

WHAT IS A FIRE-SAFE SPACE?

The Science of Fire Safety

STUDENT READING

YOUR NAME HERE:



At school(s) you practice fire safety with fire drills, and skills like stop-drop-and roll. Did you know that your chances of injury are greater than they were 40 years ago? Now, citizens have the least amount of time in history to escape their burning home – 3 minutes or less^[1]. With all our technological advances and knowledge, why does it seem our homes and spaces are less safe?

Let's take a moment to better understand fire. Fire requires three components to ignite and burn: fuel, oxygen, and heat. When enough fuel, oxygen, and heat are present they produce fire. Fire is the product of a **chemical reaction** that releases heat, light, and smoke.

Think about the spaces we spend our time—home, school, stores, and other businesses.

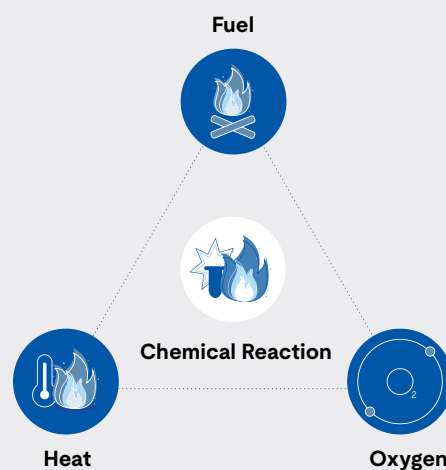
Is there *fuel*?Is there *oxygen*?Is there *heat*?

Fuel is anything that can ignite and burn. Wood, furniture, and carpeting can be fuel for a fire. We use **organic materials** like wood and cotton to build our homes and furniture, but the materials in our homes have changed over time. Synthetic materials have become more common. **Synthetic materials** contain plastics, ignite fast, burn hot, and release more thermal energy than organic materials. Synthetic materials make it easier for fire to spread.

Oxygen makes up 21% of our air. Older homes had many separate rooms. Newer homes have tall ceilings and open floor plans. New designs allow for more oxygen to be available to the fire, and fires can grow much larger.

Heat is the transfer of *thermal energy*. Cooking appliances, electrical devices, and unattended fires can provide enough heat to start a fire. Heat hazards are also changing. Thermal runaway in devices that use lithium-ion batteries is increasing. These devices, like headphones, smart phones, and laptops, are a growing cause of fires. It seems modern lifestyles have accelerated the spread of fire^[2].

The Components of Fire



SENSEMAKING

30 years ago, a person had about 17 minutes to escape a fire. Now you only have 3 minutes! Why are homes more dangerous in the event of a fire than they used to be?

1. Consider the fire safety hazards in the spaces you spend your time. What are some ways you could address these hazards?



Fire Safety Tips and Solutions from the Experts

Today, home fires spread more quickly than they used to. This quick spread means short escape times. Research from the Fire Safety Research Institute, part of UL Research Institutes, shows that in our modern buildings, we have less than three minutes to get out of our homes in the event of a fire^[9]. However, we can make our living spaces more fire-safe by minimizing the potential spread and being prepared to quickly escape in the case of fire.

So, what can we do to ensure we have fire-safe spaces?

Closing your door at night can save your life! Experiments conducted at the Fire Safety Research Institute proved that a closed door creates a barrier between you and the fire^[9]. The temperature behind a closed door during a fire was recorded at 100°F (37.78°C) compared to 1000°F (537.78°C) when the door is open. An added benefit is that the door protects you from heat, smoke, and toxic gases – so close your doors at night while you sleep.

Three out of five home fire deaths occur when there are no working smoke alarms. Smoke alarms quickly alert people once a fire starts^[3, 4], but how do they sense fire? Smoke from a fire contains unburned fuels – matter! The matter in smoke passes through an opening in the smoke alarm and disrupts the flow of **radiant energy**. Smoke alarms utilize radiant energy from light or an isotope like Americium-241. Smoke alarms should be installed on every floor as well as inside and outside every sleeping area.

