miles with a 45-pound pack in less than 45 minutes. Sometimes on steep, smoky mountainsides (or foot searing flat ground) firefighters carry chain saws, lengths of firehose, backpacks full of water, and shovels or “Pulaskis” (a combination ax and hoe). This is in addition to their personal safety gear, which includes a shelter you can crawl into if you find yourself surrounded by advancing fire. The shelter protects you from heat up to 1000 degrees and there is enough oxygen for two minutes. Large fires create their own wind and you have to hold the shelter down. We are trained to break it out in 15 seconds. Thankfully, I have never been placed in a position where I have had to use my shelter but I know other firefighters who have.

A typical day for wildland firefighters begins at approximately 4:45 a.m. when we get out of our tents and get in line for breakfast. The mess hall opens at 5:00 a.m. and if you get there late – no breakfast. After breakfast is a daily briefing beginning at 6:00 a.m. After the briefing we fill our coolers with ice and fluids, pick up our sack lunches, fuel the vehicles, acquire our equipment, and receive our assignments. At 7:00 a.m. sharp we head for the fire line.

Our day usually will run until 7:00 p.m. and occasionally until 9:00 or 10:00 p.m. Firefighters can’t just say it’s six o’clock, time to go home. When we finally return to camp, (after a jolting 1½ hour drive down the mountain) we are filthy, soot stained, tired and hungry. After washing our hands and face our first stop is the mess hall for dinner, then to the showers. Standing in line for these luxuries and sore feet is all a part of the day. By this time that sleeping bag is looking pretty good and 4:45 a.m. will come all too soon.

I have been doing this for three fire seasons (generally April 15 to July 15). You may wonder why someone like myself would actually want to go back year after year to these hot, smoke-filled, dusty, miserable places. The money is certainly not the reason, although with hazardous duty pay and overtime it’s not too bad. There are a number of reasons most of us choose to go back. One is that we actually love what we do and we come to be a very close knit group after being on a fire line for two weeks. We come to depend on each other under all sorts of extreme and dangerous conditions. We function as if our lives depend on it, and they often do. Another great perk of the job is that we are helping people when they most need it. Many of these people are at risk for losing everything. When we leave an area we get waves and thank you signs and offers of food. This inspires you to give a little extra to your job. Anyone who likes to help people couldn’t help but love this job.
HOT HABITATS (CLASSIFIED)

SUBJECTS: English/Language Arts, Science, Health

GRADES: 4-8

DURATION: One class period

GROUP SIZE: One class of 25-30 students

SETTING: Indoors or Outdoors

KEY VOCABULARY: Habitat, niche, deciduous, canopy, propagate, arson, humus layer, prairie, adaptation, serotinous, classified advertisement, savanna, nocturnal

ANTICIPATORY SET: Today we are going to talk about the type of “habitat” you would like to settle down in. We will look in newspapers for just the right spot for you.

OBJECTIVES: The students will be able to 1) determine suitable habitats for several species of animals; and 2) understand that fire is not always a detriment to an animal's habitat.

MATERIALS: Newspaper classified ads, animal habitat cards, pencil, paper

BACKGROUND: Unlike people, animals and plants in a forest ecosystem do not always have a choice of where they live. Because of our ability to change our “habitats” to suit the climate or other things that might make our lives unpleasant, we can live almost anywhere. Our water is piped into our house, we have grocery stores for our food and space in and around our homes to move around in.

A forest habitat is made up of a great variety of plants and animals and they rarely have a choice of where they live. A habitat is a place where a plant or animal naturally lives. This area must provide everything an organism needs to thrive – food, water and space to reproduce and grow. Several organisms can share a habitat and occupy various niches. A niche is the location or function of a species within a specific community.

In a deciduous forest (deciduous trees lose their leaves each year) there are a variety of niches in which to “hang out”. For example, the scarlet tanager, a bright red songbird, eats insects in the high canopy of the forest. Woodpeckers prefer the trunk of trees to find their insects. Squirrels scavenge for nuts, helping to broadcast and propagate new trees. Deer browse on the forest floor consuming acorns, grasses, shrubs and herbs. Smaller animals such as moles tunnel beneath the forest floor in search of insects and grubs. Hawks soar above all of this preying on mice, snakes and other small animals.

Sometimes a habitat is disrupted by change, either manmade or natural. Examples of manmade disruptions may include urban land development, timber harvesting and agriculture. Natural disruptions include a number of weather related threats – tornados, hurricanes, blizzards, floods and drought.

Fire is another disruption to forest habitats and can either be natural (the majority of natural fires in the western United States are caused by lightning) or manmade. Fire caused by man is usually from carelessness – a cigarette tossed out a car window, poorly extinguished campfires, etc. Unfortunately, on occasion, manmade fires are caused by arsonists. Arson is the willful or malicious burning of land or buildings and causes millions of dollars of damage to homes and property each year.
To survive a fire most animals will either flee (deer, fox, bison, bobcats, etc), fly to another area (almost all bird species) or burrow deeper underground (rats, mice, moles, shrews, snakes, lizards, turtles, etc.). Nestlings and chicks of wild turkeys and other birds may not be able to fly. These and other animals cannot escape the fire's path. Their remains attract scavengers and predators, such as coyote, to burned areas.

After a fire, organisms that inhabit the top few inches of the forest floor (humus layer) often decrease. Undesirable pests (pinecone beetles, red maple leaf cutters, etc.) living in the humus layer of deciduous forests are often reduced by fire while other beneficial insects such as ants thrive. Ants are important to prairie landscapes. Their tunnels help air and water get to the plants' roots. Ant populations usually increase after a prairie fire.

Plants do not have the luxury of escaping fire as animals do. They are unable to run, fly, creep, crawl or burrow to escape the flames. Plants have developed adaptations to survive a fire. Bark thickness is the most important factor in a tree's resistance to fire. Examples of such trees are: the giant sequoia, red pine and ponderosa pine. Trees such as the maple, beech, and Eastern red cedar, as well as some small woody shrubs, usually have thin bark. Soil insulates underground roots and organs of these more fragile thin-barked plants and new shoots will appear even after a fire destroys the surface part of the plant. Some conifers have serotinous cones (remaining closed until the occurrence of high temperatures such as created by fire) and their species would be threatened if fire did not occur on a regular basis.

Today, we are beginning to realize that fire is not always destructive, it is merely one of the many means of change that take place in a forest ecosystem.

**PROCEDURE:**

1. Before the lesson begins the teacher will read the information found on the front and back of the animal habitat cards (found in this lesson) and become familiar with the type of habitat each animal prefers.

2. The teacher asks students to bring in the classified advertisement section from newspapers.

3. The students will look through the classifieds and circle ads for apartments or homes that appeal to them. Ask several students to read the ads they have circled.

4. The teacher will make a list of features under the student's name on the dry erase board. For example, if students' ads repeatedly feature lake frontage and large spacious lawns, you might write "likes to swim and fish, needs lots of space." Include enough students so that a variety of "habitats" emerge.

5. The teacher will now explain that just as we have different preferences and needs for living areas, so do animals.

6. Identify the different animals in the pictures included in this lesson and read the information on the front and back of the animal card about where the animal lives, what it eats, etc.

7. Divide the class into small groups of three to four students and give each group an animal card. Inform the students that they will write a classified ad to advertise the type of "home" this animal would prefer. A typical advertisement for a raccoon might read:

   Beautiful lakeside property with abundant fish, crayfish and frogs just ready to catch. Some of the forest surrounding the property burned a few years ago but has made a great comeback. Many dead trees with large cavities just waiting for the right inhabitant. Come have a look.
CLOSURE: This lesson has taught us that fire is an element to be respected. It is also a necessary component, under certain circumstances, to maintain proper habitats for many plants and animals to thrive.

EVALUATION: The teacher can evaluate the students by the classified advertisements brought into class as well as the materials written for the animal's habitats.

EXTENSIONS:
1. The students can research plant adaptations to fire and write the same type of classified ads for the most appropriate habitat of the chosen plant.
2. Students can investigate the circumstances of the disappearance of the prairie and savanna habitats that once covered large areas of Kentucky.
3. Students can write classified ads for other animals living in different habitats.
The bison is the largest land animal in North America with a height of five to six feet and weighing 800-2,000 pounds. Bison were once indigenous to Kentucky and were a major source of food for Native Americans. Native people used bison hides for clothing and burned "buffalo chips" in their fires. Before the Civil War, professional hunters, as well as settlers, reduced the number of bison in the United States from 60 million to less than 1,000. Today there are approximately 30,000 in North America. The bison was reintroduced in Kentucky a few years ago but their range is limited because of the disappearance of the prairie habitat that once covered 2.4 million acres of Central and Western Kentucky.

Elk are in the same family as the white-tailed deer that is so common throughout the eastern United States. Elk are much larger than deer and until approximately 150 years ago were a common species in Kentucky. Elk, unlike bison who eat only grasses, will feed on twigs, bark, herbs and grasses. As more and more people inhabited Kentucky large mammals such as bison, elk, black bear, mountain lion, timber wolf and red wolf soon became extinct because of over hunting and loss of habitat.
Bison's Adaptation to Fire

Bison are fast runners and are able to avoid most wildland fires. Fire is essential to maintaining the prairie habitat that the bison is dependent upon. Unlike other large mammals, bison primarily eat grass. Fire stimulates the growth of tender new grasses. Prairies were created by lightning-caused fires or by fires set by Native Americans.

Elk's Adaptation to Fire

Elk are fast runners and are therefore able to avoid most wildland fires. In the past, elk were associated with the open, mixed hardwood savannas of central Kentucky. Their browsing, along with white-tailed deer and bison, was likely responsible for maintaining the patchy forests and grasslands typifying the savanna habitat. Fire is important in maintaining the openness of these habitats. Without fire, open areas are overtaken by native and non-native species, and are unable to sustain this type of environment. Some ecologists believe the oak savannas are one of the most threatened ecosystems in North America.
The bobcat is a small mammal weighing anywhere from 15-35 pounds. They have thick, soft fur, long legs and a short, stubby tail. Bobcats are good climbers and like to hunt small animals and birds. They are nocturnal (active at night) and solitary. Their home may be a cave or hollow log and is called a den.

The bald eagle is the national bird of the United States. At one time this regal bird was placed on the endangered species list but has made a dramatic comeback. It is still listed as threatened in all but three of the lower 48 states and as with all birds of prey is protected by federal law. DDT, an insecticide, entered the eagle's food chain and their eggshells became so thin that young eaglets could not survive. DDT is now banned in the United States and the eagle is again found in many parts of our country, including Kentucky. This bird builds its nest in the same place each year, adding sticks and enlarging it to massive proportions. Sometimes these nests may weigh as much as 1,000 pounds. One nest was found that has been used for 34 years and weighs over two tons! The eagle usually lives near water – oceans, lakes, rivers, etc.
Bobcat's Adaptation to Fire

The bobcat can usually escape wildland fires by running or hiding in a den. Soon after a fire, tender new plants begin to appear. These plants attract animals such as rabbits and other small mammals. The burned areas make it easier for the bobcat to catch these animals but also removes the plants the bobcats use to hide in when moving about.

Bald Eagle's Adaptation to Fire

The bald eagle can escape even rapidly moving wildland fires by simply flying away. Many of these fires do not even reach their nests, which are high in trees and on high, rocky cliffs. Fires create dead trees, called snags. These snags are used for perches and also for their nests. Because of the open areas created by fire, eagles are able to see and hunt for its food in a more efficient manner. The eagle's diet consists of fish (swimming close to the water's surface), small mammals, waterfowl, wading birds, and dead animals (carrion).
Coyote

The coyote is a relative of the wolf. Coyotes live in most areas of North America and all of the United States except Hawaii. Coyotes hunt at night (nocturnal) and for the most part eat rodents and rabbits but will also eat birds, insects, snakes and lizards. They will on occasion kill sheep and calves. Wild dogs probably do much of the damage attributed to the coyote. Since the coyote's main diet is rodents and rabbits they are actually doing a real service to farmers and ranchers.

Eastern Cottontail Rabbit

These cute, furry mammals are found in all states east of the Mississippi River and in five to six states located on the western side of the Mississippi. The cottontail lives in slight depressions in the ground, in a burrow, or beneath a brush pile. They feed on green vegetation in the warm months and on twigs and barks in the winter. Rabbits are a popular game animal for hunters and are also a food source of many larger mammals and birds of prey.
Coyote’s Adaptation to Fire

Coyotes are very mobile and can escape most wildland fires by running away. These fires burn away the ground cover that hides the coyote’s prey – rodents, rabbits and other small mammals – making it easier for them to hunt. Tender grasses and plants, which sprout after a fire, attract greater numbers of the small animals that the coyote likes to eat.

Cottontail Rabbit's Adaptation to Fire

Rabbits can run quite fast and are able to escape many wildland fires. Their speed accompanied by their sense of smell helps them escape. Many new grasses and plants grow after a fire. Rabbits like to eat these tender young plants and are attracted to newly burned areas. Fires remove the protective brush that the rabbit uses for cover to hide from their predators. This makes them easier to be seen and be caught but it also makes it easier for the rabbit to see and escape from their enemies.
Quail are a favorite bird for hunters in Kentucky. One of the most recognizable species of quail is the Bobwhite because of the cheerful, whistled bob-white or poor-bob-white call heard in the summer months. Families form coveys of 8 to 25 birds and remain together in the cover of low bushes. They often huddle together for warmth on cool evenings. The quail prefers an open habitat with brush, farmlands, pastures, and forest edges.
Quail's Adaptation to Fire

Quail can easily escape fire by flying. They are attracted to burned areas because of an abundance of insects and seeds. Although there is a good food source in these burned areas the bushes they use for cover and warmth are usually removed and they will be forced to find a new place to live.
PLOT MONITORING

SUBJECTS: English/Language Arts, Mathematics, Science, Health

GRADES: 4-8

DURATION: One class period

GROUP SIZE: one class of 25 - 30 students

SETTING: Outdoor classroom, open field, forest, or mixed landscape

KEY VOCABULARY: Plot, monitoring, fuel load, fuel model, fuel moisture,

ANTICIPATORY SET: Today you will learn to sample vegetation near your school. Using that information, you will predict the fire potential of the area around your school.

OBJECTIVES: Students will 1) understand correlation between fuel loads and fire potential; 2) be able to set up and obtain information from a monitoring plot;

MATERIALS: One dowel rod, one tape measure, one ruler, and one clipboard for each pair of students; 2 stakes; 31 meters of cord (rope, string, or flagging tape); Plot Measurement worksheets; pencils; roll of newsprint or other long paper; red, yellow, blue and green marker pens.

BACKGROUND: In nature, fires are an integral, cyclic part of a healthy forest. Depending (in part) on the type of debris (fallen branches, leaves, and other plant materials) that has accumulated in any given area this fire cycle may occur every 3-10 years, or may only occur once every hundred years or more. The ability of this debris to burn is directly related to the size and moisture level of the fuel. Smaller fuels ignite at a lower temperature, burn quickly, and are extinguished with less effort. Larger fuels require higher ignition temperatures, burn very slowly, and produce sufficient heat to dry out and ignite near-by fuels.

Under the right conditions, fuels can easily ignite when moisture levels reach 10% or less. Living fuels (growing plants, shrubs and trees) always contain at least 30% moisture levels. Dead woods and plants can contain as low as 0% moisture. Daily weather conditions will change the moisture content of dead fuels. The moisture content level of living plants is more likely to be affected by
insect damage and long-term or catastrophic weather conditions, such as drought, storms, or prolonged extremes of temperature. Heat from existing fires can dry living and dead fuels, reducing their moisture content to this 10% level. Once dry enough, the possibility of the fuel igniting is greatly increased.

A fuel is any material that will burn. Different types of materials burn at different temperatures. Natural fuels are catalogued into 13 various types, or models. Types 1, 2, and 3 include grasses. Types 4, 5, 6, and 7 include shrubs. Types 8, 9, and 10 are timber litter. Types 11, 12, and 13 include logging slash. In general, the state of Kentucky is considered to have a fuel load of 8 or 9.

Fuel moisture is the amount of water in a fuel. It is expressed as a percentage of the oven-dry weight of that particular material. Fuel moisture levels can be categorized as light fuels or heavy fuels. Light fuels include leaves, grasses, and shrubs. Heavy fuels include limbs, logs, and stumps.

Fuels are affected by the temperature. As the temperature rises, heat from the sun dries out materials on the ground. If the air temperature is 90 degrees, the ground temperature can be 110 degrees! Fuels exposed to the sun will be hotter than the same fuels found in the shade. There can be as much as a 50-degree difference in temperature between areas exposed to the sun and those in the shade!

The moisture level within dead and dried vegetation can be affected by changing weather conditions. Fuels can thus be grouped, or catalogued, as one-hour, ten-hour, 100-hour or 1,000-hour fuels – the amount of time it takes to produce these changes. As the humidity level falls, moisture is pulled from available fuels by the surrounding dry air. These same fuels absorb moisture from the air when the humidity rises. Light fuels (one-hour fuels) are fuels with a stem diameter of 0”-¼”. All grasses are listed as one-hour fuels. These fuels are very susceptible to humidity changes. They can quickly dry out in low humidity or become more moist during a sudden rainstorm. Relative humidity levels, sun exposure and/or daytime temperature ranges can change the fire potential of this fuel in a very short time. Light fuels can change dramatically during a day in the sun.

Ten-hour fuels include ¼”-1” diameter sticks, twigs, and limbs. We expect these fuels to take approximately ten hours to change their fire potential by becoming either too moist to burn or dry enough to burn easily.

100-hour fuels are those that are 1”-3” in diameter. They and the 1000-hour fuels (diameter over 3”) would be very slow to change. They include large branches, logs and living trees. Their moisture level changes very slowly over a longer period of time and they are not as affected by daily weather conditions. While heavy fuels are not affected by daily temperature changes, other factors such as insect damage, disease, and drought can weaken them. These conditions help to make the heavy fuels more susceptible to ignition.

Fuels are also affected by fuel load. Fuel load is the quantity of fuel in a given area. A mowed lawn has a light fuel load and wouldn't be able to support a large fire. A forested area with lots of fallen trees, broken and dried limbs, and a thick carpet of dried leaves would have a heavy fuel load. A fire in this forest would be able to burn hot, have high flames, and last a long time.

The distribution of the fuels within an area will also influence fire behavior. Scattered fuels (i.e., a single stick laying on a sandy beach) won't be able to sustain a fire for very long. Fuels which touch and/or overlap (i.e., wood stacked for a campfire) are better able to provide a continuous burning.

Fires are also affected by fuel load. Fuel load is the quantity of fuel in a given area. A mowed lawn has a light fuel load and wouldn't be able to support a large fire. A forested area with lots of fallen trees, broken and dried limbs, and a thick carpet of dried leaves would have a heavy fuel load. A fire in this forest would be able to burn hot, have high flames, and last a long time.

Fire managers continuously monitor both the fuel load and the fuel moisture levels of their area. Fuel moisture levels are determined by the weather. Fuel loads are determined by local and seasonal growth rates. In this lesson, students will study fuels found near their school.
PROCEDURE:

Before the lesson begins:

1. Using a marker, draw lines on your cord at 30 centimeter intervals for a distance of 31 meters. There will be 103 points marked on a line 31 meters long. Each mark will be referred to as a "point intercept" (Pnt).

2. Choose an area for students to survey. Choose a "natural" or un-mowed area which contains any combination of grasses, flowers, shrubs, trees and/or fallen logs. Measure a distance of 30 meters in your chosen survey area.

3. Place a stake at each end of your area and tie the marked cord to each of the two stakes. Make the cord as taunt as possible. Be careful to not trample down the vegetation under the cord when setting up your survey line!

In the classroom:

4. The teacher should show the students a sample piece of marked cord, pointing out the "point intercept" marks. Caution the children that when they are in the field they should be careful not to trample the vegetation under or near the cord.

5. Go over the following directions while in the classroom:
   - Pairs of students will work together. These two students should put their names on the "Plot Measurement Worksheet". Each pair of students will survey 3-4 points of intercept along the survey cord.
   - Find your first "point intercept" (Pnt), the mark closest to your beginning stake. At this and each "point intercept" along the cord, gently drop the dowel rod until it touches the ground. Record each individual plant (exact plant identification is not necessary) that touches the dowel rod on a separate line on the "Plot Measurement" worksheet. Count each plant only once, even if the dowel rod touches the same plant more than once. Don’t forget to include branches touching their dowel rod from nearby shrubs or sapling trees. Also include sticks and branches lying on the ground if they touch the dowel rod.
   - If the dowel rod fails to touch any vegetation at this point, record the substrate (bare soil, rock, forest litter, etc.) in the species column. Bare soil and rocks will have a "0" diameter. Using your ruler, measure the depth of forest litter. Put that information under the diameter column. If the dowel rod hits several types of substrate, record only that which the pole hits first (i.e., if leaves cover a rock, only record the depth of the leaves).
   - As an example: If you are in an open field working at your second intersect point and your dowel rod touches the side of a log, two different plants of grass, a tulip, and 2" of leaf litter on the ground, the worksheet would look like the table below:
   - On their "Plot Measurement" worksheet, instruct the students to record the following information:

<table>
<thead>
<tr>
<th>Species or substrate type</th>
<th>Diameter of Stem or Blade of Grass</th>
<th>Vegetation</th>
<th>Heat Potential</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0&quot;</td>
<td>Under ¼ &quot;</td>
<td>¼&quot; – 1&quot;</td>
</tr>
<tr>
<td>Grass</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grass</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flower</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leaf Litter</td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
children to first indicate which point intersect they are working at, then list each species of plant that touches their dowel rod on a separate line. NOTE: Younger students need only writing down “grass”, "flower", "shrub", "log", or "tree". Older students could use an appropriate field guide for more specific species identification.

- Next, students should measure the diameter or width of the stem, branch, trunk, or log that touches their dowel rod. Do this for each different plant that is located at this sampling spot.
- Under the "vegetation" column, indicate whether the plant is living or dead.
- Finally, check the appropriate heat potential column to indicate whether your sampling spot is in an open field (in the sun) or is located under a canopy of trees (in the shade).

**Outdoors:**

6. Move the class outside to the survey cord. Position each pairing at the appropriate starting point along the marked cord. Caution the students not to trample the vegetation close to the cord. Have the students begin working.

7. After all data has been collected, have the students group their data by size. For each point intersect, students should count the number of plants that can be found in each of the five size categories: (1) those that are 0" in diameter (rocks and bare soil); (2) those that are under ¼" diameter; (3) ¼"-1" diameter; (4) 1"-3" diameter; and (5) those over 3" in diameter.

