



FIRE Science

DEAR EDUCATOR,

Once again, the Home Safety Council® has teamed up with Weekly Reader to create home fire safety education materials for you and your students. Why is teaching home fire safety in school important? More than 8 out of 10 fire deaths in the United States occur where kids think they are safest: at home. More than 50 percent of all home fire deaths take place between 11 p.m. and 7 a.m., when most people are fast asleep!

If you were to question students about how much time they have to escape a home fire, you'd probably be surprised at their responses. Many students may think they have time to rescue pets, collect personal items, and investigate or fight fires—but they don't. A family may have less than three minutes to escape a home fire, so surviving depends on early warning and fast response.

This educational program will help you assess students' concept of time during a fire emergency, explain the science behind how fire works, and explore life-saving technologies, such as fire sprinklers and interconnected smoke alarms. We've also included the All-Ways Fire Safe at Home DVD Library, a companion DVD of fire footage developed by the Home Safety Council and others. The DVD will help students visualize just how quickly a home fire can start and spread and demonstrate why it is important to react immediately to a fire emergency.

Empowering students with information that will keep them safe no matter where they are is important to you and to us. Let us know if this program has helped any of your students prevent a home fire or save lives. Visit us at www.homesafetycouncil.org

Enjoy teaching this important program!

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President
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TARGET AUDIENCE:

The activities in FIRE SCIENCE are designed for students in grades 6 through 8.

PROGRAM OBJECTIVES:

- To assess students' prior knowledge of fire safety and fire science
- To further middle school students' interest in science
- To provide educators with new formats in which to discuss fire and home safety with students
- To foster students' ability to recognize best practices in regards to fire safety

COMPONENTS:

- Teacher's Page
- Student Page 1: FIRE TIME-LAPSE
- Student Page 2: HOME TECHNOLOGY THAT CAN SAVE YOUR LIFE
- Student Page 3: HOME SAFETY MAKEOVER
- All-Ways Fire Safe at Home DVD Library: Includes fire and flashover video created by the Home Fire Sprinkler Coalition, National Institute of Standards and Technology (NIST), and CBS's *The Early Show* with the Home Safety Council

NATIONAL SCIENCE STANDARDS^{1,2}:

- Knows that matter has different states (i.e., solid, liquid, gas) and that each state has different properties; some common materials can be changed from one state to another by heating and cooling
- Knows that oxidation involves the combining of oxygen with another substance (e.g., burning, rusting)
- Knows that heat can be produced in many ways (e.g., burning, rubbing, mixing substances together)
- Knows that most chemical reactions involve a transfer of energy (e.g., heat, light, mechanical motion, electricity)

SPECIAL NOTE TO TEACHERS:

Parents and caregivers should be informed immediately if you hear about or suspect inappropriate use of fire or fire tools by students. Fire setting behavior in children and youth is very dangerous and an issue of great concern to the entire community. It requires professional intervention. Local fire departments, law enforcement, juvenile justice representatives and mental health professionals have been working together to promote fire prevention education for all children and to provide targeted intervention programs for identified fire setters. Your local fire department is a good place to start for information on how you can help.

TELL US WHAT YOU THINK!

Please complete the enclosed teacher reply card so we can create future programs to meet your needs.

STUDENT PAGE 1: FIRE TIME-LAPSE

This active learning exercise will be used to generate students' interest and introduce the program. After students propose how much time will elapse during a fire scenario (in whole minutes), show the All-Ways Fire Safe at Home DVD to the class. Students will be able to confirm or revise their predictions by watching the fire footage and then examining the timeline provided on the poster. When you show the time-elapsed footage, ask students to note the conditions in the room and the state of the fire as time passes into the chart below.

DISCUSSION TOPIC:

Talk about specific actions and objects that can add more time to a fire evacuation from the home.

