

REAL Science Challenge – Coffee Lab Safety

Introduction

Although coffee drinking has a long history, the process by which coffee is brewed has remained relatively unchanged. After coffee beans are processed, roasted, and ground, there are generally 2 methods: immersion and drip.

In the immersion method, ground coffee beans are placed in a container or vessel. Hot water is then added to the container - thereby immersing the ground coffee beans. Slowly, the hot water becomes coffee as coffee flavors, oils, and other chemicals leave the coffee beans. When coffee brewing is finished, the coffee grounds are separated from the coffee by pouring the coffee mixture over a filter or plunging a coffee filter into the container holding the coffee mixture - thereby pressing the coffee grounds to the bottom of the vessel. Coffee is poured out and is served. Specialized coffee brewing equipment like the French Press use the immersion method to brew coffee

In the drip method, ground coffee beans are placed in a funnel that's been lined with filter paper. Hot water is slowly poured over it, and the hot water flows down the filter and over and through the ground coffee beans. A container below the funnel collects the hot coffee that results. Home coffee brewing machines as well as specialized coffee brewing equipment like the Hario V60 or Chemex brewers brew coffee using the drip method.

Objective

In this activity, you will learn about and practice correct science lab safety rules by brewing coffee through the drip method. You will also learn the names and setup of commonly used pieces of science lab equipment.

Materials

150 mL water	9 grams of ground coffee
1 - 100 mL beaker	1 - hot plate
2 - 250 mL beakers	1 - electronic balance
1 - beaker tongs	1 - pair of safety goggles
1 - ring stand	1 - stirring rod
1 - ring clamp	1 - wash bottle filled with water
1 - filter funnel	1 - spoon
1 - filter paper	

Procedure

1. Put on safety goggles and clear your desk. Collect your materials.
2. Fill first 250 mL beaker with 150 mL of water. Place beaker on hot plate and set on high.
3. Attach ring clamp to ring stand. Place filter funnel through ring clamp.
4. Place second 250 mL beaker below the filter funnel. Adjust the height of the filter funnel so that the end of filter funnel is just below the top of the beaker.
5. Fold filter paper into filter funnel and lightly wet filter paper to hold it in place by squirting water from wash bottle onto filter paper.
6. Take 100mL beaker and measure out approximately 9 g of ground coffee into it. Record the mass in Table 1 of the Data and Observations section.
7. Pour the coffee grounds into the filter funnel. Find the mass of the beaker and record the mass in Table 1.
8. By finding the difference between the previous two measurements, determine how much coffee grounds were poured into the filter funnel.
9. When the water starts to boil, use the beaker tongs to hold the beaker while you pour hot water slowly into the filter funnel. Pour hot water a little bit at a time making sure not to overflow the filter funnel. Use the stirring rod to stir the coffee mixture.
10. When coffee stops flowing into the collecting beaker, brewing is finished. Clean up. Compost filter paper and coffee grounds if possible. Wash all equipment and return equipment to its proper place.

Data and Observations

Mass of beaker and coffee grounds:	
Mass of beaker:	
Mass of coffee grounds added to filter funnel:	

Table 1

Below, sketch the final setup of your equipment. Label all pieces of equipment.

Discussion

1. In your opinion, what 2 lab safety rules were the most important ones students needed to follow in today's lab? Explain by providing evidence and reasoning.

2. If you were to brew coffee in this manner again, what are 2 things you would do to improve your results? Explain by providing evidence and reasoning.

Extension

A big misconception is that a regular cup of coffee - with no sugar or cream added - should be black. In fact, a good cup of coffee should have a dark amber colour. How could you adjust the experimental factors such as time, temperature, surface area, and concentration to get a better cup of coffee (if we assume that a colour with a dark amber colour is considered a good cup of coffee)? Some suggested ideas:

1. Compare brew methods to see which one provides a better cup of coffee. Compare colour of coffee produced by immersion method and drip method.
2. Using drip or immersion method, compare colour of coffee brewed by altering the temperature of the water used.
3. Using drip or immersion method, compare colour of coffee brewed by altering the size of the coffee grounds. For this, students will need to use mortar and pestles to grind roasted whole coffee beans to different sizes.