Tires

Physical Science | Lesson Guide

5th Grade

Photo Description

This image shows several vehicle tires with deep tread patterns—the grooves and ridges molded into the rubber surface. The treads are visibly worn down and dirty, showing how tires change over time from repeated use on roads. In the background, you can see a car wheel and metal rim, which helps you understand how tires are part of a vehicle's system.

Scientific Phenomena

Anchoring Phenomenon: Why do tire treads wear down over time?

Tire tread wears away due to friction—the force created when the rubber tire surface rubs against the road. Every time a car drives, the tire makes contact with the pavement, and tiny bits of rubber are scraped away. This happens repeatedly over thousands of miles of driving. The friction also creates heat, which can speed up the wearing process. Additionally, the weight of the vehicle pressing down on the tire adds pressure that increases wear. Eventually, when treads become too shallow, the tire no longer grips the road safely, and it must be replaced.

Core Science Concepts

* Friction: A force that occurs when two surfaces rub against each other, causing resistance and wear. Friction between the tire and road is what slows down a car and allows it to grip the road.

* Material Properties and Wear: Rubber is a material that can be worn away by repeated rubbing and friction. Different materials (like rubber, plastic, or metal) wear at different rates depending on their properties.

* Force and Motion: The weight of the vehicle (a downward force) combined with the motion of driving creates continuous stress on tires, which causes them to gradually break down.

* Energy Transfer: Friction converts some of the energy from a moving car into heat and wear, which is why tires get warm during driving and eventually deteriorate.

Pedagogical Tip:

Consider bringing a worn tire tread gauge or an actual worn tire to class so students can observe the depth difference between new and old treads. This concrete visual makes the abstract concept of friction's effects much more tangible for fifth graders who are still developing abstract reasoning skills.

UDL Suggestions:

Representation: Provide high-contrast close-up photos of tire treads alongside diagrams showing the friction process. For kinesthetic learners, use a worn piece of sandpaper and a smooth piece to physically demonstrate how surfaces change with friction. Action & Expression: Allow students to choose between drawing a labeled diagram, creating a digital slide, or building a model to explain tire wear.

Zoom In / Zoom Out

Zoom In: The Microscopic World of Rubber

If you could zoom way down to see the rubber material of a tire under a microscope, you'd discover that rubber is made of tiny chains of molecules linked together. When friction happens, the heat and rubbing actually break some of these molecular chains apart, causing small pieces of rubber to come loose—this is what we call wear. The darker, worn-looking areas on the tire in the photo show where millions and millions of these tiny rubber pieces have been rubbed away. Scientists can study rubber at the atomic level to understand which types of rubber last longer and resist wear better.

Zoom Out: The Tire's Role in Transportation Systems

When you zoom out and look at the big picture, a single tire is just one tiny part of an enormous global transportation system. Millions of cars, trucks, and buses are driving every day, which means billions of tires are wearing out and needing replacement. This creates a huge industry of tire manufacturers, recycling centers, and landfills. The wear on tires also affects road conditions—tiny rubber particles end up on roads and in waterways, which scientists are studying to understand environmental impacts. Additionally, tire wear affects fuel efficiency (more worn tires create more friction, making cars work harder), which connects to energy use and climate change on a planetary scale.

Discussion Questions

1. What do you think would happen to a tire if someone drove a car in circles in the same spot over and over? (Bloom's: Predict/Analyze | DOK: 2)

2. Why might a race car driver need to change tires more often than someone who drives slowly on quiet streets? (Bloom's: Analyze | DOK: 3)

3. How could tire companies design a tire that lasts longer without wearing out as quickly? (Bloom's: Create/Evaluate | DOK: 3)

4. Explain the connection between friction, heat, and tire wear. Why do all three happen together? (Bloom's: Understand/Analyze | DOK: 2)

Potential Student Misconceptions

Misconception 1: "Tires wear out because they get old, not because of use."

Clarification: Tires don't wear simply because time passes—they wear because of friction from driving. A tire stored in a garage for ten years will look almost the same as when it was new, but a tire driven thousands of miles will be worn down. It's the motion and rubbing that causes wear, not age itself. You can test this by comparing an old unused tire to a heavily driven one!

Misconception 2: "Once a tire is worn down, you can just keep driving on it because it's still made of rubber."

Clarification: When treads wear down too much, the tire becomes unsafe—it can't grip wet roads properly, which increases the chance of skidding or hydroplaning (when the tire loses contact with water-covered pavement). Deep treads channel water away from the tire. Without them, tires lose their grip, similar to how trying to walk on ice with smooth-soled shoes is slippery compared to shoes with good traction. Safety is the main reason worn tires must be replaced.

Misconception 3: "All materials wear at the same speed."