- Missing or inoperative smoke alarms.
- Going back to sleep instead of moving fast when the smoke alarm sounds.
- Rescuing pets and collecting personal items.
- Investigating the fire.
- A front door lock that requires an inside key.
- Windows that are painted or nailed shut.
- Security bars that do not have a quick-release latch inside.
- Clutter on stairs and at exits.
- Not hearing a smoke alarm because a fire started in a remote home area.

AS YOU WATCH THE DVD:

FIRE DEVELOPMENT	PREDICTION TIME (Whole minutes)	ACTION TIME (Whole minutes)
How long will it take for a smoke alarm to sound?		
How long will it take someone to wake up and get out of bed?		
How long will it take for a house fire to get out of control?		
How long will it take someone to get to the exit door and escape the house?		
How long will it take for the fire to spread to the rest of the house?		
How long will it take for the fire to reach the ceiling?		
TOTAL ELAPSED TIME		

EXTENSION ACTIVITY:

Assign students to practice their home fire safety plans using a stop watch. Record each student's time and ask the class to find the mean, median, range, and mode for the list of data. You can even implement this activity as a "before and after" exercise, so students can correct any dangers, such as windows painted shut, and see how they improved their escape times.

STUDENT PAGE 2: HOME TECHNOLOGY THAT CAN SAVE YOUR LIFE

In this activity, students will learn that fire sprinkler systems are activated by heat, not smoke. They work automatically at the first sign of fire danger and immediately reduce the effects of fire.

EXTENSION ACTIVITY:

Find out if your school is protected by fire sprinklers. Then have students create a list of local community buildings with installed fire sprinkler systems. Start by investigating office buildings, hospitals, colleges and universities, hotels, museums, libraries, malls, restaurants, theaters, and historic buildings. (Students may be surprised to learn that many public buildings do not have fire sprinklers.) Then invite a fire specialist to your school to talk about home fire safety. Contact a home builder or sprinkler contractor who can show what home fire sprinklers look like and talk about how they work. Visit www.homefiresprinkler.org/hfsc.html for free, downloadable educational movies, animated sequences, and other materials, or contact your local fire department for help in finding local specialists. Have students create an exhibit to demonstrate what they learned. Share the exhibit with other classes in your school, and then donate it to your local fire department for use in community safety education.

STUDENT PAGE 3: HOME SAFETY MAKEOVER

In this activity, students will examine and appraise a floor plan and layout of an apartment to identify fire safety hazards and upgrade fire safety technology. Students will need to find 15 things wrong or missing with the apartment that can cause and fuel a fire, or make it worse. As a follow-up assignment, have students calculate the total square footage of the apartment.

ANSWERS:

- kitchen:** matches and lighter not stored properly
- kitchen:** unattended cooking on stove
- kitchen:** flammable dish cloth is too close to stove
- kitchen:** cooking can cause false smoke alarms that might be ignored
- living room:** metal screen (MS) or tempered glass (TG) near fireplace (missing)
- living room:** unattended candles burning with nearby papers
- living room:** smoke alarm too close to window
- master bedroom:** blankets too close to space heater
- master bedroom:** no smoke alarm
- bedroom:** window blocked by furniture
- closet:** fire escape ladder should be under a bed
- hallway 1:** blocked by bicycle, toys, clothes, and other clutter
- office:** overloaded electrical outlet
- office:** door is the only way out (missing windows)
- living room:** fire extinguisher should be located at the home exit door



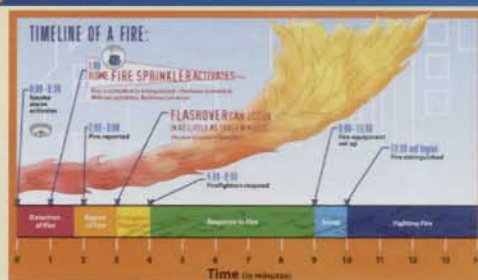
HOME SAFETY EXTRA!

Total sq. ft.: 768 square feet

"TIMELINE OF A FIRE" POSTER

Three minutes or less. That's all the time you may have to escape a fire in your home. Don't wait!

