

Fighting Fire with STEM

Fire Forensics

Objectives

The students will:

- Find key ideas and details from text
- Explore deductive and inductive reasoning
- Interpret the meaning of images in order to justify a hypothesis
- Explore the ability to create, test, and prove hypothesis
- Write an opinion supported by factual information from observations
- Write a sequential series of events based on evidence
- Explore sequential and logical thinking process
- Predict possible outcomes from observations and information analysis

Standards

MP2	RI.5.1	W.4.8	SEP3	SEP5
MP5	RI.5.7	W.4.9	MS-ETS1-1	SEP6
MP6	RI.5.10	W.5.7	MS-ETS1-2	SEP7
MP7	SEP4	W.6.1	SEP1	SEP8
SEP2	W.4.7	5-PS1-3		

Background

Observe, preserve, document, and communicate; these are the main points of a fire investigator. A fire investigator is the person who conducts a fire analysis to figure out how a fire started when it started, and why it started. First responders and fire investigators are critical elements in the fire department and the police department. A fire investigator provides information such as equipment malfunctioning patterns, misuse of tools or equipment, common mistakes individuals make, negligence patterns, and equipment defects. This information is shared with manufactures and the public to warn them about possible products and procedures creating fires. This information is a key component for manufactures, so they can change material goods, add more restrictions to products, add more information for the user to be familiar before dealing with

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specific products, recall products, or even by eliminating products already in the market. On the other hand, fire investigators are equally important to the police department because every fire scene could be a crime scene and the fire investigator report becomes evidence to a prosecutor or a defender in court. There are numerous cases where fire is the way to eliminate evidence or to perform a fraud.

First responders, in this case the firefighters at the scene dealing with the fire are the first set of eyes for the fire investigators because they collect data at the time they are dealing with the fire. For example, a back door is noticed open at the scene and it is 5° outside. It is not a normal situation to happen so that is a sign. Another example, if there are six unplug TV's in one room, or if there are signs of a forced entry by someone before the firefighters arrival. All these are mental notes the firefighters collect during the event of a fire to later share with the fire investigators, adding details to the reconstruction of the incident.

Two main reasons of a train of thought will take place during the unit. One of them is deductive reasoning, which refers to the ability to start logical reasoning going from a generalization up to finish with specific instances. In other words, conclusions are drawn from ideas or statements.

The other idea we will be using is inductive reasoning, which refers to the ability to start an analysis by making observations in science known as empiricism. Here the gathering of data will increase the chances of reaching a true conclusion. In other words, conclusions are drawn from several observations.

Both methods will be useful for this unit because the evidence provided by the fire investigators is a big puzzle of elements, visual and verbal clues, and serials of events that took place at the fire scene.

Fire investigators look for clues to guide them to either find evidence to prove what they think happened or to find evidence to roll out what they think did not happened. According to fire investigators from the Oswego Illinois fire department, fire is a sequential and predictable phenomenon because it follows key elements such as oxygen supply, fuel, and heat in order to keep burning. Since science and math provide a logical explanation to fire behavior, investigators follow specific clues to find out what caused the fire as well as the point of origin. Fire will always burn up and out due to the air temperature and the earth's gravity. The combustion is always going to look for oxygen to keep feeding the chemical chain reaction it needs to grow and survive. Fire investigators are pattern recognition experts with a vast STEM knowledge capable of reconstructing a fire event by placing hundreds, if not thousands of pieces together based on evidence and reasoning via deductive or inductive.

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Inquiry Overview

Students will analyze different types of fabrics commonly used in the production of everyday items. Then students will analyze the physical properties of the fabrics and will predict the fabric's behavior during and after combustion. They will also compare their prediction to the actual process after watching a video. Lastly, they will prepare a presentation to explain the reason why certain fabrics burn in a certain way due to their structure.

Suggested Inquiry Approach

Students will start working on the fabric analysis and prediction #1, they will use samples of fabrics such as cotton, rayon, silk, nylon, and polyester. Then, students will utilize the sample fabrics to observe their texture, strength, elasticity, smell, and other physical properties. Next, the teacher will provide images of the fabric materials under the microscope for the students to observe. Later on, students will make predictions about the behavior of the fabric before the combustion occurs (based on the fabric's observation), under combustion (flame and smoke) and after combustion (residues and ash).