Clarification: Different materials have different properties that affect how quickly they wear. Rubber wears faster than steel or plastic when rubbed repeatedly. Even different types of rubber wear at different rates! This is why scientists and engineers work to create better rubber formulas that resist friction wear longer. Material choice matters a lot in designing products that last.

Extension Activities

1. Tire Tread Measurement Lab: Provide students with pennies, a ruler, and pictures of different tires (or actual tire cross-sections if available). Have them measure tread depth using a penny (inserting Lincoln's head to see how deep the groove is). Students can compare new tires to worn ones and graph their findings. This makes the invisible wear visible and quantifiable.

2. Friction Exploration Station: Set up three surfaces (smooth tile, carpeted floor, sandpaper) and have students roll a toy car down ramps of equal height onto each surface. Students measure and record how far the car travels on each surface, then write a conclusion about which surface causes more friction and why this relates to tire wear.

3. Design a Better Tire Challenge: In small groups, have students sketch or build a prototype tire (using clay, rubber bands, or other safe materials) that they think would last longer. Students must explain the scientific reasoning behind their design choices (e.g., thicker rubber, different tread patterns, harder material). They can test prototypes by dragging them across sandpaper and comparing wear.

Cross-Curricular Ideas

Math Connection: Measuring and Graphing Tire Wear

Students can collect data on tire tread depth using the penny test (inserting a penny into treads to measure depth) or by examining photographs of tires at different stages of wear. They can create bar graphs or line graphs showing tread depth decreasing over time or across different vehicle types. Students could also calculate how many miles a tire lasts before needing replacement, then determine the cost per mile—introducing basic division and real-world application of math skills.

ELA Connection: Write an Informative Brochure for Drivers

Have students research tire safety and maintenance, then write and design an informative brochure or poster explaining why tire care matters, how to check tread depth, and when to replace tires. Students practice technical writing, persuasive language, and organizing information for an audience (parents and drivers). They could include diagrams, bullet points, and clear explanations of friction and wear in their own words.

Social Studies Connection: The Tire Industry and Economics

Explore how the tire business works—where tires are manufactured, how they're distributed to stores, and what happens to old tires. Students can research tire recycling programs in their community, learn about jobs in the tire industry, and discuss the economic impact of vehicle maintenance. This connects to local economy, global trade, and resource management.

Art Connection: Design a Better Tire Tread Pattern

Students can sketch creative and functional tire tread designs using circles, grids, or clay models. They research real tread patterns and learn that engineers must balance gripping power, water drainage, and durability. Students present their designs with labeled diagrams explaining how their tread pattern would reduce wear or improve safety. This combines art, design thinking, and scientific reasoning.

STEM Career Connection

Tire Engineer / Materials Scientist

Tire engineers design and test new tire designs to make them last longer, grip better, and be safer. Materials scientists work specifically on creating new types of rubber and compounds that resist friction and wear. They use computers to test designs and work in labs mixing different materials to find the perfect blend. These professionals help companies like Goodyear, Michelin, and Bridgestone invent better tires.

Average Annual Salary: $75,000–$110,000 USD

Automotive Mechanic

Mechanics inspect vehicles and maintain tires—checking tread depth, rotating tires to ensure even wear, and replacing worn tires. They help keep cars safe and running well. Mechanics use measurement tools, understand how vehicles work, and give customers advice about tire care. Many mechanics run their own repair shops or work for car dealerships.

Average Annual Salary: $38,000–$52,000 USD

Rubber Chemist / Polymer Scientist

These scientists study rubber and plastic materials at the molecular level to understand how they break down under stress and heat. They experiment with different chemical formulas to create rubber that's more durable, flexible, and resistant to wear. Their work directly impacts tire quality and longevity. They spend time in laboratories conducting experiments and analyzing data.

Average Annual Salary: $62,000–$95,000 USD

NGSS Connections

Performance Expectation:
5-PS2-1: Support an argument that the gravitational force exerted by Earth on objects is downward.

Disciplinary Core Ideas:
* 5-PS2.A (Forces and Motion)
* 5-PS2.B (Types of Interactions)

Crosscutting Concepts:
* Cause and Effect
* Energy and Matter

Science Vocabulary

* Tread: The grooved pattern on the surface of a tire that helps it grip the road and channels water away.

* Friction: A force that resists motion when two surfaces rub together; it slows things down and can create heat and wear.

* Wear: The gradual damage or loss of material that happens when something is used repeatedly over time.

* Grip: The ability of a tire to hold firmly to the road surface without slipping.

* Material Properties: The characteristics of a substance that describe how it looks, feels, and behaves (like hardness, flexibility, or resistance to wear).

External Resources

Children's Books:
Tires* by Mari Schuh (Simple Machines series) – Explains how tires work and why they're important.
How Do Wheels Work?* by Thomas K. and Heather Adamson – Covers tires, friction, and vehicle systems in accessible language.
What Do Wheels Do?* by Robin Page – Picture book exploring wheels, tires, and motion.