8. Students may now graph their data by plants located at each intersect point. Using a long sheet of newsprint or other appropriate paper, draw a graph that has 36 points along the horizontal (X) axis. This will represent the 36 "point intercept" sampling points at which the students were working. [Note: you may have more or fewer intercept points depending upon the size of your class. To determine the number of points along the horizontal (X) axis, multiply the number of pairs of students times their 3 intercept points to get the total required graphing points. A class of 24 students would graph 36 points (12 pairs of students times 3 intercept points = 36 graphing points)]. The graph should be marked in consecutive whole numbers along the vertical (Y) axis. This will represent the total number of plants in each size grouping. Each pair of students should come in turn to mark the total number of plants within each size category that they found at each intersect point. The total number of small diameter plants (under ¼") found at intersect point #1 will be marked with a red marker above the #1 spot along the horizontal axis. The total number of medium diameter plants (¼"-1") found at intersect point #1 will be marked in green above the #1 spot along the horizontal axis. The total number of large diameter plants (1"-3") will be marked in blue, and the total number of very large diameter plants (over 3") will be marked in yellow above the #1 spot along the horizontal axis. Bare soil and/or rock substrate should be shown in black. Continue in this way for each intersect point along the graph until all groups have had a chance to plot their data.

9. Using the red marker, connect all red dots along the length of the graph. Repeat with the green, blue, and yellow markers. Connect the black dots only if they are located at adjacent intersect points.

10. Review with the class the fire potential of their sample plot. Did their sampling area have more small fuels that were 0"-¼" in diameter, or more large fuels that were 1"-3" in diameter?

11. Using the information that the students know about ignition possibilities, what is the likelihood of a fire in this sample plot immediately after a rainstorm? What is the likelihood of a fire if there has been no rain for one month? Are there more living or dead materials in their plot? Will that change the fire-potential of the area? When you look at the graph, which spot along the graph is most likely to catch on fire first? Why?

**ALTERNATIVES:**
• For very young students, have each pair of students sample only one intersect point. Mark the "intersect points" at four-foot intervals along the cord.

• Older students could use an appropriate field guide for plant identification. Plants that can not be identified in the field may be collected for later identification in the classroom.

CLOSURE: There are many pieces of data that must be considered in predicting fire potential. Sometimes this can seem confusing and/or overwhelming. By using a sampling system, it is easier to look at all the variables. Scientists use random sample plots to make their predictions. Would you be interested in a career in fire prediction?

EVALUATION:
Outdoors, teachers will be able to evaluate students' ability to follow directions, to work cooperatively, and to remain on task. In the classroom students can be evaluated through their worksheets, their ability to graph results, and their participation in class discussions.

EXTENSIONS:
1. Review your sampling data a second time. What was the total number of living vs. dead vegetation at each sampling point? What percentage of your vegetation was located in the sun vs. plants located in the shade? Graph your data. Compare these graph results with your initial vegetation study. Is there a way to show all your data on one chart or graph? Would this new data change your fire prediction?

2. What other graphing methods might you be able to use with this data?

3. Choose a second sampling site that might contain a different variety of vegetation. Sample this second area. Compare results.

4. Allow younger students to collect a leaf, stem, or piece of wood at each intersect point. Have them group their collected vegetation into various categories. How many ways can these samples be grouped? Allow students to decide and graph their results. How many plants are in each category? Which category size is most abundant in their sample plot? Now take a second look at your collection. What other characteristics can you find among the vegetation samples? Do you notice a variety of leaf shapes, colors, textures, strengths (soft leaves, hard bark), etc. What other ways might lend itself to grouping your samples? Some possibilities may include groupings by leaf shape; types of flowers (including plants with no flowers); color of flower or leaf; size of stem; etc. Can you devise ways to graph these new results?
### PLOT MEASUREMENT WORKSHEET

**POINT #_________**

**Names:________________________________________**

<table>
<thead>
<tr>
<th>Species or substrate type</th>
<th>Diameter or Width of Stem or Blade</th>
<th>Vegetation</th>
<th>Heat Potential</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0” Under ¼ ” ¼” – 1” 1” – 3” Over 3”</td>
<td>Dead</td>
<td>Living</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

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[Diagram of a plant being measured]
SUBJECTS: Mathematics, Science, Practical Living/Vocational Studies

GRADES: 4-8

DURATION: One class period

GROUP SIZE: One class of 25-30 students

SETTING: Indoors and/or Outdoors

KEY VOCABULARY: Estimate, educated guess, frame of reference

ANTICIPATORY SET: How often have you been asked to estimate the size, weight, or volume of some item? Most people don't carry a ruler or measuring cup with them all day long. Learning to make a good estimate is essential in science and beneficial in your everyday life.

OBJECTIVES: Students will learn to make estimates of size based on a given quantity.

MATERIALS: Four students of various heights, measuring tape marked in centimeters, tape or string, wire bent to form a square that measures 10-centimeters to a side

BACKGROUND: News reporters like facts. Their favorite questions are who, what, when, where, and how did it happen? In reporting events such as a wildland fire, initial news reports usually tell when and how the fire started. Later daily updates will tell the number of acres burned, any threats to homes, and the percentage of the fire that is under control (contained) or completely out.

Have you ever wondered how someone knows that a fire burned 3,000 acres today or is 20% contained? How do they measure sizes this large while still fighting the fire? Firefighters have learned to estimate size through years of experience.

Estimates are also used in homes every day as people fix meals for you to eat. Cookbooks will instruct you to add one teaspoon of salt or one-eighth teaspoon of pepper. But how many of you have ever watched your parents or grandparents cook a meal? Does the cook measure out the exact amount of salt and pepper in order to season the food or do they just sprinkle these seasonings over the food? How do they know when to stop so dinner isn't too salty or too spicy to eat? They have learned to estimate these amounts extremely accurately!

This is easier to do then you might expect! Today's lesson will give you experience in estimating size and distance.
PROCEDURE:

1. Before class, the teacher should mark off a 2-meter by 3-meter rectangular plot with masking tape, flagging tape, or string.

2. Have one student stand in front of the class. Ask the class to estimate this student’s height in centimeters. As a frame of reference, tell students that the distance from their cuticle to the white area on their fingernail is approximately 1 centimeter. Record all estimates on the board.

3. Tell the class they will now check their answers. Using a tape measure, have classmates measure his/her height in centimeters.

4. Compare the range of estimates to the actual height of this student.

5. Choose a second student to stand next to the first student. Since the height of the first student is now known, ask the class to estimate the height of the second student. Record these estimates on the board.

6. Measure the actual height of the second student and compare this figure with the second set of estimates. Was the range of estimates closer to the actual height of this second student?

7. Repeat until the heights of four different students have been estimated. Point out that the range of guesses got closer to the exact height as the students had more practice.

8. Next, ask one of the four students to raise and extend both arms out at shoulder height. The distance from finger tip to finger tip is their “reach”. Are students able to estimate the length of this student’s reach?

9. Working in pairs, have each student estimate the reach of their partner. Next, have them estimate their own reach. Allow them to use the original four students as a base for comparison if they would like. Were they able to correctly estimate reach to within 10% of the actual distance? [NOTE: A student’s reach will be the same as his/her height.]

10. Still working in pairs, ask students to estimate the distance of their pace. A pace is the length of two normal steps. Have one student place their heels at a set line and take two normal steps. Their partner should mark the spot where the heel of their second foot hits the ground. Students should then estimate the distance traveled. Have them measure this distance. Repeat with your partner. How accurately were they able to estimate these distances?

11. Ask the students if they think they would be able to estimate the height of a tree. All they will need is a stiff object such as a pencil, piece of dowel rod, or stick from the ground. Take the class out into the schoolyard. Pick a tree at the edge of the yard, preferably one that is standing by itself. Have one student stand next to this tree (we’ll call this student Ted). Ask Ted how tall he is. Standing 25-30 feet away from the tree, the rest of the class should hold their pencil at arms length in front of them. Instruct students to use their pencil to measure the height of Ted. Students should close one eye, place the top of their pencil at Ted’s head and place their thumbnail at the point on the pencil where they see Ted’s feet. This length along the pencil represents Ted’s height. Now have them use this distance along their pencil to measure how many Teds high the tree is. If the tree is 3 ½ times Ted’s height, then they can multiply Ted’s height by 3 ½ to find out the approximate height of the tree!
12. There is a second way to measure the tree's height. Holding their pencils at arm's length from their eye, have each student measure from the top to bottom of the tree along their pencil. Now turn their pencil sideways so that the distance along the pencil that represented the height of their tree is marking the ground from the tree trunk to a spot on the ground the same distance from the tree. Have their partner mark this spot by placing a stick, flag, or other object at the correct spot. By measuring the distance back to the tree, you will know the tree’s height! Instruct students to pace the distance from the marked spot to the tree. Since they know the length of their pace, they can now calculate the height of the tree.

13. Lead the students to your pre-marked rectangular plot. Show them the wire frame and tell them the frame is one decimeter (10 centimeters) on each side. Ask, “What size is this plot of land”? Allow the students to experiment with various methods of estimating the size of the plot.
CLOSEUP: It is easy to make fairly accurate estimates if you have a frame of reference. Today you practiced estimating. Can you think of other incidences where you would want to estimate?

EVALUATION: Teachers are able to observe: 1) student's ability to work alone, in pairs, and in large group situations; 2) student's skill levels in using a tape measure and making basic mathematical computations; 3) student's willingness to participate during a variety of new situations; 4) student's problem solving skills and growing ability to estimate size and distance.

EXTENSIONS:
1. Have students graph the results of their estimation attempts. Do they notice any trend from their first attempt to estimate to their final "educated guess"?

2. Ask students to list ways they use estimations over a set period of time. Do they feel it is valuable for them to estimate accurately?

3. Practice estimating populations. Sprinkle three pounds of beans within your marked plot. Ask students how they could accurately estimate the total number of beans within this plot. Students may suggest using the wire frame to count the exact population of a small area and multiplying by 600. (They will multiply by 600 because the plot is 20 decimeters by 30 decimeters in size, or 600 frames large). Ask students how they can achieve more accuracy. They may eventually suggest counting the exact number of beans in 10 random plots, taking an average, and multiplying that number by 600. [NOTE: To save time, the teacher can "estimate" the total number of beans by counting the number of beans that will fit in one cup. Multiply that number by the total number of cups of beans spread in the survey plot!]
SUBJECTS: English/Language Arts, Science, Social Studies

GRADES: 4-8

DURATION: One class period of 40-60 minutes

GROUP SIZE: One class of 20-30 students

SETTING: Indoors

KEY VOCABULARY: Meteorology, wildland fire, weather symbol, firefighter

ANTICIPATORY SET: Today we are going to become amateur meteorologists. We will learn to read weather maps and will also discuss the tremendous impact the weather has on the wildfires that we see so often on the news.

OBJECTIVES: The students will be able to: 1) be familiar with some of the more common weather symbols; 2) understand the impact weather has on wildland fires.

MATERIALS: Question sheet, weather symbol information sheets, map of the United States, and a bell or other noisemaker for each group.

BACKGROUND: All of the Earth’s weather comes from basically two sources, the sun and the moisture in the air. These two work together to form clouds, to make rain and thunderstorms, and to cause winds to blow.

The blanket of air around the Earth is the atmosphere. All of our weather happens in the bottom layer of the atmosphere. This bottom layer is called the troposphere and is six to ten miles thick. Meteorology is the study of the changes in temperature, air pressure, moisture, and wind direction in the troposphere.

An air mass is a large area of air that has similar temperature and moisture properties throughout. When two air masses come together, the line between them is called a front. Along a front there are usually clouds, rain, and sometimes thunderstorms. The movement of air masses assists in creating a variety of weather conditions.

Wildfires and weather are as interrelated as the prairie and the bison. Weather conditions can directly contribute to the occurrence of wildland fire through lightning strikes or indirectly through an extended dry spell contributing to the availability of fuel and a lower fuel moisture level. All these weather factors combined with a low dew point, which indicates the amount of moisture in the air, can lead to dangerous conditions for firefighters. Relative humidity can be inferred from dew point levels.

A large wildfire is often capable of modifying local weather conditions and can “produce its own weather”. These larger fires can create their own winds, thus increasing their flow of oxygen. A really large fire can generate hurricane-force winds, up to 120 miles per hour. The high temperatures “preheat” the fuels in the fire’s path, preparing them to burn more readily. When fires reach this stage, there is little firefighters can do. Nature is in charge. In the words of one fire behavior expert, “Large fires live to feed themselves.”

These large, uncontrollable fires are usually in the more arid areas of the United States where rainfall averages are as low as 15 inches per year or less. In these areas the climate is naturally dry and dew points are usually quite low. When you combine drought conditions with all of...
these other naturally occurring factors it takes only a spark to ignite a fire.

Kentucky is not immune to wildfires. Even though our average annual rainfall ranges from 36 to 50 inches, Kentucky reports thousands of acres burned each year. In fact, for the past 10 years Kentucky has averaged 1,831 wildfires that burned 62,291 acres annually. Even though we have adequate rainfall there are specific times of the year (February 15-April 30 and October 1-December 15) that burning is unlawful within one hundred fifty feet of any woodland. In each of these seasons trees are (more or less) leafless and humidity is comparatively low. This allows the sun to dry fuels on the forest floor making them more susceptible to fire. The exception during these fire seasons is from 6:00 p.m. until 6:00 a.m. During these hours the winds normally die down and humidity rises. Unfortunately, the majority of fires in Kentucky are due to arson and carelessness and occur during these fire seasons.

The intensity of fires and the rate with which they spread is directly related to wind speed, temperature and relative humidity. Climate conditions such as long-term drought conditions also play a major role in the number and intensity of wildfires. Accurate and timely weather information is vital to plan and execute strategies to suppress wildfires. This is where the National Weather Service comes into play.

One branch of the National Weather Service is devoted to providing meteorological support to wildland fire management agencies. This support includes warnings, forecasts, on-site services during wildfires, and meteorological training for firefighters.

Maps are one of the tools used by meteorologists to interpret weather to firefighters as well as the general public. All of us have seen weather maps on national and local weather reports, on the Weather Channel, and in national and local newspapers. Have you ever noticed all of those squiggly and straight lines and other strange markings on these maps? These are special symbols and codes that explain the type of clouds, how much of the sky is covered by clouds, the type of precipitation that's falling, the temperature, the wind speed, the wind direction, and other important weather information. These symbols are used because they take up much less space than writing all this data on a map.

Meteorologists use official weather maps, an international code system, and station models that indicate all the weather data surrounding a particular area. The international code system enables other meteorologists to read and understood weather conditions throughout the world. This system can use more than 100 different symbols and codes. Most of us see only a few of these official symbols because weather maps for television and newspapers are simplified to help the layperson better understand what is happening with the weather.

In this lesson you and your students will use weather symbols to interpret a simplified weather map. You will also be determining which areas may be safe or unsafe to send firefighters into to suppress a wildland fire.

**PROCEDURE:**
1. The teacher will pass out copies of the two weather symbol information sheets to each student (information sheets are included in this lesson). Tell the students that they are going to play a game in which they will need to become familiar with these symbols.

2. Pass out copies of the map of the United States (included in the lesson) and ask the students to take a few minutes and review the map.

3. Divide the class into four or five teams and give each group a small bell. Explain that you will be asking several questions about the map. Questions are included in the lesson.

4. Assign one person in each team to be the team speaker. Tell the students that when you ask a question they must quietly discuss the answer as a team. When an answer is agreed upon the speaker can ring the team's bell. The first speaker to ring gets the chance to answer the question for his/her team. The teacher may want to change the speaker after every question or two to give everyone a chance to speak.

5. A correct answer wins 10 points for the team and a wrong answer means the team loses 5 points.

6. The team with the most points at the end of the game wins.

**CLOSURE:** Meteorologists play an important part in all of our lives. With today's technology these professionals have saved hundreds of lives. They are able to predict dangerous storms, warn wildland fire fighters to abandon dangerous situations, and even assist the farmers in our area to choose the best time to plant and harvest their crops.

**EVALUATION:** The teacher is able to evaluate the students by the answers given during class participation and by how well they are able to read their maps.

**EXTENSIONS:**

1. The students can design their own symbols for the following weather events: rain, lightning, tornado, snow, fog.

2. Students can research all the weather symbols on the internet or in the school library. This information can be used to make a poster to display in the classroom.

3. Invite a local TV weather person to speak to the class about different professions related to weather.
## WEATHER SYMBOLS

### Precipitation Event (Symbol)  
<table>
<thead>
<tr>
<th>Event</th>
<th>Light</th>
<th>Moderate</th>
<th>Heavy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rain</td>
<td>••</td>
<td>••</td>
<td>•••</td>
</tr>
<tr>
<td>Snow</td>
<td>**</td>
<td>**</td>
<td>••</td>
</tr>
<tr>
<td>Drizzle</td>
<td>‚</td>
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</tr>
</tbody>
</table>

### Weather Events
- **Warm Front**
- **Cold Front**
- **Cirrus Clouds**
- **Cumulus Clouds**
- **Hurricane**
A station model shows where the weather station is located and has all the weather data surrounding it. In the following station plot the temperature is 76°F, the dewpoint is 55°F, and the wind direction is northeast at about 20 knots. The cloud cover is overcast and it is raining. Students will find a station model on the map in this lesson and will need to interpret what it means in relationship to fighting wildfires.

The flag-like symbol is called a wind barb and points in the direction from which the wind is blowing. Cloud cover is shown in the circle at the base of the wind barb. The wind speed is indicated by the markings on the wind barb. Do you see a pattern in the map?

### Cloud Cover
- Clear
- One Quarter
- One Half
- Three Quarters
- Completely Overcast

### Wind Speed & Direction
- Calm
- 5 Knots
- 10 Knots
- 15 Knots
- 20 Knots
- 50 Knots
- 60 Knots

1 Knot = 1.15 miles per hour
1. Is the barometer rising, falling, or steady in Louisville, Kentucky?  [falling]

2. Where is the heaviest rain in the United States?  [Texas]

3. In which state(s) is it drizzling?  [Washington, Louisiana, New York]

4. Which state(s) would be most dangerous for fire fighters to attempt to suppress a wildfire? Why?  
   [Utah, Wyoming, Colorado because each of these states has reasonably high temperatures, low dew point, winds 20-25 knots]

5. What is the wind direction, wind speed, temperature, dew point, and cloud cover in Los Angeles, California?  
   [Wind direction is southeast, wind speed is 15 knots, temperature is 75 degrees, dew point is 50 degrees, and cloud cover is clear]

6. Which states have cumulus clouds in the sky?  
   [Oklahoma, Arkansas, Missouri and Alabama]

7. What is the cloud cover over New Orleans, Louisiana?  [Completely overcast]

8. Is the barometer rising or falling over New York City?  [falling]

9. A warm front is passing through which state(s)?  
   [Nevada, Utah, Wyoming, Colorado]

10. What is happening in Montana that will be beneficial to wildland fire fighters?  
    [Heavy snow, light wind at 5 knots and dew point and temperature are the same (35) which indicates the air is completely saturated]

11. What is the cloud cover over Olympia, Washington?  [¾ overcast]

12. What kind of storm might soon reach Miami, Florida?  [A hurricane]

13. Over which city can you see cirrus clouds, Austin, Texas or Nashville, Tennessee?  
    [Austin, Texas]

14. Is the barometer rising or falling over Minneapolis, Minnesota?  [rising]

15. Which city in the southern part of the United States is completely overcast, receiving moderate rain and 30 knot winds? Hint: This city is the capital of this state.  
    [Atlanta, Georgia]

16. A cold front is passing through which state(s)?  [California, Kansas, Missouri, Illinois, Kentucky, Virginia, Maryland, Pennsylvania, and New York.]
WEATHER IN YOUR POCKET

SUBJECTS: English/Language Arts, Science, Meteorology, Health

GRADES: 4-12

DURATION: One 45-60 minute class period

GROUP SIZE: One class

SETTING: Outdoors in an open area

KEY VOCABULARY: Anemometer, psychrometer, relative humidity, dry-bulb temperature, wet-bulb temperature

ANTICIPATORY SET: Changing weather determines potential fire danger. Today you will learn to use specialized equipment to determine current weather conditions.

OBJECTIVES: Students will become familiar with the parts of a belt weather kit and be able to measure relative humidity, calculate wind speed, take dry-bulb and wet-bulb temperature readings, use a compass, and compute the rate of fire spread.

MATERIALS: Belt weather kit (containing an anemometer, psychrometer, compass, writing board, water bottle, and humidity tables) and Fire-Weather Observer’s Record sheets

BACKGROUND:
Changing weather changes fire’s potential to burn. The weather becomes a top priority for both firefighters calculating the safest day to conduct a prescribed burn and/or for forest managers determining the potential for a fire to occur on a specific woodland. A shift of wind direction or a drop in relative humidity can indicate an increase (a blow-up) of fire activity. How can firefighters best prepare for weather changes if they’re working several miles from their base camp?

As you learned in the previous lesson: The intensity of fire and the rate with which it spreads is directly related to the wind speed, temperature, and relative humidity. The person fighting a fire needs to know what to expect. Has the humidity in the air increased with a welcoming rain or snowstorm that will help put out this fire? Has the wind speed or wind direction changed? Could the flames be blown towards me? Could I safely move in this direction?

To help answer these questions, wildland firefighters will use a portable weather station that is small enough to attach to their belt or to be carried in their fire pack. By including a compass, an anemometer, and a psychrometer, this weather kit contains all the instruments necessary to answer these important questions.

Most wildland firefighters are working in unfamiliar territory. This may be the first time they have ever seen this particular forest, mountaintop, or state! To help orient them to the local terrain, the belt weather kit contains a compass. When used in conjunction with a local map, the firefighter can anticipate and plan for nearby situations. Maps can show safe routes away from the fire, potential hazards (such as a steep cliff or deep gully), or even natural firebreaks that can be used to slow or even stop a fire’s progress (such as a river, road, or pond). The compass prevents the firefighter from getting lost in woods thick with smoke and soot.

The compass can also be used to indicate the aspect or the direction in which a slope faces. The aspect of a slope generally determines the amount of heat the ground gets from the sun. South and southwest slopes are normally more exposed to sunlight and therefore the ground would normally be hotter. Because of the higher temperatures, the air would have lower humidity and fuels found there would have lower moisture levels. These
slopes are the most critical for the start and spread of wildfires. Shaded north-facing aspects (or slopes) typically have heavier fuels, lower temperatures, higher humidity, and higher fuel moisture levels.

