

# Your Nose Knows!



<b>Grade Level</b>	Secondary
<b>Subject</b>	Science, CTE
<b>Duration</b>	45 minutes
<b>Setting</b>	Classroom
<b>Objectives</b>	<ol style="list-style-type: none"><li>1. Use the sense of smell to recognize a dangerous situation.</li><li>2. Identify the useful and dangerous properties of natural gas.</li><li>3. Recognize the smell of natural gas (using mercaptan stickers).</li><li>4. Identify how to recognize a natural gas leak.</li></ol>

## Materials

- 25-30 small plastic sandwich bags
- Part 1: Water (clear liquid, no odor), vinegar (clear liquid, odor), cider vinegar (colored liquid, same odor as vinegar)
- Part 2: Selection of smells could include cooking extracts, flavorings or perfumes and mercaptan stickers
- Cotton balls
- Picture of natural gas flame (on a tablet or computer screen)

## Scientific Terms for Students

- Mercaptan: Chemical added to natural gas to give it a smell
- Nontoxic: Not poisonous or toxic
- Properties: A characteristic of a substance
- Odorant: A substance giving off a smell
- Combustible: Able to catch fire or burn easily

## Educator Background

Natural gas is one of the safest, cleanest burning energy sources available. The properties of natural gas make it very useful to heat and cook food as well as heat water, homes and schools.

Natural gas has unique properties that make it useful. It is lighter than air, which means it will dissipate, or spread, into the air if a leak occurs. It is nontoxic and safe when used properly.

However, like all sources of energy, it has certain characteristics that make it potentially dangerous. It is naturally colorless and odorless, so the natural gas utility companies add an odorant called mercaptan. Mercaptan smells like rotten eggs and helps detect if a leak is present. If a leak occurs inside a home or building, natural gas can be trapped inside. If the smell of mercaptan is recognized, leave immediately, go to a safe place away from the suspected leak and call 911.

Another property of natural gas is that it is combustible, meaning it is capable of igniting and burning. This is a good thing when it is burned for energy, but dangerous if it is not appropriately controlled or if a leak is present. Natural gas also needs the right mixture of oxygen to burn correctly. Without the right mixture of air, fuels can produce carbon monoxide, a poisonous gas.

Natural gas leaks are rare, but being able to recognize and respond to a suspected leak is an important part

of living and working safely. Share with students how to be aware of any unusual conditions in their home or neighborhood and immediately take appropriate actions.

### **Activity Procedure, Part One (begin as a group)**

Question students: Does everything have a smell? Let's investigate using skills of observation and our sense of smell.

1. Display two plastic sandwich bags, one with water and one with vinegar inside. Ask volunteers to smell. Question the group, "do these look the same?" (*Both are colorless liquids*). Conclude each bag may contain liquids that look the same, but are not. Each smells differently and the liquids are different. Some things in nature do **not** have a smell naturally, like water and natural gas. If time permits, share the sample bags of white vinegar and cider vinegar to demonstrate some things in nature look different, yet smell the same and have similar properties.
2. Pass around samples of mercaptan scratch and sniff stickers. Share with students that natural gas, in its natural state, is colorless and odorless. Because of this, natural gas providers must add a harmless, nontoxic odorant to it to make it more readily detectable. This odorant is usually described as smelling like a rotten egg smell.

The sense of smell has a direct connection to the brain. Scents can conjure up emotions and specific memories to cause a reaction. The smell of fresh cookies will cause a different reaction than the smell of smoke. The sense of smell can alert us to dangers like a gas leak or fire. Using our sense of smell is the best way to recognize if a natural gas leak is present so we can react safely.

3. Display a picture of natural gas flame. How would our sense of smell help us here? (*Natural gas has no odor. When ignited, there is no odor. An odor is present only if there is a leak that is not ignited.*)

Discuss the useful properties of natural gas while looking at the picture: nontoxic, colorless, combustible and odorless.

What are some of the ways we can recognize if there is a natural gas leak?