Hang this poster in a highly-visible area of the classroom after viewing the DVD and completing STUDENT PAGE 1: FIRE TIME-LAPSE. Ask students to suggest tasks that take about three minutes to complete. To reinforce the three-minute time frame, hold a timed fire drill at school.





FIRE Science FIRE TIME-LAPSE



Did you know that 8 out of 10 FIRE deaths in the United States occur at home, where people think they are safest? More than 50 percent of all home fire deaths take place between 11 p.m. and 7 a.m. Your ability to survive a fire depends on early warning and fast response. In a home fire, every passing second is your enemy. Don't waste time—get to safety quickly. The reality is: the clock begins ticking even before the smoke alarm sounds. The total fire department response time to a fire starts the moment your call is received by the dispatch center and ends at the arrival of the first firefighters who begin to put out the fire.

IMAGINE THIS: It is nearly 1:00 a.m. and your entire family is fast asleep when a fire starts in your home. Suddenly, the smoke alarm sounds. How much time do you have to escape? Write down your predictions for how long each stage of fire development takes under "Prediction Time" in the chart below. As you watch Segment 1 of the DVD, jot down how much time actually elapses during each stage under "Actual Time." Pay close attention to the condition of the fire as time passes.

FIRE DEVELOPMENT	PREDICTION TIME (whole minutes)	ACTUAL TIME (whole minutes)
How long will it take for a smoke alarm to sound?		
How long will it take everyone in your home to hear the smoke alarm and take action?		
How long will it take for a home fire sprinkler to activate?		
How long will it take everyone to get to the established outside meeting place?		
How long will it take the fire department to respond?		
How long will it take the fire department to start fighting the fire?		
TOTAL ELAPSED TIME		

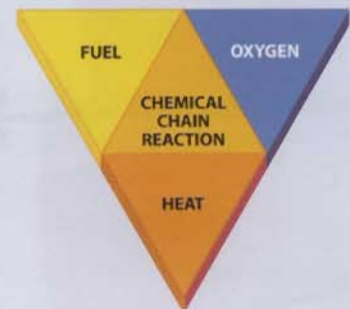
WHAT IS FIRE?

Fire, also called combustion, is a chemical reaction between two gases—oxygen and vapors from burning fuels, such as gasoline, propane, or wood. Fire occurs when there is enough heat to change the fuel from a solid to a gas. When a gas reaches the right temperature, its molecules (tiny particles that make up a substance) break apart and atoms (even smaller particles) are released. These atoms combine with oxygen in the air through a process called oxidation. Fire is rapid oxidation with the production of heat and light.

HOW DOES FIRE FORM?

To get started, a fire needs: fuel, oxygen, and heat. A chemical chain reaction that is the result of the fuel combining with the oxygen keeps the fire going by generating new heat. Combustible fuels can be in different states of matter—solid (wood), liquid (gasoline), or gas (propane)—when they burn. A fire is extinguished by removing one of the components of the fire tetrahedron. For instance, water reduces and removes heat from a fire, which stops the production of combustible vapors. The carbon dioxide in a fire extinguisher reduces oxygen and smothers the fire.

THE FIRE TETRAHEDRON:

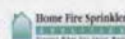


HOME SAFETY EXTRA:

As you learned from the DVD, people have three minutes or less to escape a home fire safely. Don't wait! Use a stop watch to practice your home fire safety plan with your family tonight. Identify ways you can save time during an escape. Find and remove obstacles that could slow you down on your route to safety. Don't run, but do move quickly.



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When you hear the phrase “home technology,” you probably think about cool, high-tech gadgets, like house-cleaning robots, refrigerators with built-in supermarket barcode scanners, microwaves with downloadable recipes, and virtual reality devices. You may not realize it, but home fire sprinklers and smoke alarms are also cool technologies. Unlike some home gadgets, home fire sprinklers and smoke alarms can save your life in the event of a fire. Take a look at how some fire-protection technologies and recent innovations make homes safer.

