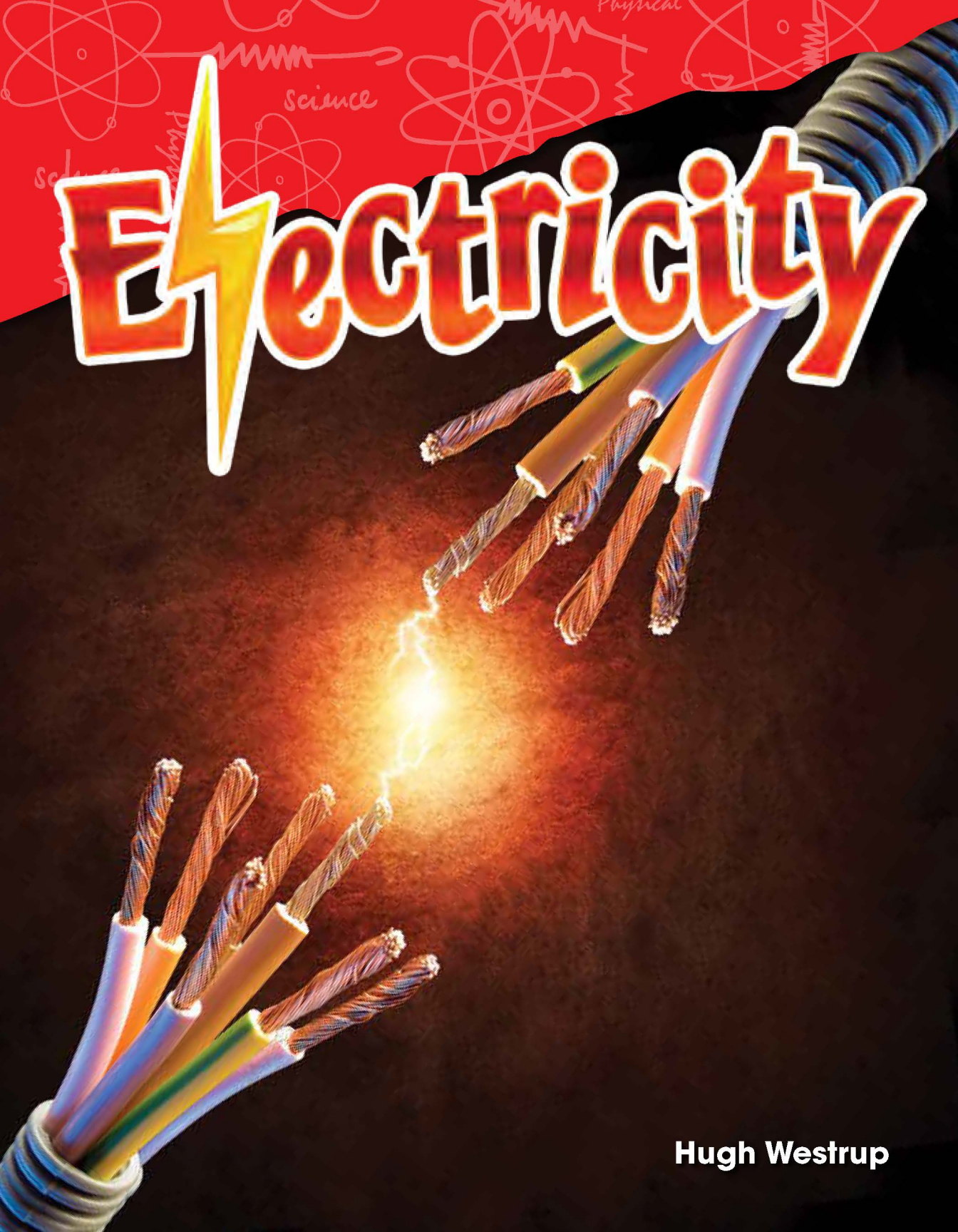
Electricity



Hugh Westrup

For teachers' inspection ONLY

Table of Contents

Power Hungry 4

Early Studies 6

Electrons on the Move 8

Controlling the Current 14

Electric Glow 26

Think Like a Scientist 28

Glossary 30

Index 31

Your Turn! 32

For teachers' inspection ONLY

Power Hungry

The date was August 14, 2003. The time was late afternoon. A large part of eastern North America lost power. More than 50 million people had no electricity. Cell phone service went down. Traffic lights failed. Trains and subways stopped in their tracks. Service stations couldn't pump gas. Businesses had to close.

Nightfall brought more troubles. Refrigerated food started to spoil. People had to use candles and flashlights to see in the dark. Stranded workers had to sleep on park benches. Miners were trapped below ground all night.



Before

For teachers' inspection ONLY

Most power was restored within two days. But the blackout reminded people how much modern life needs electrical energy. Almost everything we do requires electricity. We need it to travel. We need it to communicate. We need it for cooking, heating, and lighting.

But what is electricity?