An anemometer measures wind speed. Winds influence fires in several ways. As you learned from the lesson on the fire triangle, fire requires a combination of fuels, oxygen, and heat in order to burn. Winds assist all three components of the fire triangle, making it more difficult to contain a fire in windy conditions. First, winds encourage combustion by increasing the supply of oxygen to the flames. As a fire burns it will consume oxygen from the air. Winds carry a fresh supply of oxygen to the flame, thus feeding the flames. Winds will dry out fuels ahead of the flames. As winds blow across downed wood or across dead grasses, moisture held in these fuels will be pulled out into the air. As fuels loose moisture they become easier to ignite. Thus winds encourage the spread of fire by providing dry, consumable fuels. Winds can bend the flames over until they are almost horizontal, thus pushing them closer to their potential fuels. Or, through convection, heated air can be pushed ahead of the flames towards downwind fuels. Both cases will bring the heat closer to the fuel source, helping to dry the fuels in front of the fire, and putting the ignition spark closer to the fuels. Because of this pushing force against the fire front, winds begin to influence the direction of the fire's spread. Firefighters hope the winds blow the flames towards natural firebreaks such as roads, rivers, or lakes, but more often winds blow the flames towards new patches of dry, combustible fuels. Winds can also carry sparks from the main fire to new locations as far as 10 miles away! Winds are thus responsible for starting new fires and starting fires on many fronts simultaneously. When these new "spot fires" are great distances from the main fire it can definitely stretch the resources available for fighting a fire! Knowing the direction and speed of winds help firefighters plan their strategy.

A psychrometer is used for measuring the temperature and relative humidity. Temperature is a measurement of the warmth or coldness of a substance. The higher the ground or fuel temperature, the easier it is for the fuel to ignite and burn. The higher the air temperature, the faster fuels will dry and become easier to ignite. Fuels exposed to the sun can be as much as 50 degrees hotter then the same fuels lying in the shade! Because the sun controls the earth's temperature, firefighters measure the air temperature in order to predict fire potential.

Relative humidity is a ratio of the amount of moisture in the air compared to the amount which the air could hold at the same temperature and pressure if it were saturated. Relative humidity is usually expressed as a percentage. The relative humidity is important because dead forest fuels and the air constantly exchange moisture. During periods of low humidity the air pulls moisture from the fuels. During periods of high humidity (think of rain), moisture is absorbed by the fuels. Light fuels (such as grass) will lose moisture quickly during changes in relative humidity. This change in moisture can happen in as little as an hour! Heavy fuels (such as fallen tree trunks) have a much slower exchange of moisture with the surrounding air. For heavy fuels, it may take several weeks to change their moisture level.

In this lesson, students will have a chance to examine the weather around them. What is the potential for fires to spread on the day of your measurements?
PROCEDURE:
1. Assemble the class outdoors. Have students work in small groups. Give each group a belt weather kit, one copy of the Fire-Weather Observer's Record and a pencil.

2. Direct students to complete the top section of the form as a group. On the first line, they should fill in their location (school yard, outdoor classroom, or city name); today’s date; and the name(s) of everyone in their group. On the second line they should fill in the exposure (ridgetop, hillside, forest, field, etc.); and elevation (on average, the highest locations in south-central Kentucky are approximately 800 feet above sea level). Leave the aspect blank for now. Aspect is the direction the land is sloped. Students may circle the aspect after they learn to use their compass.

3. Have the class take out their compass from pocket number 7 of their belt weather kit. Explain that the compass can be used to show directions (north, south, east, or west as well as points in between), it can be used to locate items shown on a map or help you travel through unknown terrain (orienteering), and today it will be used to help determine the weather!

4. To determine the aspect, have students examine their compass. A bottom rectangle of clear plastic has a ruler along the top edge. Facing the ruler is an arrow that says “Direction of travel”. Students should hold their compass close to their chest with this direction of travel arrow pointing directly in front of them. The compass needs to be kept horizontal so that the red needle inside the circular compass housing can move freely. Have the students stand facing a distant landmark so that their back is to the slope of the hill (or with their back to the school if the schoolyard is on flat land). Without changing the position of their compass, have the students turn the housing only (the round part of the compass that has numbers from 1-360) until the floating red needle is directly over the drawn arrow, with the red end of the needle pointing to the “N” (north) painted on the edge of the housing. Now look at the letters and numbers on the round housing. The line between “Direction” and “of travel” is your index pointer. For younger children, have them look for the magnetic direction letters (N, S, E, or W) on or near this line. That will be your direction of aspect. You may require older children to record both the direction and the number of degrees indicated.

5. Now circle the aspect or direction the land is sloped (i.e., circle “S” if slope is facing south, or write “flat” if the schoolyard has no observable slope).

6. Show the class the psychrometer located in pocket number 3 of the belt weather kit. Explain that the psychrometer hangs from a chain attached to a metal bar which the students will hold tightly at all times. Caution the children to handle this instrument carefully so they do not break the two thermometers which extend below the metal casing. The two thermometers will take a “dry bulb” reading and a “wet bulb” reading. The “wet bulb” thermometer is the one with a white stocking (wick) attached to the end of the thermometer. These two temperature readings will give us not only the air temperature, but will also give us the relative humidity and dew point readings.

7. First have the children take the dry bulb temperature reading. To do this, have them stand in the shade, face the wind, and hold their psychrometer in front of them until the thermometer reaches equilibrium (2-3 minutes). Read the temperature and record this number in the appropriate column.
8. Have the students find the small bottle of water located in pocket number 5 of the belt weather kit. Instruct them to open the bottle and dip the white cloth tipped thermometer into the water until the wick is saturated. Holding the metal handle tightly at arms length, the students should whirl the psychrometer at a moderate rate for 30-60 seconds. The whirling motion is similar to the rotation of an airplane propeller. Read and record the temperature on the wet-bulb thermometer in the appropriate column.

9. To calculate the relative humidity, have the students open the “Relative Humidity and Dew Point Table” found in the belt weather kit pocket number 1. Have the students find their dry bulb temperature located down the left-hand side of the columns. Next, have them locate their wet bulb temperature listed across the top of the table. If they look at the intersection of these two columns they will find the relative humidity listed as a black number. This number should be written under the appropriate column on their form and shown as a percentage (%). The potential for a wildland fire increases as the relative humidity decreases and becomes most threatening if the relative humidity reaches 10% or less. Based on today’s relative humidity reading, is the fire threat high or low today? Is this a good or bad day to conduct a prescribed burn? NOTE: The red number in that same intersecting block tells the dew point—or the temperature (in degrees Fahrenheit) at which the moisture in the air will condense to form a layer of dew on the ground. Ask the students why they think dew only forms in the early morning hours? Would finding a layer of ground moisture in the morning assist or hinder a firefighter with his duties?

10. Show the class the anemometer found in pocket number 2 of the belt weather kit. Explain that this instrument is used to measure the wind speed. Turn so the wind is blowing into your face. Hold the anemometer vertically with the red scale facing you. Watch the small white ball move up the scale. The height of the ball indicates the wind velocity in miles-per-hour. Sometimes the white ball in your anemometer will remain fairly stable but suddenly rise rapidly only to fall back to the original level. This would be an indication that you are experiencing wind gusts. Record wind speed in the appropriate column. Record wind gusts under the “Characteristics & Comments” column. Strong winds and/or the presence of wind gusts increase the potential for fires to spread. Based on your readings, should a farmer burn his fields today? Is this a good day for you to burn a pile of leaves?

11. Using your compass, calculate the wind direction. Wind direction is determined by the direction from which the wind is blowing. For example, a north wind means the wind is blowing from the north. Stand facing the wind. Using your compass, find what direction you are facing. Record the direction on your worksheet. If you were fighting a fire, which side of the fire would you stand on today based on your wind readings? Why?

12. Under “Characteristics and Comments”, you can indicate the speed of wind gusts; whether the sky is clear, foggy, or cloudy; or whether the day is sunny, raining, or snowing.
CLOSURE: When land managers consider conducting a prescribed burn they first look at the weather. Changing weather can spell danger to a wildland firefighter. A shift of wind direction or a drop in relative humidity can indicate an increase (a blow-up) of fire activity. Today you have learned how to gather weather information even if you’re busy fighting a fire in a remote wilderness area.

EVALUATION: Teachers will be able to evaluate the worksheets produced by the class. Teachers will be able to observe student’s ability to follow directions and their ability to cooperate with each other in their small group settings.

EXTENSIONS:
1. Have students compare the air temperature with ground and fuel temperatures. Place a thermometer on the ground in the sun. Place a second thermometer on the ground in the shade. Are these temperatures the same or different? Take temperature readings under a leaf pile; in a parked vehicle; under a log; under a black cloth and under a white cloth; on the north and south sides of a hill. Are all the temperature readings the same? Why or why not?

2. Have the students repeat their weather readings every 15 minutes until the end of class. Were there any noticeable shifts in wind direction/speed or changes in humidity or temperature readings during this time period?

3. Have students repeat their weather readings during the day. Did they notice a pattern to the rises or falls in wind, humidity, or temperature? Have students graph their results.

4. Have students repeat their weather readings at the same time every day for a week. Did they notice changes? Compare student’s results with the “official” weather summary found in the newspaper or on the Internet. Are they the same, similar, or very different? If different, what could cause the irregularity? Have students find the location of their “official” weather station. Is it close to their school or many miles away? Are there topographic features that might cause different readings?

5. Plan a field trip to a near-by weather station or have a local meteorologist visit your classroom to discuss weather monitoring with your students.
<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Name(s)</th>
<th>Exposure</th>
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<th>Temperature</th>
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<th>Wet</th>
<th>Relative Humidity (%)</th>
<th>Wind Speed (m.p.h.)</th>
<th>Wind Direction (from)</th>
<th>Characteristics &amp; Comments</th>
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</tbody>
</table>
SUBJECTS: English/Language Arts, Mathematics, Social Studies, Health, Physical Education, Practical Living/Vocational Studies

GRADES: 4-8

DURATION: one class period

GROUP SIZE: one class of 25-30 students

SETTING: Outdoors or in the classroom

KEY VOCABULARY: Nomex, fire shelter, MRE, flagging, McLeod, Pulaski, fusee, drip torch, logistics, retardant, firebreak

ANTICIPATORY SET: Just like any other specialized occupation, when men and women work on prescribed burns or fight wildland fires, they require special clothing and equipment in order to be efficient and safe. Have you ever thought of the cost to outfit just one firefighter? How do these men and women obtain their equipment? How do they get to the fire? How do they get their food and showers when they’re in the middle of the wilderness? Where do they sleep? Firefighters are just one part of a team that is needed to coordinate the efforts that go into controlling a fire. This lesson will introduce students to a few of the more than 240 wildland fire occupations.

OBJECTIVES: Students will 1) recognize and become familiar with personal protective equipment; 2) be exposed to hand-held firefighting equipment; 3) recognize that safety is the number one priority for all firefighters; and 4) realize that firefighters are only one element of a team.

MATERIALS:
- Fire box containing firefighter clothing and equipment
- National Fire Equipment System Catalogs
- Supplies Resource Order form
- Pencils
- Fire Shelter

BACKGROUND: When a prescribed burn is planned or when a wildland fire is reported, teams of fire experts are called in to oversee and organize the men and women who will be working to contain the flames. An incident commander is the person in charge. He or she will head a team who makes decisions regarding the logistics of fighting the fire. These decisions include the number of people needed, the placement of these people on or near the fire, the use of specialized equipment, the safety of people and buildings, payment of salaries and supplies, and obtaining basic services such as food, medical care, radios, showers, and firefighting supplies. Before firefighters can be sent to a fire someone must make travel arrangements. Some people will drive their car or truck to the incident. A bus may be hired, or, depending upon the size of the fire and the distance the firefighters must come, plane tickets or rental cars must be obtained. Upon arrival at the fire, will these firefighters need hotel reservations or will they be sleeping in tents at a base camp? Once at the fire, the supply officer will order sufficient shovels, uniforms, first aid kits, helmets, radios, weather kits, batteries, pumps, water hoses, screwdrivers, pencils, chainsaws, gloves, and tool kits needed for the firefighters to do their job. In addition, meals, drinking water, portable toilets and even showers may be requested.

Dispatchers are the people who make the travel arrangements and find the needed people, supplies, and equip-
ment. They also keep track of every person and piece of property. When the fire is over, the dispatchers will either send the people and equipment home, or they may send them to another fire. **Time keepers** record the number of hours that each firefighter works so they can be paid correctly. They also track the number of hours different machines are used. Machines and equipment may not be paid, but very often they need to go for a "check-up" after so many hours of usage. This is particularly important for aircraft that may be carrying firefighters into remote areas or flying over fires to drop retardant! **Pilots** and **crewmembers** are needed to fly these fixed-winged planes and helicopters. **Radio operators** keep in constant contact with everyone on the ground and in the air.

Photographs of firefighters at work are taken by the **Information Officer (IO)**. The IO also writes news articles which describe the fire and detail the progress in putting it out. **Firefighters** are usually photographed using various types of shovels, rakes, and chainsaws. These are the standard tools used to fight a wildfire, to clear an area of available fuel, or to make firebreaks. However, specialized firefighters may be called in to help. **Smokejumpers** are highly trained firefighters who parachute from an airplane to reach fires in remote or inaccessible wilderness areas. They are usually the first firefighters on the scene and may be many miles from the nearest help! A **Fire Crew** is a group of 20 firefighters who operate as a team. Type I crews have trained together all during the year, even during the months when there are no fires to fight! Type II crews are made up of trained individuals who may have never worked together before. The size and danger posed by an individual fire will determine which fire crew is used. Fire crews are under the direction of crew bosses. **Crew bosses** must have a lot of experience as they not only direct the actions of the crew while on the fire line, but they must also keep track of changing weather conditions, fire activity, and are ultimately responsible for the safety of their crew members. **Tractor and plow operators, water handling specialist, and dozer bosses** all operate the heavy machinery that helps clear areas with heavy undergrowth.

Every person working on or near a fire - from firefighter to time keeper - must be safe. To prove they are physically fit, all personnel who may be sent near the fire line must pass a pack test. A **pack test** will check their stamina and endurance. To pass, the firefighter must carry a 45-pound backpack for 3-miles in 45 minutes or less (without running!) In addition, everyone associated with a fire wears Nomex (fire-retardant) clothing and keeps specialized gear handy "just in case". Specialized clothing includes:

- **Clothing** – The long-sleeved fire shirt and the loose-fitting, cuffless fire pants are both made of a fire-resistant Nomex material. The shirt is bright yellow for easy visibility and the long sleeves are kept rolled down! The fire jeans are made with many large pockets to carry items the firefighter must have handy. Underwear must always be 100% cotton since synthetic materials such as nylon and rayon can melt and stick to the skin in extreme heat!

- **Boots** – Heavy-duty, laced, leather boots with 8-inch tops provide ankle support while non-skid soles provide good traction on steep terrain. Each firefighter must purchase their own boots. Boots cost $85 - $350 per pair.

- **Heavy-Duty Leather Gloves** – protect the firefighter's hands.

- **Hardhat** – This helmet is made of durable fiberglass. It protects the firefighter's head from sparks and falling debris. Like the fire shirt, it is a bright yellow so the firefighter is easily seen, even in wooded areas or in thick smoke.

- **Goggles** – protect a firefighter's eyes from the heat, smoke and soot, or other debris in the air.
Each firefighter must carry certain equipment and supplies at all times while fighting a fire. These items may include:

- **Field Pack** – (firefighter, unisex, complete) is worn on the back and is designed to carry all necessary gear.

- **Fire Shelter** – The fire shelter is kept within reach at all times. It is made of fiberglass and aluminum. When opened, the shelter wraps around the firefighter like a cocoon and can reduce the radiant heat from a deadly 1,000-degree fire to a survivable 120 degrees. It also provides a temporary pocket of breathable air during fire-entrapment situations. The fire shelter can mean the difference between life and death, and is kept in a plastic case until needed.

- **Canteen** – dehydration is always a danger. Wildland firefighters carry at least two quarts of water in their pack. Some carry more!

- **Earplugs** – can provide protection from loud sounds, debris, and dirt stirred up by fires.

- **Handbooks** – Reference books provide needed information on techniques, safety measures, and task responsibilities. Every firefighter is issued a copy of the “Fireline Handbook”.

- **Map and Compass** – The firefighter will probably be working in unfamiliar territory. To locate the fire, to plan the best route of travel, and to locate homes that may be threatened, a marked map of the region and a compass are essential tools!

- **First Aid** – Basic first aid supplies (including a lip balm, moleskin to take care of blisters, insect repellant, and personal medications) are useful and sometimes essential!

- **Toilet Paper** – Some things are always necessary!

- **Food** – Firefighters use a lot of calories during the day. Meals-Ready-to-Eat (MRE’s) are balanced, high-calorie meals that can be easily carried in a backpack or pocket. Extra snacks help keep their energy level high.

- **Flagging Ribbon** – Brightly colored tape is used for quick identity (each person carries at least two colors). They are used to mark safety routes away from the fire, to mark work areas, to mark hazards, or to identify unstable (killer) trees.

- **Space Blanket** – A thermal space blanket is both waterproof and windproof. It protects firefighters from wind, rain, or cold weather.

- **Brush Coat** – Made of cotton and fire-resistant Nomex with reflective stripes, these coats are usually used only when the temperatures drop (on night shifts, in camp, or during dawn briefings). They provide protection from flames, but are usually too bulky and hot to wear while fighting large wildland fires during the day!

- **Headlamp** – Lights the way after dark and leaves the hands free to work. Don’t forget to pack four extra batteries!

- **Radio** – Communication with headquarters and other fire crews is essential! Radios allow firefighters to hear updated weather reports, changes in fire plans, and allows them to report changing or dangerous conditions.
**Bladder Bag** – A backpack pump that can hold up to 5-gallons of water. Water can cool flames before digging.

**Tool** (combination shovel and grub hoe) – Combination tools allow firefighters to do a variety of jobs while carrying a minimum amount of equipment.

**McLeod** – Used to rake flammable materials away from the fire and to move smoldering logs during mop-up. The McLeod is used extensively in the western United States.

**Shovel** – Used for digging, scraping, and spreading loose dirt over small flames.

**Rake** – used primarily in Eastern forests where thick layers of leaves and twigs need to be cleared from firebreak areas.

**Pulaski** – A chopping and trenching tool that combines an axe blade with a narrow, adze-like blade.

**Chain Saw** – Useful for moving or cutting trees while making a firebreak. Chain saw operators must wear thick chaps (leg guards) to safeguard against injury.

**Drip Torch** – This small, handheld fuel can drips a burning mixture of diesel fuel and gasoline. The can has a handle, nozzle and igniter. It is used to start backfires or prescribed burns.

**Belt Weather Kit** – All firefighters must watch for changing weather conditions. The belt weather kit contains an anemometer, psychrometer, compass, and small bottle of water to take wind direction, wind speed, temperature, and relative humidity readings.

**Fusee** – These are like flares that burn extremely hot. They are used to start backfires or prescribed burns. They are designed to ignite in all weather conditions. They have a delayed fuse to prevent injuries.
PROCEDURE:

When firefighters report for duty, they must be completely outfitted and ready to work.

1. Using items found in the fire box, describe and show each article of clothing and tool to the class. Tell why each item is important for the job or for safety. Show how to use the tools.

2. Next, show the class the firefighters backpack. Describe and show the items carried inside the backpack. You may like to have a student volunteer put on and/or hold the items as you describe them. Are the equipment and safety articles easy to wear and carry?

3. How much do all the items weigh? Explain to the students that firefighters need to know their total weight. If they are transported by airplane, the airplane will have a weight limit. Each firefighter will be weighed with all his/her clothing and gear. A 20-person crew is allowed 4,800 lbs. (including people and gear). How much weight allowance is each person allowed? How much does the average firefighter weigh? [185-lbs.] How much weight is available for his/her professional and personal gear? If the firefighter is carrying too much weight they will need to leave items behind. For this reason, firefighters become expert at estimating their weight. Have each student estimate the total weight of the items shown. Record the guesses on the board. (HINT: The firefighter shirt weighs 1 pound.)

4. Allow students to work in pairs or in small groups. Give each group of students a copy of the "National Fire Equipment System Catalog" and a copy of the Supplies Resource Order form.

5. Ask students to open the catalog to the section marked "Alphabetical Section". Review with students the procedure for finding items alphabetically. Point out that each entry will have a catalog number, a name, details such as size or length, the weight (listed as WT:), and volume (listed as CU: __ ft). The last line of each entry contains a series of three capital letters. These letters give the location (regional cache or warehouse) from which the item can be ordered. [Note: only fire Supply Officers can order from this catalog.] To the right of this description you will find the price. The price is related to the unit of issue. That information is located along the far right side of the page. Most items are sold EA (each), although you may also find items sold in a RO (roll), as a PR (pair, i.e., a pair of gloves or a pair of jeans), in a PG (package), or by the BX (box of so many). See pages 54 and 55 of the 2001 catalog or page 43 in the 1999 catalog for detailed explanations.

6. Review the various columns on the Supply Resource Order form. Be certain the students know how to find the required information. You might list on the board page numbers of some specialty items:

<table>
<thead>
<tr>
<th>Item</th>
<th>2001 Catalog page</th>
<th>1999 Catalog page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pocket first aid kit</td>
<td>211</td>
<td>182</td>
</tr>
<tr>
<td>Fireline Handbook</td>
<td>321</td>
<td>311</td>
</tr>
<tr>
<td>Belt Weather kit</td>
<td>204</td>
<td>174</td>
</tr>
<tr>
<td>Command/Tactical Radio Kit (for 16)</td>
<td>249</td>
<td>227</td>
</tr>
</tbody>
</table>

7. The students will now become fire Supply Officers. Tell the students to complete their Supply Resource Order form in order to outfit a new firefighter with all the required clothing displayed in class, all the items found in the backpack, one drip torch, and one tool of their choice from the above list.

8. Have the students calculate the total cost of outfitting this new firefighter. This firefighter is one member of a 20-person crew. How much would it cost to outfit the entire crew?

9. Would you like to wear this one outfit every day for your 14-day tour of duty? How could you get clean clothes? Allow students to brainstorm. Some possibilities would be to carry several outfits or to wash your clothes after work. What are the advantages or disadvantages of these choices. On many fires the Supply Officer will set up a laundry service. After working all day, the firefighters can exchange their dirty clothes for a clean outfit. The laundry service then washes the dirty clothes for exchange the next day. This goes on until the fire is put out.
10. What is the total weight of all these items? Compare this weight with the estimates made at the beginning of class. Were any guesses accurate? Would you get tired carrying that many pounds for 10-hours each day?

11. Even though they expect to be at a fire for 14 days, firefighters are not allowed to carry more than 65 pounds of gear to the fire. Look at the total weight of the items you have just ordered for your firefighter (including the weight of the pack). If these items were for you, what would you add to your pack if you have some extra weight allowance available? How many sets of clothing will you pack? [Don’t forget off-duty entertainment — will you read a book, write a letter, or play cards? Will you bring your own pillow, a favorite snack, long johns or extra underwear? How much will your sleeping bag (4-lbs, 12-oz.) and tent (7-lbs) weigh? All these items must be included in your 65-pound limit!]. If you are overweight, what will you leave behind? Remember, you must be able to do your job and remain safe!

**CLOSURE:** The proper clothing and equipment can cost a lot of money. But not having the proper items can be even more costly if someone becomes seriously injured or dies. Safety is always more important than cost.

**EVALUATION:** The teacher will be able to: 1) evaluate student comprehension and participation through class discussions; 2) evaluate problem solving abilities through the “what if” questions and answers; and 3) evaluate student worksheets for correct information and calculations.