**See:**

- A damaged connection to a gas appliance
- Dirt or dust blowing up from the ground
- Dead or brown vegetation in a moist, green field or lawn
- Flames at or near an exposed pipeline
- Continuous bubbling in wet areas or water being blown into the air at a pond, river or creek

**Hear:**

- A hissing, roaring or blowing sound

**Smell:**

- An odorant called mercaptan is added to the natural gas so that leaks can be more easily detected
- The odor smells like rotten eggs

If you suspect a natural gas leak:

- **Stop** what you are doing.
- **Leave** the area immediately.
- **Call** 911 and the natural gas company from a safe place away from the leak.

Share and discuss how to react if a natural gas leak is detected:

1. Leave the area immediately.
2. Once you are a safe distance away from the odor, call the natural gas company or 911. DO NOT use a telephone or cell phone inside your home. A spark from a phone or electronic switch could ignite the natural gas.
3. Avoid flames and do NOT turn electric equipment or appliances on or off, not even a flashlight.
4. Never look for a natural gas leak with a lighted flame or a match.
5. Do not try to make repairs yourself. Call a certified natural gas contractor.

### **Activity Procedure, Part Two (small groups)**

#### Determining Scents

Before the experiment, explain the **wafting technique** for determining smells in substances.

*Wafting is a technique of using your hand to draw air over the opening of a container in the direction of your nose. Air mixed with the substance is drawn into your nose so that the smell from the original substance is diluted.*

1. Prepare five to six sandwich bags of scents.
  - a. Apply liberal amounts of scents from food extracts (like vanilla and mint) or spray air freshener on two cotton balls and place in different bags.
  - b. Thoroughly scratch several mercaptan-scented stickers, place between two cotton balls and put in a plastic bag.
  - c. Number each bag.
2. Divide the class into groups equal to the number of prepared bags.
3. Have a student from each group collect a bag from you and return to the group.
4. Have students determine the scent using wafting as explained before the experiment. Students should make a chart of the numbered bags and the scent determined for each.
5. Students should return each bag to you and pick up another until all bags have been tested.
6. After each group has determined the scent for all bags, begin a discussion with the following topics.
  - a. Discuss the correct scent for each bag. Did each group get the same answer or the correct answer?
  - b. Discuss each student's ability to differentiate each scent. Are there students that cannot smell due to a cold or stuffy nose or are they a super sniffer (heightened sense of smell)?
  - c. Discuss with students how distance from the source of a smell affects determining a scent. (*The scent is diluted the farther away from the source.*)
  - d. Discuss with students how scents moving through soil from a buried natural gas pipeline can be stripped away. (*The scent is absorbed by the soil as it moves away from the source of the leak.*)

## Wrap-up

Discuss the following questions with the class.

1. How can your sense of smell keep you safe? *(to recognize unsafe conditions, fire/natural gas/rotten food)*
2. What does natural gas smell like in nature? *(odorless)*
3. How can you recognize a natural gas leak? *(smell of rotten eggs or sulfur [mercaptan], dirt or dust blowing up from the ground, flames at or near an exposed pipeline, continuous bubbling in wet areas or water being blown into the air at a pond, river or creek, a hissing, roaring or blowing sound)*
4. What should you do if you detect a natural gas leak? *(leave immediately, contact natural gas company)*
5. Why is it dangerous to use a phone or cell phone if you smell natural gas? *(a spark could cause the natural gas to ignite)*
6. What phone numbers could you call for immediate help? *(911 and natural gas company)*

## Science Standards Addressed

### SCIENTIFIC & ENGINEERING PRACTICES

Developing and Using Models	Planning and Carrying Out Investigations
<p>Modeling in 9 – 12 builds on K – 8 and progresses to using, synthesizing and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.</p> <p>Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-PS3-2), (HS-PS3-5)</p>	<p>Planning and carrying out investigations to answer questions or test solutions to problems in 9 – 12 builds on K – 8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical and empirical models.</p> <p>Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements consider limitations on the precision of the data (e.g., number of trials, cost, risk, time) and refine the design accordingly. (HS-PS3-4)</p>