Every home should have an escape plan. When a fire ignites, there is no time to make your plan. To make sure your family is prepared create an escape plan that identifies two ways out of every room and a meeting place at a safe location outside.



SENSEMAKING

Smoke alarms offer the earliest warning possible that there is a fire. Closing your door reduces deadly carbon-monoxide levels, dangerous heat and the spread of fire.

2. What other technologies, innovations, or designs might reduce the risk of a fire igniting, minimize its spread, or help make fire-safe spaces?



How can we design fire-safe spaces?

Fire safety has changed greatly over the last 50 years. Some innovations include fire sprinklers, fire extinguishers, fire-resistant building materials, fire-proof fabrics, and fire doors. These technologies have helped architects, technicians, and designers think more about fire safety.

Did you know that fire sprinklers are heat activated? Most people think it can be set off by smoke, but actually heat from a fire transfers throughout the entire room. When the temperature at the fire sprinkler reaches 155°F (68.33°C), that sprinkler will start to activate. The water from a fire sprinkler absorbs the heat of the fire, controlling its growth and often extinguishing it^[3].

How would you put out a small fire in your home? Fire extinguishers are designed to cover the fire and create a barrier between the fire and the oxygen that it needs to keep burning. Make sure your fire extinguisher is accessible and appropriate for the fire hazard.

How can we engineer spaces to minimize the spread of fire? Fire Doors are designed to hold up in fires and prevent heat moving from room to room. They also keep oxygen and smoke from flowing from one side to the other^[4]. This enables buildings to be broken up and delays the spread of fire.

Have you thought about what your home is made of? Some building materials have properties that allow them to absorb more thermal energy slowing the transfer of heat from one room to another. Natural materials and synthetic materials such as wood and nylon are common in buildings. Due to their chemical make up, they are the main fuel in the chemical reaction for fire. These materials are more likely to catch fire than inorganic materials. Inorganic materials like stone, drywall made from gypsum or fiber glass, and ceramic tile are nonflammable. These materials have the ability to absorb extremely large amounts of energy before they break down. Designers purposefully use inorganic materials as barriers in building design to prevent fire spread.

Building designers, interior decorators, fire protection engineers, fire protection technicians, and citizens all play a role in making a fire-safe-space. Each person has to consider hazards in a space and design interventions for fire safety.

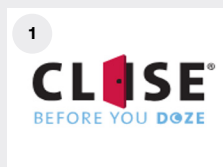


SENSEMAKING

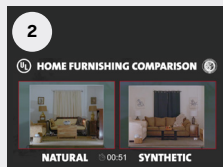
We've learned that modern homes burn much quicker, and there is less time to escape. Awareness of these risks, allows people to take steps to make their own spaces fire safe.

3. How can you apply the technologies and recommendations from this reading to make spaces safer?
4. Justify one of your choices by describing how matter and energy interact.
5. What fire-safety technologies, designs and innovations are you imagining for a safer future?

Use the resources below to learn more about what it takes to make a fire-safe space.



See the impact when you [Close Your Door](#) in the event of a fire and other fire safety strategies to keep you and your family safe.



Learn more about how synthetic materials have changed home fires. UL's [Fire Safety Research Institute](#) performed side by side tests to see how different room furnishings affect fire.



Explore how fire dynamics play a role in activating fire sprinklers. In this article, the [National Fire Sprinkler Association](#) shares the science behind sprinkler activation.



Take a journey through time to see how modern enhancements to aging fire protection systems can make all the difference. [The Evolution of Fire Protection Systems - National Fire Sprinkler Association](#)

Now take action!

Glossary

Chemical Reaction: when atoms in contact with each other rearrange to form new bonds.

Organic Materials: natural materials that have plant, animal, or insect origins.

Synthetic Materials: human-made compounds that are designed to mimic natural materials or create new materials with unique properties.

Heat: transfer of energy between two entities due to a difference in their kinetic energy.

Radiant Energy: energy of electromagnetic waves that can travel through space without medium.

Inorganic Materials: natural materials that do not contain living material