**EXTENSIONS:**

1. If there is a local prescribed burn or a wildland fire in the news, have the students find out the number of people assigned to that fire. Based on their class calculations, how much did it cost to outfit all the people working on that fire for just one day?

2. Invite a Forest Service or National Park ranger to your classroom to discuss their experiences on a wildland fire or with a prescribed burn. Ask the ranger to demonstrate the correct usage of the various tools. If there is an appropriate place on the school grounds, allow students to use each of the hand tools.

3. Demonstrate the correct procedure to deploy a fire shelter. Students can practice using a fire shelter. Allow groups of 4-6 students to run 30-50 yards, open their fire shelter, get situated inside and hold the shelter down while you shake the tents to simulate strong fire winds! To survive, they would need to do all that in 30-seconds or less!

4. Ask students if they would be interested in working on a wildland fire or on a prescribed burn. There are over 200 possible wildland fire positions. Students could choose a fire position/job that interests them. Using the Internet and other resources, have students research the duties and responsibilities of their chosen position/job. What specialized training (if any) is required for this position/job? Have students share their findings orally or organize their written reports into a classroom “fire careers” book.

5. Have the class train to pass the walking part of the “pack test”. Students “pass” when they can walk 3 miles in 45-minutes.
6. Ask a member of your local volunteer fire department to come to class and explain the clothing and equipment used during a structure or field fire in your neighborhood. Compare his/her clothing and equipment with that used by wildland firefighters. Why do you think their gear and clothing is so different? What are the advantages and disadvantages of each? Do you think the volunteer fireman would be as efficient or as safe if he/she dressed in and used the wildland fire equipment while fighting a house fire? Why or why not? What would happen to a wildland firefighter if he/she tried to fight a forest fire while wearing the volunteer fireman’s clothing?
### Firefighting Costs Money!

**Supply Resource Order Form**

<table>
<thead>
<tr>
<th>RESOURCE NUMBER</th>
<th>RESOURCE NAME</th>
<th>QUANTITY</th>
<th>PRICE EACH UNIT</th>
<th>TOTAL PRICE</th>
<th>WEIGHT</th>
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<tbody>
<tr>
<td>0065</td>
<td>Fireline Handbook</td>
<td>1</td>
<td>$2.43</td>
<td>$2.43</td>
<td>10 oz.</td>
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**TOTALS:**

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**Note:** The table template is designed to be filled out with additional resource orders and their details. The example provided is a single entry for the Fireline Handbook.
History of Fire in Kentucky

Fire has played a crucial role in the forests of eastern Kentucky for around 10,000 years. Over that time, people have been responsible for the vast majority of ignitions; lightning fires are relatively rare events. Humans have remained the chief cause of fire in Kentucky for millennia, but motivations behind forest burning have changed dramatically over time. This section presents a history of fire, focusing on the changing reasons and objectives for burning in the forests of Kentucky.

- As recently as 13,000 years ago, the forests of Eastern Kentucky were uninhabited by humans. During this time, forest fires were an infrequent event.
- From 10,000 years ago to 3,000 years ago, fires were used by Native Americans primarily to drive game animals. Native American populations were low during this time and fire was of minor importance in Kentucky’s forests.
- Beginning roughly 3,000 years ago, Native American populations began to increase in the forests of eastern Kentucky. These early peoples used fire to clear land for gardens, create food for game animals, and to make travel easier by controlling brush in the understory. Fire was widely used as a land management tool. During this time, the forest was almost completely dominated by fire-tolerant tree species, such as oak, chestnut, and pine.
- By around 1800, European settlers had totally displaced native peoples, but the role of fire in the landscape had changed little. Early Euro-Americans used fire to clear land for agriculture, to drive game, and to promote forage for cattle.
- In the late 1800s and early 1900s, most of the forestland in eastern Kentucky was cut for lumber. Extremely hot fires were often associated with harvesting as unmerchantable debris was often burned.
- In response to the increased frequency of dangerous and destructive fires in the early 1900s, the U.S. Forest Service adopted a successful policy of fire suppression. This policy changed how the public perceived fire. Fire was no longer viewed as a management tool, but a threat to timber quality and public safety.
- Today, arson and escaped debris fires account for the vast majority of wildfire in Kentucky. Contrary to the historic use of fire as a management tool, fire today primarily results from carelessness or is motivated by entertainment or revenge.

Current State of Fire in Kentucky

Today, fires that burn Kentucky’s forest landscapes are caused by intentional arson, the accidental spread of debris fires, or by controlled, prescribed fires. The intensity, extent, and duration of arson and accidental fires are unpredictable. In contrast, ignition of prescribed fires follows rigid restrictions regarding weather and burning conditions to insure that these burns are safely maintained within pre-designated areas.

Currently, most people view arson and accidental fires as detrimental and damaging to Kentucky’s forests; at the same time, many see prescribed burning as
beneficial to the health of the land. How can fire play both positive and negative roles in Kentucky's forests?

Any fire, arson, accidental or prescribed, can pose risks to human health, loss of life, personal property, or natural resources. Motivated by these concerns, active fire suppression has altered the species composition, health, and economic viability of Kentucky's forests for nearly a century. Research shows that fire can serve as a beneficial and efficient tool for restoring, conserving, and utilizing forest ecosystems. The following benefits may justify careful use of prescribed fire to meet both ecological and social needs:

- Reduce fuel loads to decrease the potential of catastrophic and destructive wildfires
- Curtail incidence of disease and insect damages to forest and timber
- Increase reproduction, growth, and quality of desired forest species by reducing competition
- Improve or create wildlife habitats
- Restore historic ecosystems and landscapes
- Control invasive, non-native, and undesirable plants
- Increase or maintain native plant and animal species diversity
- Enhance scientific knowledge, public awareness, and education of fire's effects on the land.

In spite of the multiple reasons for returning managed fires to Kentucky's landscape, the public's preoccupation with arson burning, and the risks of smoke damage and escaped fire present obstacles to the use of prescribed burning.

Future of Fire in Kentucky's Forests: A Community Decision

As with both historic and current burning in Kentucky's forests, future fire management activities will be the end result of formal or informal societal decisions. Present-day concern about the prevalence of arson fire combined with a growing awareness of the juxtaposed negative and positive roles of fire in Kentucky forests justifies an expanded dialogue on the role of fire in Kentucky's future forests. A community-based approach encourages broad participation of public and private stakeholder groups and land management agencies, and the formation of decision-making partnerships. Such a strategy has the advantages of:

- Drawing from local knowledge, experience, and interests
- Increasing public awareness, and
- Forming collaborative partnerships between diverse stakeholder groups.

This approach opens up a dialogue between people who might not normally interact. It brings together multiple sources of knowledge (i.e., scientific, historical, cultural) and differing viewpoints to create opportunities for sharing information. These relationships also produce an atmosphere of collaborative problem solving and build an avenue for cooperation in projects and management operations. Perhaps most importantly, this cooperative approach to land management revitalizes the link between human communities and forest ecosystems. In Kentucky, community-based approaches are part of fire management activities in The Nature Conservancy's Fire Program and the Firewise Council of McCreary County.

The Nature Conservancy's (TNC) interaction with other agencies and the public is an example of community-based fire management. They work often with government agencies such as the United States Forest Service (USFS) and the Kentucky Division of Forestry (KDF). The Nature Conservancy has a Fire Learning Network for "sharing best practices and lessons learned" with its partners. TNC involves the community by sending out promotional mass mailings early in the fire season to make them aware of prescribed fire on Conservancy land, and meets with adjacent property owners in the prescribed fire planning process. They tap into local knowledge of ecosystems by preferring local individuals to work as project managers. TNC's goal of restoring and maintaining "functional landscapes" includes the use of fire. However, an essential part of the "functional landscape" is the people of the community and their link to the land.
The McCreary County Firewise Council brings together representatives from volunteer fire departments, the County Judge Executive, Chamber of Commerce, KDF, the local water district, USFS, the National Park Service, search & rescue teams, and interested individuals. Dialogue between these groups evolved into the following shared community priorities:

- To work on a county-wide risk assessment
- To educate the public on wildfire potential, prevention, and protection, and
- To reduce fire hazard by mechanical and prescribed fire methods.

In addition to activities aimed at meeting the three initial objectives, the community dialogue has generated unexpected successes. Most notably, as a result of the FireWise education campaign, there has been a reduced number of accidental and arson fires in McCreary County. Successful networking and improved relationships between the various agencies and members of the private sector has also resulted in more productive fire and land management. This initiative has resulted in a vision-centered, cooperative, decision-making body of managers and community stakeholders while renewing interest and dialogue regarding the community’s vision for the future of its forestland.

Potentially, the most valuable outcome of Kentucky’s community-based fire management activities is the realization that a healthy, proactive community atmosphere can lead to a healthy forest ecosystem which then returns ecological, economic, and aesthetic values to the community. Healthy ecosystems and healthy communities rely on one another for strength, health and value.

In Conclusion

Public land management in the U.S. is under the power of several separate agencies. The management theories and operation techniques of these agencies are based on a scientific understanding of the land, and decisions are commonly made with little public input at all. This has caused the separation of people from the land. A rich heritage once flourished around people’s regard for the land they lived on and near. Land management agencies were established to protect land for future use and appreciation. Instead, agencies have tended to alienate people from the land by removing them from the decision making process. Reconnecting this link between people and the landscape is one benefit of an integrated approach to land management.
Chronology of Large Wildland Fires

1825 - The Miramichi fire in Maine and New Brunswick; three million acres burned; 160 people killed

1846 - The Yaquina fire in Oregon; 450,000 acres burned

1853 - The Nestucca fire in Oregon; 320,000 acres burned

1865 - The Silverton fire in Oregon; one million acres burned

1866 - The Coos fire in Oregon; 300,000 acres burned

1871 - The Peshtigo fire in Wisconsin and Michigan; the most deadly fire in U.S. history; 1,500 people killed; 3.7 million acres burned

1876 - The Bighorn fire in Wyoming; 500,000 acres burned

1881 - A Michigan forest fire destroyed one million acres of timber; 169 lives lost

1894 - The Hinckley fire in Minnesota; 160,000 acres burned; twelve towns wiped out; 418 lives lost

1903 - The Adirondack fire in New York; 637,000 acres burned

1910 - The Great Fire of 1910 in Idaho and Montana; more than three million acres burned; 86 lives lost; also called “The Big Blowup”

1918 - The Cloquet fire in Minnesota; Cloquet, a thriving sawmill town of 12,000 was gutted; timber land and property losses estimated at $30 million; 400 people perished

1932 - The Matilija Canyon fire in California’s Santa Barbara National Forest; 256 square miles burned; 2,500 firefighters on the lines; no lives lost

1933 - The first of four Tillamook burns, in the Oregon coast range; subsequent fires burned in 1939, 1945 and 1951. In all, 355,000 acres of some of the finest timber in America were destroyed

1947 - Texas; in September and October, 900 man-caused fires burned 55,000 acres of timber in eastern Texas; losses exceeded $1 million

1947 - Maine; almost 206,000 acres; 16 lives lost

1949 - Mann Gulch fire in Montana; just over 4,000 acres, but 13 Smokejumpers killed

1967 - Sundance fire in Idaho; 56,000 acres total burned; 50,000 of these acres burned in only 9 hours

1988 - Yellowstone National Park, Montana and Wyoming; a fire that was being allowed to burn broke out of the park. In all, more than 1.5 million acres of national park, national forest, and private forest land were burned

1991 - Oakland Hills fire in California; 25 lives lost; 2,900 structures destroyed

1998 - The Volusia Complex and the Flagler/St. John fires in Florida; thousands of people were evacuated from several counties with each of these fires

2000 - 90,000 wildfires burnt over 8 million acres, costing close to $2 billion; this was double the yearly average; 2000 was the worst wildfire year since 1910

2000 - The Cerro Grande fire in New Mexico; 44,000 acres; 235 structures destroyed; Los Alamos National Laboratory damaged; 25,000 people evacuated; 20,000 foot-high plumes of smoke stretching 300 miles; 1500 archaeological sites scared or destroyed; $1 billion; originally a prescribed burn

2002 - the Biscuit fire in Oregon; 499,570 acres; 13 structures lost; about $148 million

2003 - in October alone, 10 fires in California burned 736,558 acres. In all, 4,750 structures were destroyed and 168 damaged, at a cost of more than $63 million.
Fire: Behavior, Effects, Weather

Fire Weather
Covers fire weather basics. (1994)  39:12  NFES 2236

People, Parks and Fire
Prescribed burn programs are an important land management tool that benefits park visitors and neighbors. (2001)  9:30

Fire Management in the National Park Service
This video definitively outlines wildland fire policy in the NPS, as told by managers and practitioners in the field. Addresses the four key components of the program at the field level (suppression, prevention, research, prescribed fire) which are foundational to a successful fire management plan. (1994)  18:00  NFES 1848

Evolution of Policy: From Fire Control To Fire Management
This video takes a generic interagency look at federal fire policy development, from the early days of land management to the present. Originally produced from a slide/tape program in 1994, the 1997 version has added a 5-minute update on the latest Federal fire policy information. (1997)  17:43  NFES 2436

Fire Behavior in the Wildland/Urban Interface
Wildland/Urban Interface fires have caused the need for structure and wildland firefighters to be aware of tactical and safety differences for both types of fire. Wildland fire steps for sizing up a fire and structure triage are discussed. (1990)  27:09  NFES 2132

Fire Equipment

Wildfire: Handtools
This video demonstrates use of the basic firefighting tools. (1986)  17:30  NFES 2036

Fire Prevention and Education

Making Your Home Fire Wise
Presents ideas and techniques for homeowners when constructing or modifying homes in wildland/urban interface areas. Topics include roofs, windows, eaves, and decks, with some attention given to landscaping. The on-camera host demonstrates how a simple walk around the house can give the homeowner an initial firewise assessment of the property. (1997)  22:29  NFES 2534

Focus on Wildland Fire Prevention: Profiling Four Programs That Really Work
This video profiles four different successful prevention programs. (1993)  21:00  NFES 2376

One Step Beyond
This video shows the steps and contacts necessary to develop an effective fire prevention plan. The video also introduces the computer-based system of fire planning and analysis. (1996)  16:29  NFES 2509

Safety and Health

Fatigue and the Firefighter's Environment
Properly managing fatigue means more rested, productive people on shift and fewer accidents and injuries. Specific steps that can be taken by a manager or by a firefighter to control fatigue are discussed. (1989)  22:00  NFES 2071

Firefighter Safety in the Wildland/Urban Interface Fires
This video is divided into two sections: Firefighter Safety (14:33 minutes) and Safety Checkout (9:33 minutes). The video covers safety of the firefighter, the area immediately surrounding the firefighter and the overall environment of the fire itself. (1989)  26:31  NFES 2103

Using Your Fire Shelter
Videotape discusses care and deployment of a fire shelter. (2001)  27:20  NFES 1568

Suppression Skills

Fire in the Interface
Follows an engine crew during an interface fire. Goes through the decision process whether a particular home has proper safeguards for protection. (1988)  12:00  NFES 2094

Wildfire: Handtools
This video demonstrates use of the basic firefighting tools. (1986)  17:30  NFES 2036
### GRADE 4 ENGLISH/LANGUAGE ARTS

#### Reading

**Students will**

- understand and respond to a variety of reading materials, making connections to students’ lives, to real world issues, and/or to current events (additional supporting Academic Expectation 6.1).
- recognize characteristics and elements of different kinds of works.
- utilize text features and organizational patterns to interpret transactive reading materials (informational, practical/workplace, and persuasive).
- respond to authors’ opinions and details used to support those opinions.
- employ reading strategies (e.g., word analysis, re-reading, context clues, pre-reading, raising questions, predicting, drawing conclusions).
- use contextual vocabulary and comprehensive strategies to understand text.

#### Writing

**Students will**

- respond to reading, listening, observing, and inquiry through applying writing-to-learn strategies in situations such as journals and graphic organizers and writing-to-demonstrate learning strategies in situations such as open-response questions and graphic organizers (additional supporting Academic Expectations 1.10, 5.1, 6.3).
- use information from technology and other resources to produce writing that develops and supports independent ideas (additional supporting Academic Expectation 5.1).
- write transactive pieces (writing produced for authentic purposes and audiences beyond completing an assignment to demonstrate learning) based on personal experiences, reading, listening, observing, and/or inquiry (additional supporting Academic Expectation 6.3).
- write personal pieces to communicate ideas.
- identify and apply characteristics of effective writing in producing and discussing their own work, including awareness of audience and purpose, organization, idea development, and standards of correctness (e.g., mechanics, grammar, spelling).

#### Speaking/Listening/Observing

**Students will**

- prepare and deliver formal presentations individually and/or collaboratively for specific audiences, purposes, and situations (additional supporting Academic Expectation 5.3).
- apply listening, speaking, and observing skills to conduct authentic inquiry tasks (additional supporting Academic Expectation 5.1).

#### Inquiry

**Students will**

- identify information and resources needed to address student-development questions.
- take notes from research.
- use technology as a research tool to explore and gather ideas and information for authentic tasks.

#### Technology as Communication

**Students will**

- use technology to access ideas and information.
## 4TH GRADE PROGRAM OF STUDIES

### GRADE 4 MATHEMATICS

#### Numbers, Integers & Place Value

**Students will**
- read, write, and model whole numbers from 0 to 1,000,000, developing place value for hundred thousands and millions. **X**

#### Fractions & Decimals

**Students will**
- explore appropriate estimation procedures. **X** **X**

#### Number Computation

**Students will**
- understand and apply computational procedures for adding, subtracting, multiplying, and dividing whole numbers using memorized basic facts. **X** **X**
- add, subtract, multiply, and divide whole numbers. **X** **X** **X**

#### Geometry

**Students will**
- analyze structures of geometric figures (e.g., points, rays, lines, segments, perpendicular lines, parallel lines, angles). **X** **X** **X**
- investigate geometric relationship (e.g., similarity, congruence) through manipulatives and drawings. **X** **X**

#### Measurement

**Students will**
- read and record temperatures to the nearest degree. **X**
- measure and find area and perimeter of a rectangle. **X**
- exchange units (e.g., linear, volume, mass) within a measurement system (e.g., 2 feet = 24 inches). **X**

#### Algebraic Ideas

**Students will**
- graph points on a number line. **X**

#### Probability & Statistics

**Students will**
- choose appropriate means to collect and represent data. **X** **X** **X** **X**
- pose questions, collect, organize, and display data. **X** **X** **X**
- draw conclusions based on data. **X** **X** **X**
- use counting techniques and/or tables to explore probability experiments. **X**

### GRADE 4 SCIENCE

#### Scientific Inquiry

**Students will**
- ask simple scientific questions that can be answered through observations combined with scientific information. **X** **X** **X** **X**
- use simple equipment (e.g., plant lights), tools (e.g., rulers, thermometers), skills (e.g., describing), technology (e.g., electronic media), and mathematics in scientific investigations. **X** **X** **X**
- use evidence (e.g., descriptions) from simple scientific investigations and scientific knowledge to develop reasonable explanations. **X** **X** **X** **X**
- communicate (e.g., graph, write) designs, procedures, and results of scientific investigations. **X** **X**
- review and ask questions about scientific investigations and explanations of other students. **X** **X**
### Physical Science

**Students will**
- properties (e.g., size, shape) of materials can be measured and used to describe, separate, or sort objects.
- the position and motion of an object can be described (e.g., measured, observed) by comparing it to another object or background.
- heat can be produced in many ways and can move from one object to another by conduction.
- light travels in a straight line until it strikes an object. Light can be reflected, refracted, or absorbed by objects.

### Earth/Space Science

**Students will**
- Earth’s materials have different physical (e.g., capacity to retain water) and chemical (e.g., ability to support plants) properties and provide resources that humans use.
- the Sun provides the light and heat necessary to maintain the temperature of the Earth.
- weather changes from day to day and over the seasons. Weather can be described by observing and measuring temperature, wind direction and speed, and precipitation.

### Life Science

**Students will**
- organisms have basic needs (e.g., air, water, nutrients, light) and can only survive when these needs are met.
- organisms’ patterns of behavior are related to the nature of organisms’ environments. There are many different environments (e.g., deserts, rain forests) on Earth that support different types of organisms.
- all animals depend on plants for food.
- organisms change environment. These changes may be detrimental or beneficial.

### Applications/Connections

**Students will**
- describe the role of science and technology in dealing with local issues (e.g., landfill location).
- examine the role science plays in everyday life.

### GRADE 4 SOCIAL STUDIES

#### Historical Perspective

**Students will**
- explore different perspectives and interpretations of Kentucky history by using primary and secondary sources, artifacts, and time lines.
- understand different groups throughout Kentucky’s history and their reasons for exploring and/or settling in Kentucky.
- recognize how lifestyles and conditions have changed over time in Kentucky.

#### Geography

**Students will**
- understand that all places on Earth have an absolute and relative location.
- recognize the five themes of geography (location, place, regions, movement, and relationships within places) and use them to analyze geographic issues and problems in Kentucky and regions of the United States.
- use various representations of the Earth (e.g., maps, globes, mental maps) to find and explain human and physical geographic features in Kentucky and regions of the United States.
- understand how humans have interacted with the physical environment to meet their needs in Kentucky and regions in the United States.
## 4th Grade Program of Studies

### Economics

**Students will**
- understand that producers create goods and services and consumers make economic decisions and choices.

### Government and Civics

**Students will**
- understand that individuals have rights and responsibilities that change when people assume different roles in different groups.

### Culture and Society

**Students will**
- understand similarities and differences in the ways groups and cultures within Kentucky and regions of the United States address similar needs and concerns.
- recognize the elements of culture using different groups from Kentucky’s past and regions of the United States as examples.
- understand how social institutions in Kentucky’s past and regions of the United States respond to human needs, structure society, and influence behavior.
- recognize how tensions and conflicts can develop between and among individuals, groups, and institutions.

### Grade 4 Health Education

#### Individual Well-Being

**Students will**
- explain and exhibit responsibility to oneself (e.g., do your best, be the best you can be).
- describe and practice responsibility to others.
- demonstrate respect for others.
- examine the role of rules for the effective functioning of groups.
- distinguish between goal setting and achievement.
- explain how individuals and groups are interdependent.
- explore strategies for dealing with conflict and anger.

#### Consumer Decisions

**Students will**
- evaluate media and advertising techniques.
- determine ways in which goods and services used by families impact the environment.

#### Personal Wellness

**Students will**
- follow school safety rules (e.g., playground, bus, classroom).
- use personal safety strategies (e.g., when to say no).