Activity One *Fabric Characteristics.*

Work in Pairs

Estimated Time: 180 minutes

Introduction: 10 min.

Fabric analysis and predictions #1: 40 min.

Fabric combustion video: 30 min.

Fabric analysis comparison #2: 50 min.







Fabric presentation: 40 min

Debrief: 10 min.

After the fabric analysis and predictions #1 template is completed and shared with the rest of the class, the teacher will show the fabric combustion video and distribute the fabric analysis and prediction #2 for students to write down and draw any observations obtained from the fabric combustion video. The video will show a slow motion combustion of the five fabrics on task (cotton, rayon, silk, nylon, and polyester) for students to gather more information and details about the fabric combustion.

Materials

Activity #1 for each pair of students:

-  Fabric analysis and prediction #1
-  Fabric samples
-  Hand lenses
-  Fabric analysis comparison #2
-  Fabric combustion video
-  Fabric fact sheet

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After the fabric combustion video students will compare their predictions with the actual combustion and make a detail analysis of the fabric's behavior in relationship to the fabric's physical properties.

Next, students will prepare a presentation about the relationships between the fabric's physical properties and its ability to burn and leave a residue or ash. Lastly, students will share their presentation with the class and find similarities on the fabric's behavior.

Debrief

After all the presentations are done, show the following video to the students and ask them the following questions.

<https://www.today.com/style/deal-day-30-percent-luvey-dovey-pajamas-t121839>

-  Why is it important for a firefighter to be aware of the combustion behavior of different fabrics?
-  How can you explain the fabric behavior under combustion to your parents, so they are more aware of the risk of fire involved in purchasing products made out of synthetic materials?

Inquiry Overview

Students will analyze real evidence provided by the Oswego Fire Investigation Department and find out what caused the fire and point of origin. Students will follow pattern recognition strategies, personal interviews from witnesses, and other information to help with the investigation as well as deductive and/or inductive reasoning as best fits into the investigation.

Suggested Inquiry Approach

The activity is broken down into two parts. For the first part, students will analyze the evidence gathered at the fire scene. They will place it together with other sources of evidence to reconstruct the fire event and identify the fire's point of origin as well as the cause of the fire.

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Activity two Fire Investigation Training.

Estimated Time: 220 minutes

Introduction: 10 min.
Fire investigation evidence analysis #1: 50 min.
Fire event reconstruction presentation #2: 30 min. Fire investigation evidence analysis #2: 30 min. Fire event reconstruction presentation #2: 30 min. Debrief: 30 min.

Materials

Activity #2 for each pair of students:

-  Fire investigation training evidence
-  Fire incident report
-  Sticky notes
-  Masking tape





For the second part, students will present their findings to the rest of the class and explain the fire event according to their point of view. Every group will have a few minutes to present. After that, students will go back to their evidence and make changes if needed or add details based on the evidence or point of view shared from other members of the class.

NOTE: STUDENTS WHO ARE NOT PRESENTING MUST BE FOCUSING ON THE PRESENTER BECAUSE VITAL DETAILS WILL BE SHARED.

Next, every group will go back to the front of the class and present their reconstruction of the fire event once again. The reason why students have to revise their findings is that every person will see different details when analyzing the same data as other people. The more data, similarities, similar points of view, and pattern recognition between teams the better the result will be. Lastly, students will present the fire incident report they were filling out throughout the activity.

Debrief

Since this is a fire investigation training, we know exactly what or who started the fire and the exact point of origin of the fire. The students are missing a few pictures of evidence that shows what happened. Now, it is time to reveal the answer. Distribute the folder with the label “Missing Evidence” to every group and ask them to evaluate their findings to the facts and see how close they were to solve the mystery.

-  What clues were the most significant for your investigation?
-  What was the most appropriate reasoning (deductive or inductive) thinking during this investigation?
-  How close was your investigation to the facts about the fire event?
-  Where you able to distinguish between the damage caused by the fire versus the damage caused by the water or the firefighters? If so, how did you do it?