

# Burning Coal

**Overview:** The soft coal called “bituminous coal” contains 15-20% volatile matter, making it a cheap, easy source of energy. Coal goes through three stages when burned: coal gas, coal tar, and coking.

**What to Learn:** Bituminous coal (also called black coal) is a soft, black organic sedimentary rock that contains 85% carbon. It’s a lower grade than anthracite coal, which contains 93% carbon. Bituminous coal can either be dull or shiny, whereas anthracite is hard and shiny. Lignite, a lower grade than bituminous, is a crumbly, black type of coal that only contains 72% carbon.

## Materials

- Votive candle
- Paperclip
- Hammer (if your piece of coal is large)
- Pliers (to bend paperclip)
- Lighter with adult help
- Cup of water
- Rock samples (in the video: bituminous coal, anthracite coal)

## Experiment

1. Move your experiment outside. Do not do this indoors! Fumes generated must be properly ventilated.
2. Open up and bend the paperclip into a shape that will allow you to hold the coal without it falling off the end. Use pliers to bend the paperclip.
3. Set a small piece (about the size of a pea) of bituminous coal at the end of the paperclip.
4. Put on your goggles. NO EXCEPTIONS!
5. Have an adult light your candle.
6. Place the coal piece at the top of the flame for the most intense heat.
7. Look for brown to black smoke to come from the coal. Record your observations in your data table.
8. When you’re done, place the entire piece of coal in your cup of water.

Optional: If you’ve got a test tube and stand, you can do the following experiment:

9. Put on your goggles, and pick up the test tube with the test tube holder.
10. Place a small piece of bituminous coal in the test tube (about the size of a pea).
11. Place the tube at an angle in a proper holder.
12. Turn on the heat source, and wave it near the bottom of the test tube for a few minutes, until you notice any slight changes.
13. As your coal sample heats up, look for bubbles or gas, which is coal gas, one of the first of three things produced by coal. The coal gas was captured and used as fuel in household lamps and streetlights before electricity was available.
14. As you continue to heat the sample, look for brown stuff along the sides of the tube called coal tar, which is used in dyes, aspirin, textiles, pesticides, and more.
15. As your sample continues to burn, notice if there are any gray-black solids in the bottom. This will look a lot like ash, but it’s called coke and it’s used to purify metals in a chemical process.

# Burning Coal Data Table

| <b>Trial #</b> | <b>Size of Coal</b><br><i>(mass, weight, or approximate diameter)</i> | <b>Observations</b><br><i>(How long did it burn? What colors did you see on the coal during burning and after? etc...)</i> |
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## Reading

Coal comes in two main forms: bituminous and anthracite. Bituminous coal is the stuff used to generate energy, whether electricity, heated water, or as a product in other substances. It's more abundant than anthracite, which is the purer version of coal. Anthracite burns hotter and cleaner, but it's more scarce. Coal also exists in two other forms as peat, which used to serve as fuel for heating homes as well as lignite, which is more pure than peat but not quite as pure as bituminous.

Coal is one of the two kinds of rocks that are not made from minerals (amber is the other).

Today's lab lets you burn coal to identify the byproducts of combustion. When coal is burned, it releases volatile compounds that are hazardous to your health, including methane, hydrogen, carbon monoxide, carbon dioxide, nitrogen, and volatile hydrocarbons, but the chemical reaction leaves behind a purer form of carbon than found in the coal itself. So make sure to do this experiment outside!

## Exercises

1. What are the three products that coal generates?
2. Name four types of coal.
3. What are two things we use coal for?
4. What type of coal is the most pure?
5. What is the dominant element in coal?
6. What are three alternatives to generating energy, instead of using coal?

**Answers to Exercises: Burning Coal:**

1. What are the three products that coal generates? (coal gas, coal tar, and coke)
2. Name four types of coal. (bituminous, peat, anthracite, and lignite)
3. What are two things we use coal for? (heating water and generating electricity)
4. What type of coal is the most pure? (anthracite)
5. What is the dominant element in coal? (carbon)
6. What are three alternatives to generating energy, instead of using coal? (solar power, natural gas, and wind power)