#### Mental Wellness

**Students will**
- examine positive and negative consequences of choices.
- develop an awareness of personal rights and responsibilities.
- develop decision-making strategies.
## 5TH GRADE PROGRAM OF STUDIES

<table>
<thead>
<tr>
<th>Recipe for a Fire</th>
<th>Stoppping the Flames</th>
<th>Fire &amp; Man – Friend or Foe</th>
<th>Hot Habitats</th>
<th>Plot Monitoring</th>
<th>Acre by Acre</th>
<th>Fire &amp; Weather</th>
<th>Weather in your pocket</th>
<th>Firefighting costs Money</th>
</tr>
</thead>
</table>

### GRADE 5 ENGLISH/LANGUAGE ARTS

#### Reading

**Students will**

- identify meaning from a variety of reading materials, making connections to students' lives, to real world issues, and/or to current events (additional supporting Academic Expectation 6.1).
- identify and apply information contained in directions and forms to complete authentic tasks.
- employ reading strategies to locate and apply ideas and information for inquiry projects and other authentic tasks.
- respond to a variety of reading materials by summarizing, identifying sequence, generalizing, and comparing/contrasting.
- use vocabulary and comprehension strategies in context, as well as technology, to understand text.

| X | X | X | X | X |

#### Writing

**Students will**

- respond to reading, listening, observing, and inquiry through applying writing-to-learn strategies in situations such as journals and graphic organizers and writing-to-demonstrate-learning strategies in situations such as open-response questions and graphic organizers (additional supporting Academic Expectations 1.10, 5.1, 6.3).
- use information from technology and other resources to produce writing that develops and supports independent ideas and contains source citations (additional supporting Academic Expectation 5.1).
- write transactive pieces (writing produced for authentic purposes and audiences beyond completing an assignment to demonstrate learning) which develop ideas for authentic audiences and purposes (additional supporting Academic Expectation 6.3).
- write personal pieces, including essays, which reflect on personal experience and make connections to real-world issues (additional supporting Academic Expectation 6.3).
- apply characteristics of effective writing in their own works and recognize them in works of others, including awareness of audience and purpose, organization, idea development, and standards of correctness (e.g., mechanics, grammar, spelling).

| X | X |

#### Speaking/Listening/Observing

**Students will**

- adjust communication based on audience, purpose, and situation.
- prepare and deliver formal presentations individually and/or collaboratively for specific audiences, purposes, and situations, with and without technology and visual aids (additional supporting Academic Expectation 5.3).
- use appropriate delivery techniques including correct and appropriate language, nonverbal cues, and visual aids.
- apply listening, speaking, and observing skills to conduct and to respond to authentic inquiry tasks (additional supporting Academic Expectation 5.1).

| X | X | X | X | X | X |

### Inquiry

**Students will**

- develop questions to obtain ideas and information for authentic tasks.
- identify types of resources for a variety of tasks and select resources appropriate for specific tasks (additional supporting Academic Expectation 5.4).
### 5th Grade Program of Studies

<table>
<thead>
<tr>
<th>Recipe for a Fire</th>
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<th>Fire &amp; Weather</th>
<th>Weather in your Pocket</th>
<th>Firefighting Costs</th>
<th>Money</th>
</tr>
</thead>
</table>

- **Technology as Communication**
  - **Students will**
    - use technology to access ideas and information.
    - explore technology as a means of communication.

- **GRADE 5 MATHEMATICS**

#### Numbers, Integers & Place Value

- **Students will**
  - read, write, and model whole numbers from 0 to 100,000,000, developing place value for ten millions and one hundred millions.
  - explore appropriate estimation procedures.

#### Fractions & Decimals

- **Students will**
  - read, write, and identify decimals through ten-thousandths.
  - explore appropriate estimation procedures.

#### Number Computation

- **Students will**
  - add and subtract decimals to hundredths using manipulatives or symbolic notation.
  - explore appropriate estimation procedures.

#### Geometry

- **Students will**
  - identify and model basic two- and three-dimensional shapes by appearance and in different orientations (i.e., turn models different ways).

#### Measurement

- **Students will**
  - determine area and perimeter of triangles and rectangles.
  - relate units (e.g., linear, volume, mass) within a measurement system (e.g., 125 cm = 1 m 25 cm).

#### Probability & Statistics

- **Students will**
  - develop meaning and interpretation of arithmetic mean (average) for numerical data.
  - pose questions; collect, organize, display data; and choose an appropriate way to collect and represent data.
  - explore how sample size affects the reliability of the outcome.
  - make predictions.
  - find mean, median, mode, and range for a set of data.

### GRADE 5 SCIENCE

#### Scientific Inquiry

- **Students will**
  - identify questions that can be answered through scientific investigations combined with scientific information.
  - use appropriate equipment (e.g., watches), tools (e.g., rain gauges), techniques (e.g., classifying), technology (e.g., calculators), and mathematics in scientific investigations.
  - use evidence (e.g., classifications), logic, and scientific knowledge to develop scientific explanations.
  - design and conduct different kinds of scientific investigations to answer different kinds of questions.
  - communicate (e.g., draw, speak) designs, procedures, and results of scientific investigations.
  - review and analyze scientific investigations and explanations of other students.
## 5TH GRADE PROGRAM OF STUDIES

<table>
<thead>
<tr>
<th>Core Subject</th>
<th>Course Title</th>
<th>5th Grade Program of Studies</th>
<th>6th Grade Program of Studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Science</td>
<td>Students will</td>
<td>- demonstrate that energy is a property of substances.</td>
<td>X</td>
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<tr>
<td></td>
<td></td>
<td>- observe forms of energy transfer (e.g., vibrations in materials).</td>
<td>X</td>
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<tr>
<td></td>
<td></td>
<td>- observe the ways heat can move.</td>
<td>X</td>
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<tr>
<td></td>
<td></td>
<td>- recognize that the Sun’s energy arrives as light with a range of wavelengths and explore how light interacts with matter.</td>
<td>X</td>
</tr>
<tr>
<td>Earth/Space Science</td>
<td>Students will</td>
<td>- explore the characteristics of the atmosphere and how the water cycle affects the atmosphere, clouds, weather, and climate.</td>
<td>X X X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- investigate living organisms’ effects (e.g., changes in the composition of the atmosphere and the environment) on the Earth system.</td>
<td>X</td>
</tr>
<tr>
<td>Applications/Connections</td>
<td>Students will</td>
<td>- examine the role of science in explaining and predicting natural events (e.g., floods, earthquakes, volcanoes).</td>
<td>X X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- demonstrate the role science plays in everyday life and explore different careers in science.</td>
<td>X X X X X X</td>
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<tr>
<td></td>
<td></td>
<td>- recognize how science is used to understand changes in populations, issues related to resources, and changes in environments.</td>
<td>X X X X X X</td>
</tr>
</tbody>
</table>

### GRADE 5 SOCIAL STUDIES

#### Historical Perspective

**Students will**
- explore the interpretive nature (how perceptions of people and passing of time influence accounts of historical events) of the history of the United States using a variety of tools (e.g., primary and secondary sources, data, artifacts). X
- trace change over time in the history of the United States and identify reasons for change. X X
- examine the historical contributions of individuals and groups. X X

#### Geography

**Students will**
- use a variety of tools to obtain and present geographic information (e.g., landforms, natural resources, natural disasters) about the United States and its close neighbors (i.e., Canada, Mexico). X
- develop mental maps of the United States. X
- recognize unique places in the United States. X
- examine how the history of the United States was influenced by its physical environment. X
- understand human settlement patterns in the United States and how they were related to the physical environment. X
- understand how the people of the United States have used technology to modify the environment to meet their needs. X X X

#### Culture and Society

**Students will**
- understand how culture in the United States has been influenced by languages, literature, arts, beliefs, and behaviors of diverse groups. X
- examine social interactions among diverse groups in the history of the United States. X
# 5th Grade Program of Studies

## Grade 5 Health Education

<table>
<thead>
<tr>
<th>Individual Well-Being</th>
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</thead>
<tbody>
<tr>
<td>Students will</td>
<td></td>
</tr>
<tr>
<td>❑ demonstrate responsibility to oneself and others.</td>
<td>X</td>
</tr>
<tr>
<td>❑ apply rules in groups and determine how their application enables groups to function effectively.</td>
<td>X</td>
</tr>
<tr>
<td>❑ demonstrate how individuals and groups are interdependent.</td>
<td>X</td>
</tr>
<tr>
<td>❑ determine unsafe or threatening situations and procedures for dealing with them.</td>
<td>X</td>
</tr>
<tr>
<td>❑ apply conflict resolution strategies.</td>
<td>X</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Consumer Decisions</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Students will</td>
<td></td>
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<tr>
<td>❑ analyze differences between needs and wants and provide examples.</td>
<td>X</td>
</tr>
<tr>
<td>❑ apply decision-making strategies when buying products based on price, features, and quality.</td>
<td>X</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mental Wellness</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Students will</td>
<td></td>
</tr>
<tr>
<td>❑ analyze positive and negative consequences of choices and actions.</td>
<td>X</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Community Services</th>
<th></th>
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<tbody>
<tr>
<td>Students will</td>
<td></td>
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<tr>
<td>❑ identify governmental health and safety regulations.</td>
<td>X</td>
</tr>
<tr>
<td>❑ describe and access health and safety services that agencies (e.g., health department, fire department, police department) provide to the community.</td>
<td>X</td>
</tr>
<tr>
<td>❑ identify community guidelines (e.g., animal control, sanitation, immunization) that promote healthy environments.</td>
<td>X</td>
</tr>
</tbody>
</table>

## Grade 5 Physical Education

<table>
<thead>
<tr>
<th>Personal Wellness</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Students will</td>
<td></td>
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<tr>
<td>❑ evaluate their own progress toward fitness goals using appropriate instruments (e.g., stopwatch, tape measure).</td>
<td>X</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Psychomotor</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Students will</td>
<td></td>
</tr>
<tr>
<td>❑ improve competency and consistency in performing locomotor (e.g., walk, run, hop) and nonlocomotor (e.g., push, pull, twist, turn, curl, stretch, balance) skills in games and sports.</td>
<td>X</td>
</tr>
<tr>
<td>❑ demonstrate movement concepts as they are used in various games and activities (e.g., space awareness, effort, relationship that occurs between objects and individuals).</td>
<td></td>
</tr>
<tr>
<td>❑ exhibit motor skills with fundamental locomotor movement (e.g., walk, run, hop) in the performance of games and sports.</td>
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<table>
<thead>
<tr>
<th>Lifetime Activity</th>
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<tbody>
<tr>
<td>Students will</td>
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<tr>
<td>❑ refine practice techniques to achieve consistency for a variety of physical activities.</td>
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<tr>
<td>❑ demonstrate sportsmanship (e.g., complying with rules, responding appropriately) in games and sports activities.</td>
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</table>
# 6TH GRADE PROGRAM OF STUDIES

<table>
<thead>
<tr>
<th>Reading</th>
<th>Writing</th>
<th>Speaking/Literacy/Observing</th>
<th>Inquiry</th>
<th>Technology as Communication</th>
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</thead>
<tbody>
<tr>
<td><strong>GRADE 6 ENGLISH/LANGUAGE ARTS</strong></td>
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<tr>
<td><strong>Reading Students will</strong></td>
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<tr>
<td>❑ identify meaning of a variety of reading materials, making connections to students’ lives, to real world issues, and/or to current events.</td>
<td>❑ respond to transactive reading materials (informational, practical/workplace, and persuasive), supporting ideas through summarizing and through identifying main ideas, details, and examples.</td>
<td>❑ interpret text features (e.g., layout, boldface print, bullets, diagrams) of transactive reading materials to understand passages and complete authentic tasks.</td>
<td>❑ identify and apply logical sequence in reading materials to complete tasks or procedures.</td>
<td>❑ employ reading strategies (e.g., skimming, scanning) to locate and apply information in varied print and nonprint (e.g., computers, electronic media, interviews) sources for inquiry projects and other authentic tasks.</td>
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<td>❑ use vocabulary and comprehension strategies, as well as technology, to understand text.</td>
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<td><strong>Writing Students will</strong></td>
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<td>❑ respond to reading, listening, observing, and inquiry through applying writing-to-learn strategies in situations such as graphic organizers, notetaking, journals, and logs and writing-to-demonstrate-learning strategies in situations such as graphic organizers, open-response questions, and summaries.</td>
<td>❑ use information from technology and other resources to produce writing that develops and supports independent ideas and contains source citations.</td>
<td>❑ write transactive pieces (writing produced for authentic purposes and audiences beyond completing an assignment to demonstrate learning) based on personal experience, reading, listening, observing, and/or inquiry (additional supporting Academic Expectation 6.3).</td>
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<td>❑ use information from technology and other resources to produce writing that develops and supports independent ideas and contains source citations.</td>
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<tr>
<td><strong>Speaking/Literacy/Observing Students will</strong></td>
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<tr>
<td>❑ interpret meaning from verbal/nonverbal cues by applying appropriate listening and observing strategies.</td>
<td>❑ convey meaning through appropriate delivery techniques (e.g., correct and appropriate language, nonverbal cues, visual aids, volume, rate, and tone).</td>
<td>❑ apply listening, speaking, and observing skills to conduct authentic inquiry tasks and to create products (additional supporting Academic Expectation 5.1).</td>
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<td>❑ use technology to access ideas and information for authentic tasks.</td>
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<td><strong>Inquiry Students will</strong></td>
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<tr>
<td>❑ develop questions to obtain ideas and information for authentic tasks (additional supporting Academic Expectation 6.3).</td>
<td>❑ identify different types of resources to accomplish a variety of tasks.</td>
<td>❑ explore and use research tools to gather information and ideas for authentic tasks.</td>
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</tbody>
</table>
GRADE 6 MATHEMATICS

Number and Computation

Students will
- continue to develop number sense including fractions, decimals, and percents (including percents greater than 100% and improper fractions). [X]
- extend understanding of operations (+, -, x, ÷ ) to include fractions and decimals. [X]
- develop place value of large and small numbers (including decimals). [X]
- extend and apply addition, subtraction, multiplication, and division of common fractions and decimals with manipulatives and symbols (e.g., mental, pencil and paper, calculators). [X]
- estimate with large and small quantities of objects. [X]

Geometry and Measurement

Students will
- read and use measurement tools (e.g., rulers, scales). [X]
- estimate, compare, and convert units of measures for length, weight/mass, and volume/capacity within the U.S. customary system and within the metric system:
  a) length (e.g., parts of an inch, inches, feet, yards, miles, millimeter, centimeter, kilometer);
  b) weight/mass (e.g., pounds, tons, grams, kilograms); and
  c) volume/capacity (e.g., cups, pints, quarts, gallons, milliliters, liters). (The intent of this standard is for students to make ballpark comparisons and not to memorize conversion factors between U.S. and metric units). [X]

Probability and Statistics

Students will
- collect, organize, analyze, and interpret data in a variety of graphical methods, including line plots, line graphs, bar graphs, and stem and leaf plots. [X]
- made predictions, draw conclusions, and verify results from statistical data and probability experiments. [X]
- select an appropriate graph to represent given data. [X]
- investigate solutions to probability problems, using counting techniques, tree diagrams, charts, and tables. [X]
- recognize the role of probability in decision making. [X]

Algebraic Ideas

Students will
- represent, interpret, and describe function relationships through tables, graphs, and verbal rules. [X]
- interpret relationships between tables and graphs. [X]
- organize data into tables and plot points onto the first quadrant of a coordinate (Cartesian) system/grid. [X]

GRADE 6 SCIENCE

Scientific Inquiry

Students will
- identify and refine questions that can be answered through scientific investigations combined with scientific information. [X]
- use appropriate equipment (e.g., binoculars), tools (e.g., beakers), techniques (e.g., ordering), technology (e.g., calculators), and mathematics in scientific investigations. [X]
- use evidence (e.g., orderings, organizations), logic, and scientific knowledge to develop scientific explanations. [X]
- design and conduct different kinds of scientific investigations to answer different kinds of questions. [X]
- communicate (e.g., speak, write) designs, procedures, and results of scientific investigations. [X]
- review and analyze scientific investigations and explanations of other students. [X]
6TH GRADE PROGRAM OF STUDIES

Physical Science

Students will
- describe, measure, and represent (e.g., arrows) an object’s motion.

Earth/Space Science

Students will
- identify phenomena (e.g., growth of plants, winds, water cycle, ocean currents) on the Earth caused by the Sun’s energy.

Life Science

Students will
- analyze internal or environmental stimuli and organisms’ behavioral responses. Explore how organisms’ behavior changes through adaptation.
- investigate factors (e.g., resources, light, water) that affect the number of organisms an ecosystem can support.

Applications/Connections

Students will
- examine the interaction between science and technology.
- recognize how science is used to understand changes in populations, issues related to resources, and changes in environments.

GRADE 6 SOCIAL STUDIES

Historical Perspective

Students will
- examine how human and physical geography influence past decisions and events.
- evaluate past, current, and future issues of land use (e.g., preservation, development, modification) from geographic perspectives.

Geography

Students will
- examine patterns on Earth’s surface, using geographic tools (e.g., maps, globes), to identify where things (e.g., people, places, landmarks) are, how they are arranged, and why they are in particular locations.
- analyze the physical and human characteristics of places and regions.
- evaluate the impact of human settlement and the interaction of humans with their environments.
- use the five themes of geography (location, place, regions, movement, and relationships within places) to organize information about various regions in the modern world.

GRADE 6 HEALTH EDUCATION

Individual Well-Being

Students will
- demonstrate conflict resolution strategies.

Consumer Decisions

Students will
- compare wants and needs in relation to consumer decisions.

Personal Wellness

Students will
- implement personal safety strategies.
### Community Services

**Students will**
- identify services provided by environmental protection agencies.

<table>
<thead>
<tr>
<th>Recipe for a Fire</th>
<th>Stopping the Flames</th>
<th>Fire &amp; Man – Friend or Foe</th>
<th>Hot Habitats</th>
<th>Plot Monitoring</th>
<th>Acre by Acre</th>
<th>Fire &amp; Weather</th>
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<th>Firefighting costs</th>
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### GRADE 6 PHYSICAL EDUCATION

#### Personal Wellness

**Students will**
- evaluate their own health-related fitness.
- establish personal fitness goals and personal fitness programs.

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#### Lifetime Activity

**Students will**
- use rules and fair play in games and sports.
- apply techniques to achieve consistency for games and sports.

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GRADE 7 ENGLISH/LANGUAGE ARTS

Reading

Students will

- identify the meaning of a variety of reading materials, making connections to students' lives, to the real world, and/or to current events. [X X X X X]

- respond to and analyze transactive reading materials (informational, practical/workplace, and persuasive) through raising and addressing questions, making predictions, drawing conclusions, solving problems, and summarizing information (additional supporting Academic Expectation 5.1). [X X X X X]

- interpret and apply information in a variety of transactive reading materials to complete authentic tasks. [X X X X X]

- identify authors' positions, main ideas, and techniques of support in persuasive materials. [X]

- employ reading strategies (e.g., skimming, scanning) to locate and apply information in varied print and nonprint (e.g., computers, media, interviews) resources for inquiry projects and other authentic tasks. [X X X X X]

- use vocabulary and comprehension strategies, as well as technology, to understand text. [X]

Writing

Students will

- respond to reading, listening, observing, and inquiry through applying writing-to-learn strategies in situations such as graphic organizers, notetaking, journals, and logs and writing-to-demonstrate-learning strategies in situations such as graphic organizers, open-response questions, and summaries. [X X]

- use information from technology and other resources to develop independent ideas and support those ideas in writings for authentic purposes and audiences. [X X]

- write transactive pieces (writing produced for authentic purposes and audiences beyond completing an assignment to demonstrate learning), based on inquiry and/or personal experience that show independent thinking and incorporate ideas and information from reading, listening, observing, and inquiry. [X]

- write personal pieces to communicate ideas. [X X]

Speaking/Listening/Observing

Students will

- adjust listening and observing strategies for specific situations and purposes (e.g., to follow directions, to acquire information, for entertainment, to complete a task). [X X X X X X]

- apply organizational skills and delivery techniques to produce oral messages and products with and without technology. [X]

- apply listening, speaking, and observing skills to conduct authentic inquiry tasks and to create products (additional supporting Academic Expectation 5.1). [X X X X X X]
7TH GRADE PROGRAM OF STUDIES

Inquiry

**Students will**
- develop effective questions to obtain ideas and information and access resources to address those questions.  
- identify the most appropriate resources to accomplish different tasks (additional supporting Academic Expectation 5.4).  
- follow a logical plan of inquiry to complete tasks.  
- use research tools to gather and organize ideas and information from library, personal, and community resources.

Technology as Communication

**Students will**
- use appropriate technology to access ideas and information for authentic tasks.

GRADE 7 MATHEMATICS

Number and Computation

**Students will**
- extend understanding of operations (=, -, x, ÷) to include integers.
- develop number sense for pi as one example of an irrational number.
- apply meaning of ratio and proportion to problems.
- extend and apply addition, subtraction, multiplication, and division of integers both concretely and symbolically (mental, pencil and paper, calculators).
- develop proportional thinking, rates, scaling, and similarity.

Geometry and Measurement

**Students will**
- find circle measurements (radius, diameter, circumference, area) and the relationships among them.

Probability and Statistics

**Students will**
- collect, organize, analyze, and interpret data in a variety of graphical methods, including circle graphs, multiple line graphs, double bar graphs, and double stem and leaf plots.
- make predictions, draw conclusions, and verify results from statistical data and probability experiments.
- select an appropriate graph to represent given data and justify its use.
- determine appropriate techniques to use when investigating solutions to probability problems (using counting techniques; tree diagrams; area models; and exhaustive, organized lists, charts, and tables).

Algebraic Ideas

**Students will**
- represent, interpret, and describe functional relationships through tables, graphs, and verbal rules (input/output).
- use a variety of methods and representations to create and solve single-variable equations that may be applied to everyday situations.
- interpret relationships between tables, graphs, verbal rules, and equations.
# 7th Grade Program of Studies

## Grade 7 Science

### Scientific Inquiry

**Students will**
- identify and refine questions that can be answered through scientific investigations combined with scientific information.
- use appropriate equipment (e.g., spring scales), tools (e.g., spatulas), techniques (e.g., measuring), technology (e.g., computers), and mathematics in scientific investigations.
- use evidence (e.g., measurements), logic, and scientific knowledge to develop scientific explanations.
- design and conduct different kinds of scientific investigations to answer different kinds of questions.
- communicate (e.g., write) designs, procedures, and results of scientific investigations.
- review and analyze scientific investigations and explanations of other students.

### Physical Science

**Students will**
- investigate characteristic properties (e.g., density) of substances.

### Life Science

**Students will**
- investigate biological adaptation and extinction.

### Applications/Connections

**Students will**
- use science to evaluate the risks and benefits to society for common activities (e.g., riding on airplanes, choice of habitation).
- describe the effects of science and technology (e.g., television, computers) on society.

## Grade 7 Social Studies

### Geography

**Students will**
- examine how technology influences modifications of the physical environment.

### Culture and Society

**Students will**
- give examples of cooperation, conflict, and competition that resulted from the interaction of cultures.