HOME FIRE SPRINKLERS

What innovation can save lives *and* protect property during a fire? A home fire sprinkler system! A fire sprinkler goes on automatically when a fire is still small, and works immediately to extinguish flames or control them. Fire sprinklers slow the spread of deadly smoke, and they also prevent **FLASHOVER**. Installing sprinklers in your home is like having a firefighter “on duty” in every room. That’s because fire sprinklers detect a fire early on and automatically activate. They work immediately to extinguish the flames or control them. This quick response controls the spread of both smoke and flames, giving your family more time to escape safely. Fire sprinkler systems are designed to be life-saving devices, but they have a wonderful side effect: protecting your home and possessions!

THE MYTHS AND REALITIES OF HOME FIRE SPRINKLERS

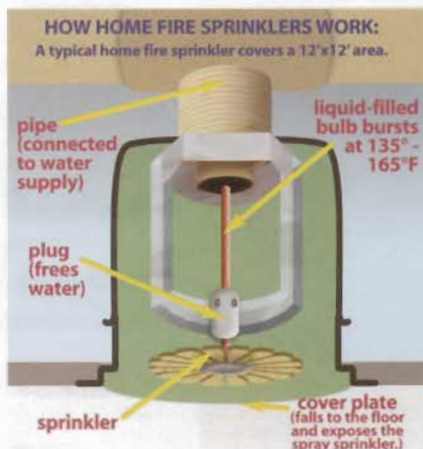


MYTH: During a fire, all of the sprinklers will activate.

REALITY: Fire sprinklers work individually. Only the sprinkler closest to the fire will activate and spray water directly on the fire. Usually only one sprinkler is needed.

MYTH: Cigar smoke will set off fire sprinklers.

REALITY: Fire sprinklers are designed to react to high temperature, not smoke.



MYTH: The water damage from fire sprinklers is worse than a fire.

REALITY: An uncontrolled fire is devastating and can lead to a total loss of a home—first from flames and then from high pressure water hoses used by the fire department. But a fire sprinkler only uses about 341 gallons of water to control a home fire. Once firefighters arrive at homes without fire sprinklers, they’ll need to use almost 3,000 gallons.

WHAT IS FLASHOVER?

A flashover happens when there is enough heat produced by a fire to ignite everything in the room at once. Hot gases spread out across the ceiling and heat other fuels in the room, such as sofas, drapes, and wood. The burning fuels get hot enough to give off vapors, which ignite almost simultaneously. During a flashover, flames can engulf everything in a room in as little as three minutes! It’s not possible to survive a flashover. Even firefighters wearing protective clothing have only a few seconds to escape the room before the temperature causes heat-related injuries and death. At flashover, the temperatures in the room can reach the 1400 to 1600°F range. (That’s about the temperature of lava!) The rapid increase in temperature ignites other things in the room, and all that heat keeps the fire going.

WHAT IS SMOKE?

Smoke is unburned fuel in its gaseous state—specifically, unburned particles of carbon. Most fuels contain the chemical elements carbon and hydrogen. During the burning process, fuels combine with oxygen in the air to form water vapor, carbon dioxide (CO₂), and carbon monoxide (CO). At certain levels, carbon monoxide is deadly to humans and animals. It slowly puts the brain to sleep by replacing oxygen in the blood. In a fire, more people die from inhaling carbon monoxide than from burns. Smoke alarms help to wake people up in time to escape.