After

For teachers' inspection ONLY

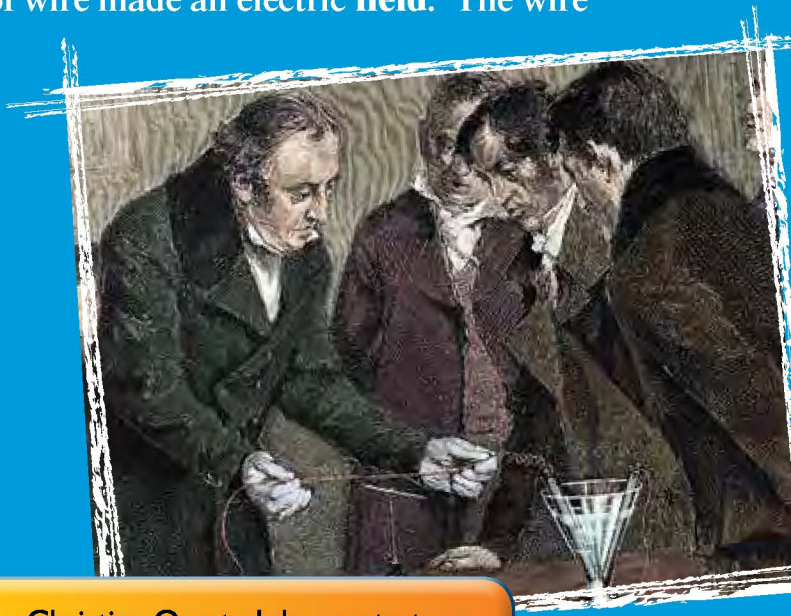
Early Studies

It wasn't always clear what electricity was or what caused it.

Thales (THEY-leez) was the first scientist to study this great **force**. He lived more than 2,500 years ago in Greece. Thales worked with pieces of amber. Amber is a hard, golden resin found in trees. Thales rubbed the amber with a cloth. That gave it the power to attract bits of straw. These were early studies of static electricity. Thales didn't know what was going on, but he saw its power.

In 1820, scientist Hans Christian Oersted found that a magnetic needle lined up with an electrified wire. The relationship between magnetism and electricity wasn't clear. But it appeared the **current** in the wire was acting on the needle even though they weren't touching. In 1831, Michael Faraday proved that moving a magnet through a loop of wire made an electric **field**. The wire became electrified.

Scientists knew they were on to something even if they didn't know what it was yet. Finally in the 1860s, James Clerk Maxwell showed how electricity and magnetism were connected. And the world was electrified with new ideas!



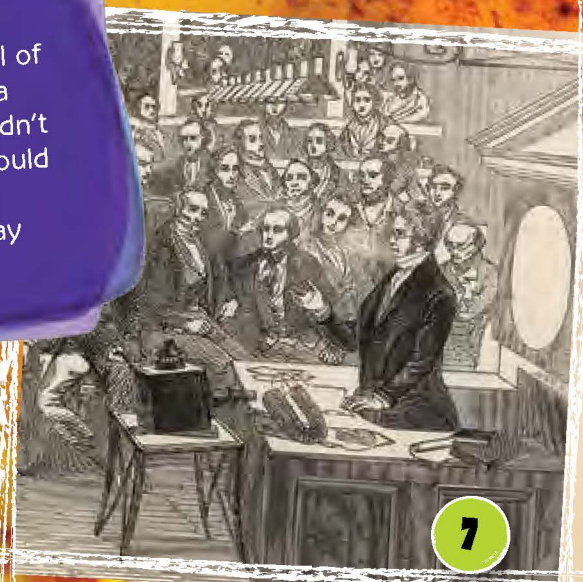
Hans Christian Oersted demonstrates a needle's reaction to an electrified wire.

For teachers' inspection ONLY

Amber is fossilized tree resin. Sometimes insects get caught in the sticky resin as it fossilizes.

Self-Taught

At first, scientists were skeptical of Faraday's work. He didn't have a college education and they couldn't believe a self-taught scientist could figure out something that they couldn't. But eventually, Faraday proved his work was accurate.



For teachers' inspection ONLY

Electrons on the Move

Electricity is still fascinating scientists two thousand years after Thales. But today, it is better understood. All matter is made up of particles called *atoms*. Atoms make up everything from our ears to the air we breathe. They're very small. Billions of atoms can fit on the period at the end of this sentence.

It was once thought that an atom is the smallest thing there is. In fact, the word *atom* comes from the Greek word *atomos*, which means "indivisible." The truth is that each atom can be divided. It's made up of smaller parts called *protons*, *neutrons*, and **electrons**. The protons and neutrons form the nucleus at the center of the atom. Electrons are smaller and lighter. They move randomly around the nucleus in sections called **orbitals**.

Protons have a positive charge. Electrons have a negative charge. Neutrons have no charge. Most atoms have the same number of protons and electrons. An atom of sulfur has 16 of each. An atom of copper has 29 of each. An atom of silver has 47 of each. The equal numbers balance the charges. The negative and positive charges are the same. So, the atom has a neutral charge.

But sometimes, that balance is upset. And that's when electricity is created!

For teachers' inspection ONLY

Smaller and Smaller

Today, scientists know that the atom is not the smallest piece of matter and can be divided. They are still searching for the smallest piece of matter. Some scientists think matter can be infinitely divided. That means you can keep splitting matter forever.



Quirky Quarks

Quarks are particles that have only a part of a charge. They combine in groups to make up protons and neutrons. There are six different types of quarks: *up*, *down*, *strange*, *charm*, *bottom*, and *top*.

Think Like a Scientist

For teachers' inspiration ONLY

What does it feel like to complete an electrical circuit? Experiment and find out!

What to Get

- 18-gauge copper wire
- lemon
- ruler
- sandpaper
- steel paper clip
- wire clippers