## Grade 7 Health Education

### Individual Well-Being

**Students will**
- examine how respect, rules, communication, and cooperation enable groups to function effectively.
- demonstrate conflict resolution strategies.
- determine procedures for dealing with unsafe and threatening situations.
### Mental Wellness

**Students will**
- develop coping strategies to use with increasing peer pressure. 

### Community Services

**Students will**
- suggest solutions to community environmental problems.

### Personal Wellness

**Students will**
- evaluate their own health-related fitness.
- develop personal fitness goals and personal fitness programs.

### Psychomotor

**Students will**
- apply movement concepts (e.g., space awareness, effort, formations that occur between objects and people) in various games and sports activities.
- demonstrate increasing competence in advanced individual, dual, and team skills.
- demonstrate improved strategies for a variety of games and activities.

### Lifetime Activity

**Students will**
- describe benefits of regular participation in leisure, recreational, and competitive physical activity.
- apply rules and fair play in games and sports.
- practice to achieve consistency in games and sports.
## Grade 8 English/Language Arts

### Reading

**Students will**
- read and understand a variety of materials, making connections to students' lives, to real world issue, and/or to current events.  
- analyze transactive reading material (informational, practical/workplace, and persuasive) to create responses through addressing issues, confirming predictions, paraphrasing information to support ideas, and formulating/supporting opinions.  
- evaluate the effectiveness of techniques and organizational aids (e.g., bullets, lists, layout, embedded visuals) in transactive reading materials to enhance understanding and to complete tasks.  
- identify and analyze authors' positions, main ideas, and techniques of support in persuasive materials.  
- employ reading strategies to locate and apply information in varied print and nonprint (e.g., computers, electronic media, interviews) resources for inquiry projects and other authentic tasks.

### Writing

**Students will**
- respond to materials read and concerns relevant to students' lives and the lives of others in society through applying writing-to-learn strategies and writing-to-demonstrate-learning strategies (additional supporting Academic Expectations 1.10, 5.1, 6.3).  
- access technology and other resources to learn and to write, developing independent ideas, synthesizing information to support ideas, and using appropriate source citations.  
- write transactive pieces (writing produced for authentic purposes and audiences beyond completing an assignment to demonstrate learning) that demonstrate independent thinking about literature, issues, and events relevant to students' lives.  
- write personal pieces to communicate ideas.

### Speaking/LISTENING/Observing

**Students will**
- collaborate to gather and interpret information from observing, speaking, and listening and to prepare and deliver messages and products.  
- apply listening, speaking and observing skills to conduct authentic independent inquiry tasks in order to create products (additional supporting Academic Expectation 5.1).

### Inquiry

**Students will**
- follow a logical, organized plan of inquiry to learn and to complete tasks (additional supporting Academic Expectation 5.5).  
- evaluate the appropriateness of resources and of ideas and information gained through inquiry.  
- create products by accessing a variety of appropriate personal, community, and/or global sources, both print and nonprint (additional supporting Academic Expectation 6.3).

### Technology as Communication

**Students will**
- use the most appropriate technology to access ideas and information for authentic tasks.  
- analyze the effectiveness of various technologies for specific purposes, audiences, and situations.
## GRADE 8 MATHEMATICS

### Number and Computation

**Students will**

- use percents, decimals, integers, and fractions (including percents less than 1).  
- students will use percents, decimals, integers, and fractions (including percents less than 1).

### Geometry and Measurement

**Students will**

- develop and apply proportionality and relationships between scale models and actual figures.  
- students will develop and apply proportionality and relationships between scale models and actual figures.

### Probability and Statistics

**Students will**

- collect, organize, analyze, and interpret data in a variety of graphical methods (e.g., circle graphs, scatter plots, box and whisker plots, histograms).
- make predictions, draw conclusions, and verify results from statistical data and probability experiments.
- select an appropriate graph to represent given data and justify its use.
- recognize that statistics can be interpreted in many ways.
- identify and describe the number of possible arrangements of several objects, using a tree diagram or the basic counting principle, and make a sample space represented in the form of a list, picture, chart, or a tree diagram.
- investigate and explain the role of probability in everyday decision making.

### Algebraic Ideas

**Students will**

- represent, interpret, and describe functional relationships through tables, graphs, and symbolic rules (input/output).
- explain how change in one variable affects change in another variable (e.g., in distance equals rate times time, increasing time, increases distance).

## GRADE 8 SCIENCE

### Scientific Inquiry

**Students will**

- identify and refine questions that can be answered through scientific investigations combined with scientific information.
- use appropriate equipment (e.g., barometers), tools (e.g., meter sticks), techniques (e.g., computer skills), technology (e.g., computers), and mathematics in scientific investigations.
- use evidence (e.g., computer models), logic, and scientific knowledge to develop scientific explanations.
- design and conduct different kinds of scientific investigations to answer different kinds of questions.
- communicate (e.g., write, graph) designs, procedures, and results of scientific investigations.
- review and analyze scientific investigations and explanations of other students.

### Physical Science

**Students will**

- analyze properties (e.g., boiling point, solubility) and changes of properties in matter.
- investigate transfer of energy (e.g., heat, light, electricity, mechanical motion, sound).

### Earth/Space Science

**Students will**

- investigate the structure of the Earth system (e.g., lithosphere, rock cycle, water cycle, weather, climate).
## 8TH GRADE PROGRAM OF STUDIES

<table>
<thead>
<tr>
<th>Life Science</th>
<th>Applications/Connections</th>
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<tbody>
<tr>
<td><strong>Students will</strong></td>
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<tr>
<td>investigate and analyze populations and ecosystems.</td>
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<tr>
<td><strong>Applications/Connections</strong></td>
<td>X</td>
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<tr>
<td>Students will</td>
<td>X X X X X</td>
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<tr>
<td>examine the interaction between science and technology.</td>
<td>X</td>
</tr>
<tr>
<td>recognize how science is used to understand changes in population, issues related to resources, and changes in environments.</td>
<td>X X X X X</td>
</tr>
<tr>
<td>examine the role of science in explaining and predicting natural events (e.g., floods, earthquakes, volcanoes).</td>
<td>X</td>
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<tr>
<td>use science to evaluate the risks and benefits to society for common activities (e.g., riding on airplanes, choice of habitation).</td>
<td>X X X X X</td>
</tr>
<tr>
<td>describe the effects of science and technology (e.g., television, computers) on society.</td>
<td>X</td>
</tr>
<tr>
<td>demonstrate the role science plays in everyday life and explore different careers in science.</td>
<td>X X X X X</td>
</tr>
<tr>
<td>recognize that science is a process that generates conceptual understandings and solves problems.</td>
<td>X X X X X</td>
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</table>

## GRADE 8 SOCIAL STUDIES

### Historical Perspective

**Students will**

- use a variety of tools (e.g., primary and secondary sources, data, artifacts) to explore the interpretive nature (how perceptions of people and passing of time influence accounts of historical events) of United States history. | X |
- recognize cause-and-effect relationships and multiple causes of events in United States history. | X |
- examine the impact of significant individuals and groups in early United States history. | X X |
- recognize the significance of geographical settings and natural resources on historical perspectives and events in early United States history. | X X |

### Geography

**Students will**

- examine patterns of human movement, settlement, and interaction in early American history and investigate how these patterns influence culture and society in the United States. | X |
- examine how early United States history was influenced by the physical environment (e.g., natural barriers, natural disasters, natural resources). | X X |
- investigate how Americans used technology, especially in early American history, to modify the environment. | X X |

### Culture and Society

**Students will**

- examine how culture in the United States has been influenced by language, literature, arts, beliefs, and behavior of people in America’s past. | X |
- analyze social interactions among diverse groups and individuals in United States history. | X |
- analyze social interactions, including conflict and cooperation, among individuals and groups in United States history. | X |
## GRADE 8 HEALTH EDUCATION

### Individual Well-Being

#### Students will

- practice group processing strategies (e.g., collaboration).  
- practice conflict resolution strategies.

### Consumer Decisions

#### Students will

- consider environmental issues when making consumer decisions.

### Personal Wellness

#### Students will

- use strategies to maintain personal safety.
- determine the impact of exercise and nutrition on appearance, performance, and disposition.

### Mental Wellness

#### Students will

- access consequences and risks of choices and actions (e.g., smoking, drinking, other drug use) and suggest alternatives.
- implement strategies (e.g., time management, decision making) to enhance personal success and achievement.

### Community Services

#### Students will

- evaluate agency and governmental standards (e.g., restaurant inspections, OSHA, water quality) and the part they play in the reduction of health risks.
- describe the role of individuals and society in conserving resources.

## GRADE 8 PHYSICAL EDUCATION

### Personal Wellness

#### Students will

- enhance personal fitness goals and personal fitness programs.

### Psychomotor

#### Students will

- apply movement concepts (e.g., space awareness, effort, formations that occur between objects and people) in various games and sports activities.
- use basic offensive and defensive strategies in modified versions of team and individual sports.

### Lifetime Activity

#### Students will

- demonstrate sportsmanship (e.g., fair play, following rules, accepting officials’ decisions, controlling responses) as it applies to participants and spectators.
- develop techniques and refine skills related to performance in games and sports.
### Core Content for Assessment – Primary Grades

<table>
<thead>
<tr>
<th>Recipe for a Fire</th>
<th>Stopping the Flames</th>
<th>Fire &amp; Man – Friend or Foe</th>
<th>Hot Habitats</th>
<th>Plot Monitoring</th>
<th>Acre by Acre</th>
<th>Fire &amp; Weather</th>
<th>Weather in your Pocket</th>
<th>Firefighting Costs Money</th>
</tr>
</thead>
</table>

#### Reading

| RD-E-1.0.6 | Explain the meaning of a passage taken from texts appropriate for elementary school students. | X |
| RD-E-1.0.8 | Describe characters, plot, setting, and problem/solution of a passage. | X |
| RD-E-10.10 | Connect literature to students' lives and real world issues. | X |
| RD-E-2.0.6 | Use text features (e.g., pictures, lists, tables, charts, graphs, tables of contents, indexes, glossaries, headings, captions) to understand a passage. | X |
| RD-E-2.0.7 | Identify the organizational pattern in a passage: sequence, cause and effect, and/or comparison and contrast. | X X |
| RD-E-2.0.8 | Identify main ideas and details that support them. | X X |
| RD-E-2.0.9 | Make predictions and draw conclusions based on what is read. | X X |
| RD-E-20.10 | Connect the content of a passage to students' lives and/or real world issues. | X X X |
| RD-E-3.0.6 | Identify an author's opinion about a subject. | X |
| RD-E-3.0.7 | Identify fact and/or opinion. | X |
| RD-E-3.0.8 | Identify information that is supported by fact. | X X |
| RD-E-4.0.6 | Locate and apply information for authentic purposes. | X X X X X |
| RD-E-4.0.7 | Explain why the correct sequence is important. | X X X X |
| RD-E-4.0.9 | Interpret specialized vocabulary (words and terms specific to understanding the content) found in practical/workplace passages. | X X X X |
| RD-E-40.10 | Identify text features and organizational aids (e.g., bold face print, italics, illustrations) that provide additional clarity. | X X X X |

#### Writing

| WR-E-1.4 | Transactive writing is informative/persuasive writing that presents ideas and information for authentic audiences to accomplish realistic purposes like those students will encounter in their lives. In transactive writing, students will write in a variety of forms such as the following: Letters; Speeches; Editorials; Articles in magazines, academic journals, newspapers; Proposals; Brochures; Other kinds of practical/workplace writing |
|          | Characteristics of transactive writing may include: Text and language features typical of the selected form; Information to engage the reader and to clarify and justify purposes; Ideas(a) to communicate the specific purpose for an intended audience; Explanation and support to help the reader understand the author's purpose; Well-organized idea development and support (e.g., facts, examples, reasons, comparisons, anecdotes, descriptive detail, charts, diagrams, photos/pictures) to accomplish the specific purpose; Effective conclusions | X X X |
|          | X |

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# Core Content for Assessment - Primary Grades

## Mathematics

### Number/Computation

| MA-E-1.1.1 | Whole numbers (0 to 100,000,000), fractions, mixed numbers, and decimals through thousandths. | X | X |
| MA-E-1.1.2 | The operations of addition, subtraction, multiplication, and division | X | X |
| MA-E-1.2.2 | Add, subtract, multiply, and divide whole numbers using a variety of methods (e.g., mental, paper and pencil, calculator). | X |
| MA-E-1.2.5 | Estimate quantities of objects. | X | X |
| MA-E-1.2.6 | Estimate computational results using an appropriate strategy. | |

### Geometry/Measurement

| MA-E-2.1.1 | Basic geometric elements and terms including points, rays, lines (perpendicular, parallel, intersecting), segments, sides, edges, faces, vertices, radius, diameter, and angles (acute, right, obtuse). | X | X |
| MA-E-2.1.2 | Basic two-dimensional shapes including circles, triangles (right, equilateral), all quadrilaterals, pentagons, hexagons, and octagons. | |
| MA-E-2.1.5 | Nonstandard and standard (U.S. Customary, metric) units of measurement. | X | X | X |
| MA-E-2.2.5 | Use nonstandard and standard units to measure weight, length, perimeter, area (figures that can be divided into rectangular shapes), and angles. | X | X |
| MA-E-2.2.6 | Use standard units to measure volume of rectangular prisms, liquid capacity, money, time, and temperature (e.g., above and below zero). | X |
| MA-E-2.2.7 | Choose appropriate tools (e.g., protractors, meter sticks, rulers) for specific measurement tasks. | X | X | X |
| MA-E-2.2.8 | Identify measurable attributes of an object and make an estimate using appropriate units of measurement. | X | X | X |
| MA-E-2.2.9 | Use measurements to describe and compare attributes of objects. | X | X | X |
| MA-E-2.3.1 | How two-dimensional shapes are alike or different. | X |
| MA-E-2.3.2 | How three-dimensional shapes are alike or different. | X |
| MA-E-2.3.3 | How units within the same measurement system (U.S. Customary or metric) are related. | X | X |

### Probability/Statistics

| MA-E-3.1.1 | Mean, median, mode, and range of a set of data. | |
| MA-E-3.1.3 | The process of using data to answer questions (e.g., pose a question, plan, collect data, organize and display data, interpret data to answer question). | X | X | X | X |
| MA-E-3.2.1 | Pose questions that can be answered by collecting data. | X | X | X | X |
| MA-E-3.2.2 | Collect, organize, and describe data (e.g., drawings, tables, charts). | X | X | X | X |
| MA-E-3.2.3 | Construct and interpret displays of data (e.g., line graph, bar graph, pictograph, line plot, simple Venn diagram, table). | X | X |
| MA-E-3.2.5 | Make predictions and draw conclusions based on data. | X | X |
| MA-E-3.2.6 | Find mean, median, mode, and range of a set of data. | X | X |
| MA-E-3.3.1 | How data are used to draw conclusions. | X | X | X | X |
| MA-E-3.3.2 | How predictions can be based on probability data. | X | X |
| MA-E-3.3.3 | How the type of display is related to data (appropriateness of graphs). | X | X | X |

### Algebraic Thinking

| MA-E-4.1.3 | A positive coordinate system of graphing using ordered pairs. | X |
| MA-E-4.2.4 | Locate whole numbers, fractions, and decimals on a number line. | X | X |
### SCIENCE

#### Physical Science

| SC-E-1.1.1 | Objects have many observable properties such as size, mass, shape, color, temperature, magnetism, and the ability to react with other substances. Some properties can be measured using tools such as metric rulers, balances, and thermometers. | X | X | X | X |
| SC-E-1.1.2 | Objects are made of one or more materials such as paper, wood, and metal. Objects can be described by the properties of the materials from which they are made. Those properties can be used to separate or classify objects or materials. | X |
| SC-E-1.1.3 | Materials can exist in different states – solid, liquid, and gas. Some common materials, such as water, can be changed from one state to another by heating or cooling. | X |
| SC-E-1.2.1 | The position of an object can be described by locating it relative to another object or the background. The position can be described using phrases such as to the right, to the left, 50 cm from the other object. | X | X | X |
| SC-E-1.3.2 | Heat can be produced in many ways such as burning or rubbing. One way heat can move from one object to another is by conduction. Some materials absorb and conduct heat better than others. For example, metal objects conduct heat better than wooden objects. | X | X | X |

#### Earth and Space Science

| SC-E-2.1.1 | Earth materials include solid rocks and soils, water, and the gases of the atmosphere. Minerals that make up rocks have properties of color, texture, and hardness. Soils have properties of color, texture, the capacity to retain water, and the ability to support plant growth. Water on Earth and in the atmosphere can be a solid, liquid, or gas. | X | X |
| SC-E-2.1.2 | Earth materials provide many of the resources humans use. The varied materials have different physical and chemical properties, which make them useful in different ways, for example, as building materials (e.g., stone, clay, marble), as sources of fuel (e.g., petroleum, natural gas), or growing the plants we use as food. | X |
| SC-E-2.2.1 | The Sun provides the light and heat necessary to maintain the temperature of Earth. The Sun’s light and heat are necessary to sustain life on Earth. | X | X |
| SC-E-2.2.2 | Objects in the sky (e.g., Sun, clouds, moon) have properties, locations, and real or apparent movements that can be observed and described. | X |
| SC-E-2.3.2 | Weather changes from day to day and over seasons. Weather can be described by observations and measurable quantities such as temperature, wind direction and speed, and precipitation. | X | X |
| SC-E-2.3.3 | Changes in movement of objects in the sky have patterns that can be observed and described. The Sun appears to move across the sky in the same way every day, but the Sun’s apparent path changes slowly over seasons. The moon moves across the sky on a daily basis much like the Sun. The observable shape of the moon changes from day to day in a cycle that lasts about a month. | X |

#### Life Science

| SC-E-3.1.1 | Things in the environment are classified as living, nonliving, and once living. Living things differ from nonliving things. Organisms are classified into groups by using various characteristics (e.g., body coverings, body structures). | X |
| SC-E-3.1.2 | Organisms have basic needs. For example, animals need air, water, and food; plants need air, water, nutrients, and light. Organisms can survive only in environments in which their needs can be met. | X |
### SC-E-3.1.3
Each plant or animal has structures that serve different functions in growth, survival, and reproduction. For example, humans have distinct body structures for walking, holding, seeing, and talking.

### SC-E-3.3.1
Plants make their own food. All animals depend on plants. Some animals eat plants for food. Other animals eat animals that eat the plants.

### SC-E-3.3.2
The world has many different environments. Distinct environments support the lives of different types of organisms. When the environment changes, some plants and animals survive and reproduce, and others die or move to new locations.

### SC-E-3.3.3
All organisms, including humans, cause changes in the environment where they live. Some of these changes are detrimental to the organism or to other organisms; other changes are beneficial (e.g., dams built by beavers benefit some aquatic organisms but are detrimental to others).

### Scientific Inquiry

<table>
<thead>
<tr>
<th>Students will:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ask simple scientific questions that can be investigated through observations combined with scientific information.</td>
</tr>
<tr>
<td>Use simple equipment (e.g., magnifiers, magnets), tools (e.g., metric rulers, thermometers), skills (e.g., classifying, predicting), technology (e.g., electronic media, calculators, World Wide Web), and mathematics in scientific investigations.</td>
</tr>
<tr>
<td>Use evidence (e.g., observations, data) from simple scientific investigations and scientific knowledge to develop reasonable explanations.</td>
</tr>
<tr>
<td>Design and conduct simple scientific investigations.</td>
</tr>
<tr>
<td>Communicate (e.g., draw, graph, write) designs, procedures, observations, and results of scientific investigations.</td>
</tr>
<tr>
<td>Review and ask questions about scientific investigations and explanations of other students.</td>
</tr>
</tbody>
</table>

### Applications/Connections

| Students will distinguish between natural objects and objects made by humans and examine the interaction between science and technology. Technology (e.g., thermometer, hand lens) is used to study science, while science provides theories for technology. Science is used to design simple technological solutions to problems (e.g., use understanding of heat transfer in designing an insulated container for ice cubes). |
| Students will examine how designing and conducting scientific investigations fosters an understanding of issues related to natural resources (e.g., scarcity), demonstrate how the study of science (e.g., aquaculture, living systems) helps explain changes in environments, and examine the role of science and technology in communities (e.g., location of landfills, new housing developments). |
| Students will examine the role science plays in everyday life. |

### SOCIAL STUDIES

**Government and Civics**

<p>| SS-E-1.1.1 | Democratic governments function according to the needs and wants of the citizens and provide for society’s needs (e.g., police and fire departments, education, highways). |
| SS-E-1.3.1 | Rights and responsibilities of the individual are determined by specific roles within various groups, including family, peer group, class, school, community, state, and country. |</p>
<table>
<thead>
<tr>
<th>Core Content for Assessment – Primary Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Culture and Society</strong></td>
</tr>
<tr>
<td>SS-E-2.1.1 Language, music, art, dress, food, stories, and folktales help define culture and may be shared among various groups.</td>
</tr>
<tr>
<td>SS-E-2.1.2 Elements of culture (e.g., language, music, art, dress, food, stories, folktales) serve to define specific groups and may result in unique perspectives.</td>
</tr>
<tr>
<td>SS-E-2.2.1 All cultures develop institutions, customs, beliefs, and holidays reflecting their unique histories, situations, and perspectives.</td>
</tr>
<tr>
<td>SS-E-2.4.1 As cultures emerge and develop, conflict and competition (e.g., disagreements, arguments, stereotypes, prejudice) may occur.</td>
</tr>
<tr>
<td>SS-E-2.4.2 Compromise and cooperation are tools for social interaction.</td>
</tr>
<tr>
<td><strong>Economics</strong></td>
</tr>
<tr>
<td>SS-E-3.1.1 Scarcity requires people to make choices about using goods, services, and limited resources.</td>
</tr>
<tr>
<td>SS-E-3.1.2 Consumers use goods and services to satisfy economic wants and needs.</td>
</tr>
<tr>
<td>SS-E-3.2.3 The U.S. economic system is based on free enterprise where businesses seek to make profits by producing or selling goods or services.</td>
</tr>
<tr>
<td>SS-E-3.3.1 A market exists whenever buyers and sellers exchange goods and services. Prices and availability of goods and services are determined by supply and demand.</td>
</tr>
<tr>
<td>SS-E-3.4.1 Producers create goods and services; consumers make economic choices about which ones to purchase.</td>
</tr>
<tr>
<td>SS-E-3.4.2 The government provides goods and services (e.g., police force, fire fighting, education, food surpluses) and pays for them with taxes. Private businesses offer similar goods and services (e.g., security guards, private schools, grocery stores) for profit.</td>
</tr>
<tr>
<td>SS-E-3.4.3 Producers who specialize create specific goods or services (e.g., computer games, tennis shoes, movie theatres).</td>
</tr>
<tr>
<td><strong>Geography</strong></td>
</tr>
<tr>
<td>SS-E-4.1.1 Simple physical, political, and thematic maps, globes, charts, photographs, aerial photography, and graphs can be used to find and explain locations and display information.</td>
</tr>
<tr>
<td>SS-E-4.1.2 Every point on Earth has an absolute location defined by latitude and longitude, and a relative location as compared to other points on Earth's surface.</td>
</tr>
<tr>
<td>SS-E-4.1.3 Mental maps are used to demonstrate where things are and how they are arranged.</td>
</tr>
<tr>
<td>SS-E-4.2.1 Every place is unique and can be described by its human (e.g., language, religion, housing) and physical characteristics (e.g., landforms, climates, water).</td>
</tr>
<tr>
<td>SS-E-4.2.2 Regions are areas that have one or more physical or human characteristics in common (e.g., physical: geographical regions of Kentucky, South, Midwest, Western Hemisphere; human: Appalachia, the Cornbelt, Amish country).</td>
</tr>
</tbody>
</table>
### CORE CONTENT FOR ASSESSMENT – PRIMARY GRADES

| SS-E-4.3.1 | Human populations gather in groups of different sizes and in different locations in the world. | X |
| SS-E-4.3.2 | Humans usually settle where there are adequate resources to meet their needs (e.g., areas with water, fertile land, protected land, different modes of transportation). | X X |
| SS-E-4.3.3 | Technology allows humans to settle in areas previously inaccessible. | X |
| SS-E-4.4.1 | People depend upon the physical environment for food, shelter, and clothing. | X X |
| SS-E-4.4.2 | People adapt to or modify the environment (e.g., produce food, build shelter, make clothing) to meet their needs. | X X |
| SS-E-4.4.3 | The physical environment both promotes and limits human activities (e.g., mountains as barriers or as protection, rivers used as boundaries or transportation routes). | X X |
| SS-E-4.4.4 | People may have different perspectives concerning the use of land (e.g., building developments, cutting down rain forest for farming). | X |

