



LEARNING CHEMISTRY
OUTSIDE OF THE CLASSROOM
Your resource for exploring
chemistry in your home!

Experiment: Nonburning Towel

Nonburning Towel

Time Required:

- 0-30 minutes
- 30-60 minutes
- 60-120 minutes (1-2 hours)
- 120-180 minutes (2-3 hours)
- 180-240 minutes (3-4 hours)
- > 4 hours

Materials Needed:

- ¼ cup (50 mL) rubbing alcohol (isopropyl alcohol)
- ¼ cup (50 mL) water (3 tbsp (44 mL) if using 70% rubbing alcohol)
- 4 cup (1 liter) container
- One cloth towel
- Tongs
- Candle
- Matches/lighter

Optional Materials:

Paper can be used instead of a towel for the same effect.

Concepts:

- Thermodynamics
- Combustion
- Redox reactions

Parental Supervision:

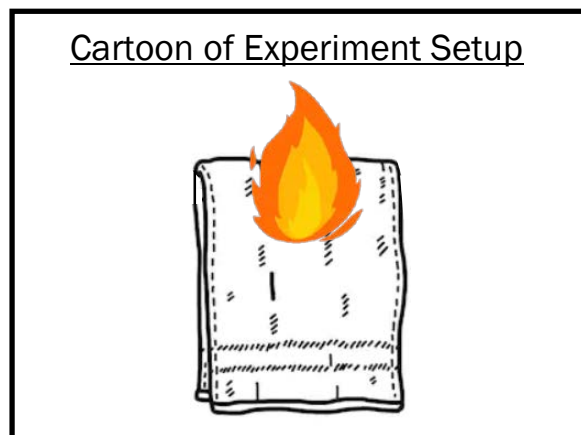
- Recommended for children under 5
- Recommended for children under 12
- Highly recommended for children under 12
- Recommended for children under 18
- Adults Only

Age Recommendation:

- 0-3
- 3-8
- 8-12
- 12-18
- Above 18

Location of Experiment:

- Indoors





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- Outdoors

Is Heat Needed?

- Microwave
 Stove Top/Oven
 Refrigerator
 Freezer

Safety:

To avoid burns the flaming towel must be handled with care. Combustible materials must be removed from the vicinity, and a fire extinguisher should be available. Rubbing alcohol can damage the eyes severely. Isopropyl (rubbing) alcohol is also extremely irritating to the digestive tract and should not be ingested. Drinking a lot of it can cause vomiting, diarrhea, pain, and bleeding in the stomach and intestines. Reduction in the amount of water used will result in charring of the towel.

Procedure:

1. Mix $\frac{1}{4}$ cup water with $\frac{1}{4}$ cup rubbing alcohol in the 4 cup container.
2. Immerse the dry towel in the alcohol-water mixture and thoroughly wet the towel.
3. Squeeze the towel to remove the excess liquid into the 4 cup container.
4. Light the candle with the matches or lighter.
5. Hold the towel at the center with the tongs.
6. At an arm's length, move the towel over the candle and allow the towel to catch fire.
7. Continue to hold the flaming towel with an extended arm to minimize any chance of burns.
8. As the flame subsides, snuff it out with a quick jerk to avoid catching the towel on fire.

Optional:

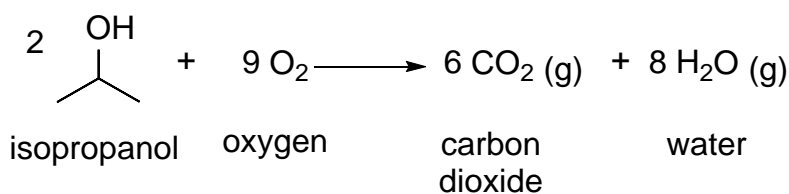
1. Repeat steps 2-8 above with a piece of paper instead of a towel.

Clean Up:

The excess alcohol-water mixture can be saved for trying this experiment again or it can be flushed down the drain with excess water.

What is going on?

The combustion reaction of isopropyl alcohol with water can be seen below. The function of the water is to absorb some of the energy of combustion as the water is heated to its boiling point and vaporized. Most of the heat produced by the combustion of the alcohol is lost to the surrounding air and vaporization of the alcohol. The vaporization of the alcohol is visible by the extensive flame surrounding the towel.



Questions and Discussion





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1. Does the combustion of rubbing alcohol adsorb or emit heat?

Answer: The combustion of rubbing alcohol is an exothermic reaction, which means that heat is released.

2. Why is water added into the reaction mixture?

Answer: Water is added to the reaction mixture to control the amount of heat emitted from the combustion reaction. This is important, because if pure rubbing alcohol was used the amount of heat emitted would be enough to have the towel catch on fire.

3. Commercial alcohol concentrations are listed in units of “alcohol proof” as opposed to alcohol percent by volume (ABV). To convert between ABV and alcohol proof, the ABV value is multiplied by 1.821. In this reaction, the rubbing alcohol concentration is about 50 % ABV. What would be its estimated alcohol proof?

Answer: Multiplying 50 by 1.821 results in an alcohol proof of 91. As can be seen in this experiment, that alcohol proof concentration is flammable. Alcohols with an alcohol concentration of 80 proof will burn a small blue flame over the top of the drink, which can be blown out with a light breath. 80 proof is the limit for flammability of for commercial alcohols. Higher ABV values (alcohol proofs) are more flammable, and lower ABV values (alcohol proofs) are not flammable.