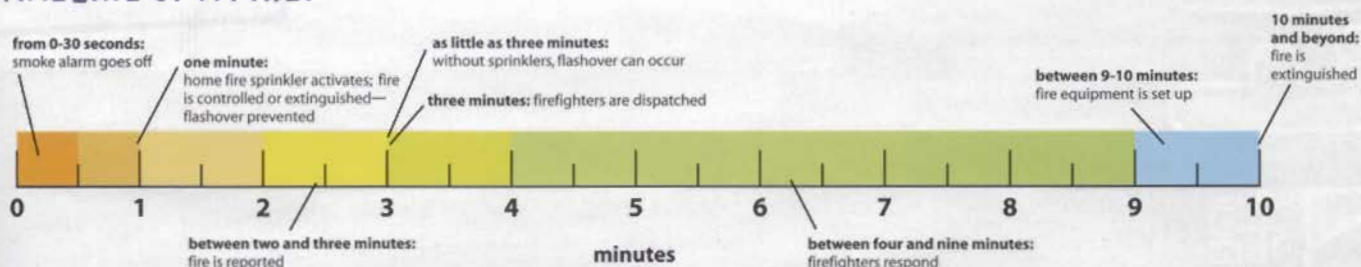
SMOKE ALARMS

Smoke alarms are absolutely essential in every home. They detect particles of **SMOKE** in the early stage of fire development. The two most common types of alarms are ionization and photoelectric. Both types signal with a very loud noise. Smoke alarms specially designed for people with hearing difficulties warn of a fire with strobe lights and vibrations in addition to an auditory alarm. Along with the standard alarm signal, some smoke alarms can also have a loud vocal warning that shouts, “Danger! Fire! Wake up! Follow your escape plan!” Others allow parents to record their voices to help awaken children.

INTERCONNECTED SMOKE ALARMS—WIRELESS OR HARDWIRED

What’s better than hearing one smoke alarm? How about hearing all of the smoke alarms in your home at once, even in rooms where there is no fire yet. You don’t have to imagine this innovation—it already exists. Interconnected smoke alarms are linked to one another by electrical wiring or through wireless technology. These connections make them more likely to be heard no matter where family members are in the home when a fire starts. Interconnected smoke alarms give people more time to escape safely.

TIMELINE OF A FIRE:



This home needs a makeover—a safety makeover, that is! A lot of families renovate their homes to increase space, value, or style. In this activity, you'll examine this floor plan and give the apartment a fire safety makeover! There are 15 things wrong or missing, and each can be a fire hazard. See if you can spot them all and write them on the clip board below. Then use the letter key below to install home safety equipment that will "make over" the apartment.



HOME FIRE SAFETY KEY:

- SA** = smoke alarm (🔊)
- EL** = fire escape ladder (🪜)
- FE** = fire extinguisher (🔥)
- MS** = metal screen (🛡️)
- TG** = tempered glass (🔪)
- 🚪** = door
- 🪟** = window

HOME FIRE SAFETY TIPS

- Test smoke alarms at least once a month and whenever you return from vacations.
- Don't investigate or fight a fire—just get to safety!
- Make sure smoke alarms are on every level of your home and inside or near every sleeping area.
- Create a family escape plan and practice it at least twice a year.
- Make sure adults are assigned to wake up children and assist others that need help escaping.
- Determine two escape routes to take from each room.
- Never leave cooking food, burning candles, or other ignited materials unattended.
- Keep anything that can catch fire away from heat sources (e.g., keep space heaters three feet away from sofas and curtains).
- Be sure that security bars on the doors and windows can be opened easily from inside the room to allow a safe exit from a window.
- Check that the lock to any outside doors can be opened from the inside without a key so that you can get out quickly.

CALCULATE THE TOTAL SQUARE FEET OF THE APARTMENT ABOVE USING THESE DIMENSIONS:

- | | |
|---------------------------|--------------------|
| Kitchen: 9' x 12' | Bathroom: 6' x 6' |
| Living room: 15' x 12' | Closet: 2' x 6' |
| Hallway 1: 24' x 3' | Hallway 2: 4' x 6' |
| Master Bedroom: 10' x 12' | Office: 10' x 12' |
| Bedroom: 8' x 12' | |

HOME SAFETY EXTRA:

Interview a firefighter! Call the non-emergency number of your fire department and ask to conduct an interview. Find out the top five things students should know about fire dangers, and share the important points on the classroom bulletin board. Invite the firefighter to join the class for discussion.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____