### History

| SS-E-5.1.1 | Accounts of historical events are influenced by the perceptions of people and passing of time. | X |
| SS-E-5.1.2 | History can be understood by using a variety of primary and secondary sources and tools (e.g., artifacts, diaries, time lines). | X X |
| SS-E-5.2.2 | People explored and settled America and Kentucky for multiple reasons (e.g., freedoms, opportunities, fleeing negative situations). | |
| SS-E-5.2.3 | The way we live has changed over time for both Kentuckians and Americans because of changes in many areas (e.g., communication, innovations/inventions, homes, transportation, recreation, traditions, education). | X |

### PRACTICAL LIVING/VOCATIONAL STUDIES

#### Health

| PL-E-1.1.1 | Individual behaviors (e.g., etiquette, fairness, politeness, sharing, listening) show responsibility and respect for others (e.g., families, peers, teams). | X X X X X |
| PL-E-1.1.3 | Groups function more effectively when members follow certain behaviors (e.g., conflict-resolution strategies, problem identification, communication). | X X X X |
| PL-E-1.5.3 | Physical fitness is based on an investment of time and effort. | X |
| PL-E-1.6.1 | There are health and safety hazards to recognize and avoid at home, school, and play. | X X |
| PL-E-1.6.3 | There are procedures (e.g., staying calm, heeding warnings, following safety procedures) for dealing with potentially unsafe and threatening situations (e.g., water, fire, animals, earthquake, stranger danger). | X X X X |
### Physical Education

<table>
<thead>
<tr>
<th>PL-E-2.1.1</th>
<th>There are fundamental motor skills for enhancing physical development:</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Locomotor (moving from one place to another) (e.g., walking, running, skipping, hopping, galloping, sliding, leaping, jumping)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonlocomotor (stationary) (e.g., turning, twisting, swinging, swaying, balancing)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PL-E-2.2.2</th>
<th>Frequent practice contributes to improved performance.</th>
<th>X</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>PL-E-2.3.1</th>
<th>Basic rules for participating in simple games (e.g., tag, four-square) and activities (e.g., relays, parachute) are needed to make games fair</th>
<th>X</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>PL-E-2.3.2</th>
<th>Rules of behavior and sportsmanship for spectators and participants during games and/or activities make them safe and enjoyable.</th>
<th>X</th>
</tr>
</thead>
</table>

### Consumerism

<table>
<thead>
<tr>
<th>PL-E-3.1.1</th>
<th>There is a distinction between needs and wants.</th>
<th>X</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>PL-E-3.1.2</th>
<th>Products and services are compared and evaluated based on price, quality, and features.</th>
<th>X</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>PL-E-3.1.4</th>
<th>Through the media, advertisers may attempt to use misleading or exaggerated information and gimmicks to influence consumer decision.</th>
<th>X</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>PL-E-3.3.1</th>
<th>There are community organizations (e.g., fire department, police department, sanitation department, nonprofit health organizations) that provide health and safety services.</th>
<th>X</th>
</tr>
</thead>
</table>

### Vocational Studies

<table>
<thead>
<tr>
<th>PL-E-4.1.1</th>
<th>People need to work (e.g., chores, jobs, employment) to meet basic needs (e.g., food, clothing, shelter), provide self-satisfaction, and provide enjoyment.</th>
<th>X</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>PL-E-4.1.2</th>
<th>Male and female roles are changing in numerous occupations (e.g., medical, corporate, teaching, military, athletics).</th>
<th>X</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>PL-E-4.1.3</th>
<th>There are different job opportunities in the home, school, and community (e.g., home business, flexible schedule).</th>
<th>X</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>PL-E-4.1.4</th>
<th>A person may hold several different jobs before deciding on a career.</th>
<th>X</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>PL-E-4.2.1</th>
<th>Self-knowledge (e.g., interests, abilities) is helpful when selecting and preparing for a career path.</th>
<th>X</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>PL-E-4.2.2</th>
<th>As a person grows and changes, career choices may change.</th>
<th>X</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>PL-E-4.3.1</th>
<th>Personal responsibility and good work habits (e.g., good attendance, honesty, dependability, punctuality, courtesy, cooperation) are important at home, school, and work.</th>
<th>X</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>PL-E-4.3.2</th>
<th>The completion of job responsibilities is important at home, school, and work.</th>
<th>X</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>PL-E-4.4.1</th>
<th>Academic skills (e.g., science, physical education, math, health, reading, writing, social studies, art, music) that relate to various jobs and careers are needed for future success.</th>
<th>X</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>PL-E-4.4.2</th>
<th>Technology (e.g., computer programs, Internet, e-mail, cellular phones, ATM, VCR) is used in many homes, schools, jobs, and careers.</th>
<th>X</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>PL-E-4.4.3</th>
<th></th>
<th>X</th>
</tr>
</thead>
</table>
## CORE CONTENT FOR ASSESSMENT – GRADES 5-7

<table>
<thead>
<tr>
<th>READING</th>
<th>RD-M-x.0.1 Identify an author’s purpose in literary, informational, persuasive, and practical/workplace materials.</th>
<th>X</th>
<th>X</th>
<th>X</th>
<th>X</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RD-M-x.0.5 Formulate questions to guide reading.</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>RD-M-x.0.6 Scan to find key information.</td>
<td>X</td>
<td>X</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>RD-M-x.0.7 Skim to get the general meaning of a passage.</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>RD-M-x.0.8 Make predictions, draw conclusions, and make generalizations about what is read.</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>RD-M-x.0.9 Reflect on and evaluate what is read.</td>
<td>X</td>
<td>X</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>RD-M-x.10 Connect information from a passage to students’ lives and/or real world issues.</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>RD-M-1.0.11 Explain the meaning of a passage taken from texts appropriate for middle-level students</td>
<td>X</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>RD-M-1.0.14 Analyze the relationship between events in a story and a character’s behavior.</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>RD-M-1.0.15 Explain how a conflict in a passage is resolved.</td>
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<td></td>
<td>RD-M-2.0.11 Use text features (e.g., lists, charts, graphs, tables of contents, indexes, glossaries, captions, diagrams, headings) to understand a passage.</td>
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<td></td>
<td>RD-M-2.0.12 Apply knowledge of organizational patterns (e.g., cause and effect, comparison, contrast, sequence) to understand a passage.</td>
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<td>RD-M-2.0.13 Identify supporting details and explain their importance in a passage.</td>
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<td>RD-M-2.0.14 Summarize information from a passage.</td>
<td>X</td>
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<td>RD-M-3.0.12 Identify an author’s opinion about a subject.</td>
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<td>RD-M-3.0.13 Apply knowledge of organizational patterns (e.g., cause and effect, comparison, contrast, sequence) to understand a passage.</td>
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<td>RD-M-3.0.14 Distinguish between fact and opinion.</td>
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<td>RD-M-3.0.15 Identify the argument and supporting evidence.</td>
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<td>RD-M-3.0.17 Identify bias and/or misinformation.</td>
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<td></td>
<td>RD-M-4.0.11 Locate and apply information for a specific purpose (e.g., following directions, completing a task).</td>
<td>X</td>
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<td></td>
<td>RD-M-4.0.12 Identify the sequence of activities needed to carry out a procedure.</td>
<td>X</td>
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<td>RD-M-4.0.13 Explain how organizational patterns and/or text features (e.g., pictures, charts, graphs, format) relate to the content of a practical/workplace passage.</td>
<td>X</td>
<td>X</td>
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<td></td>
<td>RD-M-4.0.14 Interpret the meaning of specialized vocabulary.</td>
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</tbody>
</table>
### Core Content for Assessment – Grades 5-7

#### Writing

| WR-M-1.4 | Transactive writing is informative/persuasive writing that presents ideas and information for authentic audiences to accomplish realistic purposes like those students will encounter in their lives. In transactive writing, students will write in a variety of forms such as the following: Letters; Speeches; Editorials; Articles in magazines, Academic journals, Newspapers; Proposals; Brochures; Other kinds of practical/workplace writing  
Characteristics of transactive writing may include: Text and language features of the selected form; Information to engage/orient the reader to clarify and justify purposes; Ideas which communicate the specific purpose for an intended audience; Explanation and support to help the reader understand the author’s purpose; Well-organized idea development and support (e.g., facts, examples, reasons, comparisons, anecdotes, descriptive detail, charts, diagrams, photos/pictures) to accomplish the specific purpose; Effective conclusions | X | X | X |

#### Mathematics

**Number/Computation**

| MA-M-1.1.1 | Rational numbers (integers, fractions, decimals, percents). | X | X | X |
| MA-M-1.1.3 | Meaning of proportion (equivalent ratios). | X |
| MA-M-1.1.6 | Representation of numbers and operations in a variety of equivalent forms using models, diagrams, and symbols (e.g., number lines, 10 by 10 grids, rectangular arrays, number sentences). | X |
| MA-M-1.2.1 | Add, subtract, multiply, and divide rational numbers (fractions, decimals, percents, integers) to solve problems. | X | X | X |
| MA-M-1.2.2 | Compute (e.g., estimate, use pencil and paper, use calculator, round, use mental math) large and small quantities and check for reasonable and appropriate computational results. | X | X | X |
| MA-M-1.2.3 | Apply ratios, proportional reasoning, and percents (e.g., constant rate of change, unit pricing). | X | X |

**Geometry/Measurement**

| MA-M-2.1.1 | Basic geometric elements that include points, segments, rays, lines, angles, and planes. | X | X |
| MA-M-2.1.2 | Two-dimensional shapes including circles, regular polygons, quadrilaterals (square, rectangle, rhombus, parallelogram, trapezoid), and triangles (acute, obtuse, right, equilateral, scalene, isosceles). | X |
| MA-M-2.1.4 | Congruence, symmetry, and similarity. | X |
| MA-M-2.1.5 | U.S. Customary and metric units of measurement. | X | X | X |
| MA-M-2.2.1 | Identify characteristics (e.g., sides, vertices, angles, faces, edges, congruent parts) of two-dimensional and three-dimensional shapes. | X |
| MA-M-2.2.2 | Use appropriate tools and strategies (e.g., combining and subdividing shapes) to find measures of both regular and irregular shapes. | X | X |
| MA-M-2.2.4 | Estimate measurements in standard units. | X |
| MA-M-2.3.1 | How measurements and measurement formulas are related or different (perimeter and area; rate, time and distance; circumference and area of a circle). | X |
| MA-M-2.3.3 | How proportional figures are related (scale drawing, similar figures). | X |
### CORE CONTENT FOR ASSESSMENT – GRADERS 5-7

<table>
<thead>
<tr>
<th>Probability/Statistics</th>
<th>Recipe for a Fire</th>
<th>Stepping the Flames</th>
<th>Fire &amp; Man – Friend or Foe</th>
<th>Hot Habitats</th>
<th>Plot Monitoring</th>
<th>Acre by Acre</th>
<th>Fire &amp; Weather</th>
<th>Weather in your Pocket</th>
<th>Firefighting Costs</th>
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<tbody>
<tr>
<td>MA-M-3.1.2 Meaning of dispersion (range, cluster, gaps, outliers)</td>
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<td>MA-M-3.1.3 Characteristics and appropriateness of graphs (e.g., bar, line, circle), and plots (e.g., line, stem-and-leaf, box-and-whiskers, scatter).</td>
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<tr>
<td>MA-M-3.2.1 Organize, represent, analyze, and interpret sets of data.</td>
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<tr>
<td>MA-M-3.2.2 Construct and interpret displays of data (e.g., table, circle graph, line plot, stem-and-leaf plot, box-and-whiskers plot).</td>
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<td>MA-M-3.2.3 Find mean, median, mode, and range; recognize outliers, gaps, and clusters of data.</td>
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<td>MA-M-3.2.5 Make predictions and draw conclusions from statistical data and probability experiments.</td>
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<td>MA-M-3.2.6 Use counting techniques, tree diagrams, area models, and tables to solve probability problems.</td>
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<tr>
<td>MA-M-3.3.1 How different representations of data (e.g., tables, graphs, diagrams, plots) are related.</td>
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<td>MA-M-3.3.3 How data gathering, bias issues, faulty data analysis, and misleading representations affect interpretations and conclusions about data (e.g., changing the scale on a graph, polling only a specific group of people, using limited or extremely small sample size).</td>
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<tr>
<td>MA-M-3.3.4 How probability and statistics are used to make predictions and/or draw conclusions.</td>
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</table>

### Algebraic Ideas

| MA-M-4.1.3 Rectangular (Cartesian) coordinate system/grid and ordered pairs. |                    |                     |                             |              |                |              |                |                          |                    |

### SCIENCE

#### Physical Science

| SC-M-1.1.1 A substance has characteristic physical properties (e.g., density, boiling point, solubility) that are independent of the amount of the sample. A mixture of substances often can be separated into the original substances by using one or more of these characteristic physical properties. |                   |                     |                             |              |                |              |                |                          |                    |
| SC-M-1.1.2 The chemical properties of a substance cause it to react in predictable ways with other substances to form compounds with different characteristic properties. In chemical reactions, the total mass is conserved. Substances are often classified into groups if they react in similar ways. |                   |                     |                             |              |                |              |                |                          |                    |
| SC-M-1.2.1 The motion of an object can be described by its relative position, direction of motion, and speed. That motion can be measured and represented on a graph. |                   |                     |                             | X            |                |              |                |                          |                    |
| SC-M-1.2.3 When an unbalanced force acts on an object, the change in speed and/or direction depends on the size and direction of the force. |                   |                     |                             | X            |                |              |                |                          |                    |
| SC-M-1.3.1 Energy is a property of many substances and is associated with heat, light, electricity, and sound. Energy is transferred in many ways. |                   |                     |                             | X            |                |              |                |                          |                    |
| SC-M-1.3.2 Heat energy moves in predictable ways, flowing from warmer to cooler ones, until both objects reach the same temperature. |                   |                     |                             | X            |                |              |                |                          |                    |
| SC-M-1.3.4 The Sun is a major source of energy for changes on Earth’s surface. The Sun loses energy by emitting light. A tiny fraction of that light reaches Earth, transferring energy from the Sun to Earth. |                   |                     |                             | X            |                |              |                |                          |                    |
### Earth and Space Science

| SC-M-2.1.6 | Earth is surrounded by a relatively thin blanket of air called the atmosphere. The atmosphere is a mixture of nitrogen, oxygen, and trace gases that include water vapor. The atmosphere has different properties at different elevations. | X |
| SC-M-2.1.7 | Global patterns of atmospheric movement influence local weather. Oceans have a major effect on climate, because water in the oceans holds a large amount of heat. | X X |
| SC-M-2.2.1 | The Earth’s processes we see today, including erosion, movement of lithospheric plates, and changes in atmospheric composition, are similar to those that occurred in the past. Earth’s history is also influenced by occasional catastrophes such as the impact of an asteroid or comet. | X |
| SC-M-2.3.4 | The Sun is the major source of energy for Earth. The water cycle, winds, ocean currents, and growth of plants are affected by the Sun’s energy. Seasons result from variations in the amount of the Sun’s energy hitting Earth’s surface. | X X X |

### Life Science

| SC-M-3.2.1 | All organisms must be able to obtain and use resources, grow, reproduce, and maintain stable internal conditions while living in a constantly changing external environment. | X |
| SC-M-3.5.1 | A population consists of all individuals of a species that occur together at a given place and time. All populations living together and the physical factors with which they interact compose an ecosystem. | X |
| SC-M-3.5.4 | The number of organisms an ecosystem can support depends on the resources available and abiotic factors (e.g., quantity of light and water, range of temperatures, soil composition). Given adequate biotic and abiotic resources and no diseases or predators, populations (including humans) increase at rapid rates. Lack of resources and other factors, such as predation and climate, limit the growth of populations in specific niches in the ecosystem. | X X |

### Scientific Inquiry

- Students will:
  - Refine and refocus questions that can be answered through scientific investigation combined with scientific information.
  - Use appropriate equipment, tools, techniques, and mathematics to gather, analyze, and interpret scientific data.
  - Use evidence (e.g., computer models), logic, and scientific knowledge to develop scientific explanations.
  - Design and conduct scientific investigations.
  - Communicate (e.g., write, graph) designs, procedures, observations, and results of scientific investigations.
  - Review and analyze scientific investigations and explanations of other students.

| | X | X | X |
**CORE CONTENT FOR ASSESSMENT – GRADES 5-7**

### APPLICATIONS/CONNECTIONS

<table>
<thead>
<tr>
<th>Recipe for a Fire</th>
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</table>

**Applications/Connections**

- Students will describe how science helps drive technology and technology helps drive science. Because perfectly designed solutions do not exist, technological solutions have intended benefits and unintended consequences. X X X

- Students will describe the individual’s roles and responsibilities in the following areas: changes in populations, resources and environments including ecological crises and environmental issues, natural hazards, science and technology in society, and personal and societal issues about risks and benefits. X X

- Students will demonstrate the role science plays in everyday life: past, present, and future. Science is a human endeavor. Men and women of various social and ethnic backgrounds engage in activities of science (to include careers in science). Scientists formulate and test their explanations of nature using observations, experiments, and theoretical and mathematical models. It is part of scientific inquiry to evaluate the results of scientific investigations, experiments, observations, theoretical models, and the explanations proposed by other scientists. X X X X

### SOCIAL STUDIES

**Culture and Society**

- SS-M-2.1.1 Culture is influenced by language, literature, arts, beliefs, and behaviors and may result in unique perspectives. X

- SS-M-2.2.1 All cultures develop institutions, customs, beliefs, and holidays reflecting their unique histories, situations, and perspectives. X

- SS-M-2.4.1 Conflict and competition (e.g., political, economic, religious, ethnic) may occur as cultures emerge and develop. X

- SS-M-2.4.2 Compromise and cooperation are possible choices for positive social interaction and resolution of conflict. X

**Economics**

- SS-M-3.1.2 To make informed choices, consumers must analyze advertisements, consider personal finances, and examine the opportunity cost. X

- SS-M-3.3.1 Prices of goods and services are determined by supply and demand. The market price is reached when quantity supplied equals quantity demanded. X

- SS-M-3.3.2 Money (unit of account) can be used to express the market value of goods and services. Money makes it easier to trade, borrow, invest, and save. X

- SS-M-3.3.3 Competition among buyers and sellers impacts the price of goods and services. X

- SS-M-3.4.3 Personal, national, and international economic activities are interdependent. X

**Geography**

- SS-M-4.1.1 Maps (e.g., map projections – Mercator and Robinson), globes, photographs, models, and satellite images are representations of Earth with different characteristics and uses. X

- SS-M-4.1.2 Different factors (e.g., rivers, dams, developments) affect where human activities are located and how land is used in urban, rural, and suburban areas. X
### CORE CONTENT FOR ASSESSMENT – GRADES 5-7

| SS-M-4.2.1 | Places can be made distinctive by human activities (e.g., building houses, stores, roads, railroads, irrigation) that alter physical features. | X |
| SS-M-4.2.2 | Places and regions change over time as new technologies, resources, and knowledge become available. | X |
| SS-M-4.2.3 | Regions can be different in size and defined in different ways. | X |
| SS-M-4.3.1 | Human settlement develops in different ways based on the culture and needs of settlers. | X |
| SS-M-4.3.2 | Human populations may change and/or migrate because of factors such as war, famine, disease, economic opportunity, and technology. | X |
| SS-M-4.4.1 | Technology assists human modification of the physical environment (e.g., damming a river, irrigating a desert, cooling or heating a living area). | X |
| SS-M-4.4.2 | The physical environment both promotes and limits human activities (e.g., exploration, migration, trade). | X |
| SS-M-4.4.3 | The natural resources of a place or region impact its political, social, and economic development. | X |
| SS-M-4.4.4 | Individual perspectives impact the use of natural resources (e.g., watering lawns, planting gardens, recycling paper). | X |

### History

| SS-M-5.1.1 | Different perspectives (e.g., gender, race, region, ethnic group, nationality, age, economic status, religion, politics) result in different interpretations of historical events. | X |
| SS-M-5.1.2 | Primary sources, secondary sources, artifacts, and time lines are essential tools in the study and interpretation of history. | X |
| SS-M-5.1.3 | History is a series of connected events shaped by multiple cause-and-effect relationships, tying the past to the present. | X |
| SS-M-5.2.3 | The growth of democracy and geographic expansion were significant in American history (e.g., Louisiana Purchase, Manifest Destiny, impact on Native Americans, early industrialization, early women’s rights movement). | X |

### PRACTICAL LIVING/VOCATIONAL STUDIES

### Health

| PL-M-1.1.1 | Individuals have personal rights and responsibilities (e.g., cooperation, communication, patience) when dealing with others (e.g., families, classmates, teams). | X |
| PL-M-1.1.3 | Communication, cooperation, rules, and respect are important to the effective functioning of groups. | X |
| PL-M-1.6.3 | Using safety strategies (e.g., walking in opposite direction of violence, staying calm in dangerous situations) and wearing protective gear (e.g., helmets, knee pads, elbow pads) reduce the incidence of injury or death. | X |
| PL-M-1.8.1 | The use of appropriate strategies (e.g., assertiveness, refusal skills, decision-making techniques) are positive ways to cope with peer pressure. | X |
### Physical Education

<table>
<thead>
<tr>
<th>PL-M-2.1.1</th>
<th>Principles of motor skills refinement (e.g., accuracy, technique, movement) require a logical and sequential approach.</th>
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</thead>
<tbody>
<tr>
<td>PL-M-2.2.2</td>
<td>Techniques (e.g., practice, self-evaluation) used to develop skills are related to performance in games and/or sports.</td>
</tr>
<tr>
<td>PL-M-2.2.3</td>
<td>Frequency, intensity, and time/duration are the principles of fitness training and conditioning.</td>
</tr>
<tr>
<td>PL-M-2.3.1</td>
<td>Knowledge of offensive and defensive strategies in games and/or sports makes them interesting and enjoyable.</td>
</tr>
<tr>
<td>PL-M-2.3.2</td>
<td>Rules of behavior and fair play (e.g., accepting authoritative decisions, assessing one’s own performance level, accepting skills and abilities of others through verbal and nonverbal actions for spectators and/or participants) during games are necessary.</td>
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</table>

### Consumerism

<table>
<thead>
<tr>
<th>PL-M-3.1.1</th>
<th>A comparison of needs vs. wants will influence consumer decisions.</th>
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<tbody>
<tr>
<td>PL-M-3.1.2</td>
<td>Products and services are compared and evaluated based on a range of considerations (e.g., price vs. quality, generic vs. name brand, comparison shopping vs. impulse shopping, immediate availability vs. advance ordering).</td>
</tr>
<tr>
<td>PL-M-3.1.4</td>
<td>There are positive and negative aspects of advertising strategies (e.g., providing accurate or misleading information, gimmicks).</td>
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<tr>
<td>PL-M-3.1.5</td>
<td>Environmental issues (e.g., pollution) should be considered when making consumer decisions (e.g., recycling, reducing, reusing).</td>
</tr>
<tr>
<td>PL-M-3.3.1</td>
<td>A range of resources and services are provided by community agencies: public health department, fire department, police department, family resource centers, hospitals, nonprofit organizations (e.g., American Heart Association, American Red Cross, American Cancer Society).</td>
</tr>
<tr>
<td>PL-M-3.3.2</td>
<td>Improving environmental conditions (e.g., air and water quality) and preserving natural resources impact personal and community health.</td>
</tr>
</tbody>
</table>

### Vocational Studies

<table>
<thead>
<tr>
<th>PL-M-4.1.1</th>
<th>People work to provide for their wants (e.g., entertainment, hobbies, brand-name clothing/shoes) and needs (e.g., food, clothing, shelter) and often for personal satisfaction (e.g., self-worth).</th>
</tr>
</thead>
<tbody>
<tr>
<td>PL-M-4.1.2</td>
<td>Work (e.g., manufacturing, construction, health care, food services) is important to society because it provides necessary goods and services for individuals and groups.</td>
</tr>
<tr>
<td>PL-M-4.1.3</td>
<td>Jobs and career opportunities (e.g., manufacturing, business/industry, food services, natural resources, entertainment) vary within and among communities and global regions based, in part, on available resources.</td>
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<tr>
<td>Core Content for Assessment – Grades 5-7</td>
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<td>-----------------------------------------</td>
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<tr>
<td><strong>PL-M-4.1.4</strong> New jobs and careers emerge and others are deleted due to the needs of society (e.g., increased need for nursing home care due to people living longer, day care due to more people working).</td>
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<tr>
<td><strong>PL-M-4.2.1</strong> Interests and abilities can be identified through a variety of means (e.g., formal assessment, trying new experiences, job fair).</td>
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<tr>
<td><strong>PL-M-4.2.2</strong> Jobs and careers differ in ways that match a person’s interests, aptitudes, and career goals (e.g., salary, benefits, demands of job, work environment).</td>
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<tr>
<td><strong>PL-M-4.2.3</strong> There are resources (e.g., Internet, government, publications, newspapers, magazines, counselors) and experiences (e.g., shadowing, mentoring) available for locating job and career information.</td>
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<tr>
<td><strong>PL-M-4.2.4</strong> There are various postsecondary options available (e.g., technical or vocational schools, 2-year college, 4-year college, apprenticeship, military service).</td>
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<tr>
<td><strong>PL-M-4.3.2</strong> The work habits and work ethics (e.g., cooperation, respect, time, management, team/individual responsibilities) of an individual can impact the success of a group.</td>
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<tr>
<td><strong>PL-M-4.4.1</strong> Certain academic skills (e.g., communication, research, math, science) are important to specific jobs or careers.</td>
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<tr>
<td><strong>PL-M-4.4.3</strong> Both individual and team skills (e.g., identify goals, use listening skills, follow directions, communicate orally, ask questions about tasks, use problem-solving skills) contribute to the successful completion of a task.</td>
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## READING

| RD-H-x.0.1 | Locate, evaluate, and apply information for a realistic purpose. | X | X | X | X |
| RD-H-x.0.6 | Paraphrase important parts of a passage. | X |
| RD-H-x.0.7 | Formulate opinions in response to a reading passage. | X |
| RD-H-1.0.8 | Interpret the meaning of a passage taken from texts appropriate for high school. | X |
| RDH-1.0.15 | Make connections among literature, students' lives, and/or real-world issues. | X |
| RDH-2.0.8 | Use text features (e.g., illustrations, charts, lists, tables, graphs, tables of contents, indexes, glossaries, headings, captions) to enhance understanding of a passage. | X | X | X | X |
| RDH-2.0.10 | Evaluate the effectiveness of organization and format in fulfilling the purpose of a passage. | X |
| RDH-2.0.11 | Evaluate the use of supporting details as they relate to the author's message. | X |
| RDH-2.0.12 | Make predictions and draw conclusions based on what is read. | X |
| RDH-2.0.13 | Analyze the content as it applies to students' lives and/or real world issues. | X | X |
| RD-H-3.0.9 | Identify an author's position based on evidence in a passage. | X |
| RDH-3.0.10 | Recognize the appropriateness of an argument for an intended audience. | X |
| RDH-3.0.11 | Accept or reject an argument giving supporting evidence from the passage. | X |
| RDH-3.0.12 | Compare and contrast differing points of view in two or more passages. | X |
| RDH-4.0.8 | Identify essential information needed to accomplish a task. | X | X | X | X |
| RDH-4.0.9 | Apply the information contained in practical/workplace materials. | X | X | X | X |
| RDH-4.0.10 | Follow the sequence of information. | X | X | X | X |
| RDH-4.0.11 | Utilize page format and layout (graphics and organizational aids such as bullets, bold face type, italics and indentation) to interpret information. | X | X | X | X |
| RDH-4.0.12 | Interpret the meaning of specialized vocabulary. | X | X |
## WRITING

| WR-H-1.4 | Transactive writing is informative/persuasive writing that presents ideas and information for authentic audiences to accomplish realistic purposes like those students will encounter in their lives. In transactive writing, students will write in a variety of forms such as the following: Letters; Speeches; Editorials; Articles in magazines, Academic journals, Newspapers; Proposals; Brochures; Other kinds of practical/workplace writing. Characteristics of transactive writing may include: Text and language features of the selected form; Information to engage/orient the reader to clarify and justify purposes; Ideas which communicate the specific purpose for the intended audience; Explanation and support to help the reader understand the author’s purpose; Well-organized idea development and support (e.g., facts, examples, reasons, comparisons, anecdotes, descriptive detail, charts, diagrams, photos/pictures) to accomplish a specific purpose; Effective conclusions. |

## MATHEMATICS

### Number/Computation

| MA-H-1.1.1 | Students will describe properties of, define, give examples of, and apply real numbers to both real-world and mathematical situations, and understand that irrational numbers cannot be represented by terminating or repeating decimals. |
| MA-H-1.1.2 | Students will recognize, define, give examples of, and apply to both real-world and mathematical situations finite arithmetic and geometric sequences and series. |
| MA-H-1.1.3 | Students will understand how matrices are used to represent real-world data. |
| MA-H-1.2.1 | Students will perform addition, subtraction, multiplication, and division with real numbers in problem-solving situations to specified accuracy. |
| MA-H-1.2.3 | Students will use matrix addition, subtraction, multiplication (no larger than 2 by 2), and scalar multiplication to solve real-world problems. |
| MA-H-1.2.5 | Students will use simple combinations and permutations to count discrete quantities. |
| MA-H-1.3.3 | Students will understand how to use equivalence relations (reflexive, symmetric, transitive) and order relations (less than, greater than, equal to) to solve problems using real numbers. |
| MA-H-1.3.4 | Students will understand how ratio and proportion can be used in a variety of mathematical contexts and to solve real-world problems. |

### Geometry/Measurement

| MA-H-2.2.3 | Students will determine height and distance using methods of indirect measurement such as similar triangles (including shadow or mirror method) and right triangle relationships (including trigonometric ratios). |

### Probability/Statistics

| MA-H-3.1.3 | Students will describe and give examples of various sampling techniques and biases in data collection. |
| MA-H-3.2.1 | Students will analyze, interpret results, make decisions, and draw conclusions based on a set of data. |
| MA-H-3.2.3 | Students will organize, display, and interpret statistical models (tables, graphs) of bivariate data. |
### Core Content for Assessment – Grades 8-12

| MA-H-3.2.4 | Students will interpret the results of a probability simulation, draw conclusions, and make predictions. | X | X | X | X |
| MA-H-3.2.6 | Students will determine probabilities in situations involving replacement and non-replacement. | | X |
| MA-H-3.3.2 | Students will describe how sampling techniques can influence results. | X | X | X |
| MA-H-3.3.3 | Students will understand and reason about the use and misuse of statistics and statistical representations such as type of graph and choice of scale. | | | X |

#### Algebraic Ideas

| MA-H-4.1.1 | Students will understand the concept of a function and roles of independent and dependent variables. | X |
| MA-H-4.2.4 | Students will create tables of numerical values of functions including linear, quadratic, absolute value, exponential, and simple piecewise such as some long distance phone rates. | X | X | X |

### Science

#### Physical Science

| SC-H-1.3.1 | Chemical reactions occur all around us and in every cell in our bodies. These reactions may release or consume energy. Rates of chemical reactions vary. Reaction rates depend on concentration, temperature, and properties of reactants. Catalysts speed up chemical reactions. | X |
| SC-H-1.4.1 | Objects change their motion only when a net force is applied. Laws of motion are used to describe the effects of forces on the motion of objects. | | X |

#### Earth and Space Science

| SC-H-2.1.3 | Heating of Earth’s surface and atmosphere by the Sun drives convection within the atmosphere and oceans, producing winds and ocean currents. | X | X |
| SC-H-2.1.4 | Global climate is determined by energy transfer from the Sun at and near Earth’s surface. This energy transfer is influenced by dynamic processes such as cloud cover and the Earth’s rotation and static conditions such as the position of mountain ranges and oceans. | X | X |

#### Life Science

| SC-H-3.2.2 | Behavioral responses to internal changes and external stimuli can be innate or learned. Responses to external stimuli can result from interactions with the organism’s own species and/or other species, as well as environmental changes. | X | X |
| SC-H-3.2.3 | The broad patterns of behavior exhibited by organisms have changed over time through natural selection to ensure reproductive success. Organisms often live in unpredictable environments, so their behavioral responses must be flexible enough to deal with uncertainty and change. Behaviors often have an adaptive logic. | | X |
| SC-H-3.4.3 | Biological classifications are based on how organisms are related. Organisms are classified into a hierarchy of groups and subgroups based on similarities that reflect their relationships. Species is the most fundamental unit of classification. Different species are classified by the comparison and analysis of their internal and external structures and the similarity of their chemical processes. | | X |
| SC-H-3.5.3 | Organisms both cooperate and compete in ecosystems. Often changes in one component of an ecosystem will have effects on the entire system that are difficult to predict. The interrelationships and interdependencies of these organisms may generate ecosystems that are stable for hundreds or thousands of years. | | X |
## SC-H-3.5.4 Living organisms have the capacity to produce populations of infinite size. However, behaviors, environments, and resources influence the size of populations. Models (e.g., mathematical, physical, conceptual) can be used to make predictions about changes in the size or rate of growth of a population.

## SC-H-3.5.5 Human beings live within the world’s ecosystems. Human activities can deliberately or inadvertently alter the dynamics in ecosystems. These activities can threaten current and future stability and, if not addressed, ecosystems can be irreversibly affected.

### Scientific Inquiry

Students will:
- Formulate testable hypotheses and demonstrate the logical connections between the scientific concepts guiding a hypothesis and the design of an experiment.
- Use equipment, tools, technology, and mathematics to improve scientific investigations and communications.
- Use evidence, logic, and scientific knowledge to develop and revise scientific explanations and models.
- Design and conduct different kinds of scientific investigations.
- Communicate and defend the designs, procedures, observations, and results of scientific investigations.
- Review and analyze scientific investigations and explanations of other investigators, including peers.

### Applications/Connections

Students will apply scientific theory and conceptual understandings to solve problems of technological design and examine the interaction between science and technology.

Students will explore the impact of scientific knowledge and discoveries on personal and community health; recognize how science influences human population growth, use science to analyze the use of natural resources by an increasing human population; investigate how science can be used to solve environmental quality problems, use science to investigate natural and human-induced hazards; and analyze how science and technology are necessary but not sufficient for solving local, national, and global issues.

Students will analyze the role science plays in everyday life and compare different careers in science; recognize that scientific knowledge comes from empirical standards, logical arguments, and skepticism, and is subject to change as new evidence becomes available; and investigate advances in science and technology that have important and long-lasting effects on science and society.

### SOCIAL STUDIES

#### Government and Civics

SS-H-1.3.1 The rights of one individual (e.g., smoking in public places, free speech) may, at times, be in conflict (e.g., slander, libel) with the rights of another.

#### Culture and Society

SS-H-2.1.1 Philosophy, religion, values, technology, and behavior patterns help define culture.

SS-H-2.2.1 All cultures develop institutions, customs, beliefs, and holidays reflecting their unique histories, situations, and perspectives.
### Core Content for Assessment – Grades 8-12

<table>
<thead>
<tr>
<th></th>
<th>Recipe for a Fire</th>
<th>Stopping the Flames</th>
<th>Hot Habitats</th>
<th>Plot Monitoring</th>
<th>Acre by Acre</th>
<th>Fire &amp; Weather</th>
<th>Weather in your Pocket</th>
<th>Firefighting Costs</th>
<th>Money</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SS-H-2.4.1</strong> As cultures emerge and develop, conflict and competition (e.g., violence, difference of opinion, stereotypes, prejudice, discrimination, genocide) may occur.</td>
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<td><strong>Economics</strong></td>
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<tr>
<td><strong>SS-H-3.1.2</strong> Federal, state, and local governments have limited budgets, so they must compare revenues to costs when planning public projects.</td>
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<tr>
<td><strong>SS-H-3.1.3</strong> To make informed choices, consumers must analyze advertisements, consider personal finances (including the importance of savings, investment, and use of credit), and examine opportunity cost.</td>
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<td><strong>Geography</strong></td>
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<tr>
<td><strong>SS-H-4.1.1</strong> Representations of Earth and databases can be used to analyze the distribution of physical and human features on Earth’s surface.</td>
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<tr>
<td><strong>SS-H-4.1.2</strong> Mental maps, the mental image a person has of an area including knowledge of features and spatial relationships, become more complex as experience, study, and the media bring new geographic information.</td>
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<td><strong>SS-H-4.2.2</strong> Physical characteristics create advantages and disadvantages for human activities in a specific place.</td>
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<tr>
<td><strong>SS-H-4.2.3</strong> People can develop stereotypes about places and regions (e.g., all cities are dangerous and dirty; rural areas are poor).</td>
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<tr>
<td><strong>SS-H-4.2.4</strong> People from different cultures or with different perspectives view regions (e.g., Middle East, Balkans) in different ways, sometimes resulting in conflict.</td>
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<tr>
<td><strong>SS-H-4.3.2</strong> Human migration has major physical and cultural impacts and can be the result of pressures or events that push populations from one place or pull them to another (e.g., push factors such as famines or military conflicts; pull factors such as climate or economic opportunity).</td>
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<td><strong>SS-H-4.4.1</strong> Humans develop strategies (e.g., transportation, communication, technology) to overcome limits of their physical environment.</td>
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<td><strong>SS-H-4.4.3</strong> Natural disasters may affect decisions relative to human activities (e.g., adopting building codes, buying flood insurance).</td>
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<td><strong>SS-H-4.4.4</strong> Group and individual perspectives impact the use of natural resources (e.g., mineral extraction, land reclamation).</td>
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<td><strong>History</strong></td>
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<tr>
<td><strong>SS-H-5.1.1</strong> Interpretations of history are subject to change as new information is uncovered.</td>
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<tr>
<td><strong>SS-H-5.1.2</strong> Primary sources allow individuals to experience history from the perspectives of people who lived it.</td>
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<tr>
<td><strong>SS-H-5.1.3</strong> Cause-and-effect relationships can be analyzed by looking at multiple causation (e.g., individual influences, ideas and beliefs, technology, resources).</td>
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# CORE CONTENT FOR ASSESSMENT – GRADES 8-12

## PRACTICAL LIVING/VOCATIONAL STUDIES

### Health

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td>PL-H-1.1.1</td>
<td>There are behaviors (e.g., constructive communication; fulfilling commitments; cooperation; demonstrating healthy ways to express needs, wants, feelings) that show respect and responsibility to self and others.</td>
<td>X X X X X</td>
</tr>
<tr>
<td>PL-H-1.1.2</td>
<td>Conflict-resolution strategies (e.g., peer mediation, avoiding confrontation) and the analysis of causes of conflict (e.g., violence, harassment, money problems, health problems, oppressive environments, racism) in families, schools, and communities may bring about peaceful conclusions.</td>
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<tr>
<td>PL-H-1.1.3</td>
<td>Individuals need to understand changes in roles, responsibilities, and skills needed to effectively work in groups throughout life.</td>
<td>X X X X X X</td>
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<tr>
<td>PL-H-1.3.1</td>
<td>Decisions which promote health and prevent illnesses, diseases, and injuries contribute positively to personal well-being.</td>
<td>X</td>
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<tr>
<td>PL-H-1.5.3</td>
<td>Applying the principles of fitness training and conditioning (frequency, intensity, time/duration) impact physical development.</td>
<td>X</td>
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<tr>
<td>PL-H-1.6.2</td>
<td>Practicing safety procedures (e.g., use seat belts, life vests, and helmets; avoid overcrowding vehicles) and eliminating daredevil stunts can save lives.</td>
<td>X X</td>
</tr>
<tr>
<td>PL-H-1.6.3</td>
<td>There are strategies (e.g., not sharing personal eating, drinking, and grooming utensils; regular medical and dental check ups; proper use of machinery; adhering to safety rules for firearms use and storage) that help adolescents and adults avoid health and safety hazards.</td>
<td>X</td>
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<tr>
<td>PL-H-1.6.4</td>
<td>There are emergency procedures (e.g., CPR, first aid) for responding to emergency situations (e.g., overdose, drowning, car accidents, heart attacks, seizures).</td>
<td>X X</td>
</tr>
<tr>
<td>PL-H-1.8.3</td>
<td>There are strategies (e.g., setting realistic goals, time and task management, planning, decision-making processes, perseverance) for building success as adults.</td>
<td>X X X X</td>
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</tbody>
</table>

### Physical Education

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>PL-H-2.1.1</td>
<td>There are principles (e.g., accuracy, technique, physics, mechanics) for learning and improving advanced motor skills.</td>
<td>X</td>
</tr>
<tr>
<td>PL-H-2.1.2</td>
<td>Analysis of specialized movement patterns (e.g., swinging of golf clubs, shooting basketballs) and sequence evaluation (e.g., positioning, performing, following through) can be used to make recommendations for improvement in skills and used in individual, dual, and team sports (e.g., golf, racket sports, softball, volleyball, basketball).</td>
<td>X</td>
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<tr>
<td>PL-H-2.2.2</td>
<td>Techniques (e.g., practice, peer or coach evaluation, individualized coaching) to achieve performance consistency in games and/or sports must be used.</td>
<td>X X</td>
</tr>
<tr>
<td>PL-H-2.2.3</td>
<td>Principles of fitness training and conditioning (frequency, intensity, time/duration) impact one’s ability to participate in activities.</td>
<td>X</td>
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<tr>
<td>PL-H-2.3.1</td>
<td>There are offensive and defensive strategies as well as basic rules of play for a variety of games and sports.</td>
<td>X X X</td>
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<tr>
<td>PL-H-2.3.2</td>
<td>Rules, fair play, and cooperation for spectators and sportsmanship on the part of spectators and participants during organized games and sports will benefit all.</td>
<td>X X X</td>
</tr>
</tbody>
</table>
### Consumerism

| PL-H-3.1.1 | The use of strategies (e.g., studying advertisements, reading the fine print) and techniques for evaluating various forms of consumer information (e.g., products, contracts, leases, warranties) contribute to wise purchases. |
| PL-H-3.1.4 | Methods and techniques of advertising exert an influence on consumer choices for products and services. |
| PL-H-3.1.5 | Consumer decisions have both short- and long-term impacts (e.g., water, air, and land pollution; greenhouse effect) on the environment. |
| PL-H-3.3.3 | The roles of individuals and society in protecting the environment and preserving resources include recycling, conserving, and establishing standards for waste disposal. |

### Vocational Studies

| PL-H-4.1.2 | Work has social and economic impacts on the individual, family, and society. |
| PL-H-4.1.3 | Job and career opportunities vary at the state, national, and international levels based on demand for goods and services and available resources. |
| PL-H-4.2.1 | Short- and long-term career goals should be based on an individual's personality, values, interests, aptitudes, abilities, and postsecondary opportunities. |
| PL-H-4.2.2 | There are basic academic skills (e.g., communication, research, math, science) and preparation levels (e.g., past work experience and training, leadership, certification) required or useful for various jobs and careers. |
| PL-H-4.2.3 | The advantages and disadvantages of jobs and careers in various occupational areas should be evaluated (e.g., preparation, salary, benefits, demands of job, location, work environment). |
| PL-H-4.2.4 | There are various postsecondary options (e.g., technical or vocational schools, 2-year colleges, 4-year colleges, apprenticeships, military service) to be considered when selecting or preparing for employment or a career path. |
| PL-H-4.3.1 | Employers look for employees who have positive work habits and a good work ethic (e.g., positive attitude, initiative, punctuality, communication skills). |
| PL-H-4.3.2 | Work habits/ethics (e.g., cooperation, respect, time management, individual/team responsibilities, dependability) can impact the success of a group. |
| PL-H-4.4.1 | Life-long earning potential, job options, and job satisfaction are generally related to the amount and kind of educational training of the worker. |
| PL-H-4.4.3 | Team skills (e.g., identify goals, use listening skills, follow directions, communicate orally, cooperate with others, ask questions about tasks, use problem-solving skills, use conflict resolution and mediation skills) are important in future schooling and in today's workplace. |