

GROW YOUR PALS PROGRAM GUIDE



THE NATIONAL FFA MENTORING PROGRAM

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LESSON 1.32

Gear Up! Gears and How They Work

Unit:
**MATHEMATICAL
APPLICATIONS**

PRECEPTS

- P. Technical and Functional
- J. Mental Growth
 - J1. Think critically



Lesson Type:
Small Group

NATIONAL STANDARDS

- PST.03.02.02.b. Describe features, benefits and applications of mechanical transmission components, including belts, chains, gears, bearings, seals, universals and drive shafts.
- NL-ENG.K-12.12 – Applying Language Skills
- NM-CONN.PK-12.3 – Recognize and Use Connections Among Mathematical Ideas

STUDENT LEARNING OBJECTIVES

As a result of this lesson, the student will ...

- Identify three common objects that use *gears*.
- Define a *gear*.
- Describe why a *gear* is important.





TIME

Instruction time for this lesson: **50 minutes**.



RESOURCES

Brain, Marshall. "How Bicycles Work." April 1, 2000. HowStuffWorks.com.
<http://adventure.howstuffworks.com/outdoor-activities/biking/bicycle.htm>
March 9, 2010.

Nice, Karim. "How Gears Work." November 16, 2000. HowStuffWorks.com.
<http://science.howstuffworks.com/gear.htm> March 9, 2010.

National FFA Organization. (2003). LifeKnowledge Precepts and Signs of Success.



TOOLS, EQUIPMENT AND SUPPLIES

- ✓ **Mountain bicycle.** It is best to have a bicycle that has multiple *gears*
- ✓ **Clock that uses *gears*** - optional
- ✓ **Electric drill** - optional
- ✓ **Different *gears* you may find in common objects**
- ✓ **Two bottle caps per student** (*the kind with crinkly edges*)
- ✓ **PALS.1.32.SG.TM.A** - printed out if you do not have the real items.
- ✓ **PALS1.32.SG.AS.A** - cut and place around room with geared objects
- ✓ **PALS1.32.SG.AS.B** - one per student



KEY TERMS

The following terms are presented in this lesson and appear in ***bold italics***:

Gear

Force

Energy



CONTENT OUTLINE

- I. What are three common items that use ***gears***?
 - A. Bicycle
 - B. Clock
 - C. Electric screwdriver
- II. What is a ***gear***?
 - A. A ***gear*** is a toothed machine part, such as a wheel or cylinder, that meshes with another toothed part to transmit motion or to change speed or direction

- III. Why is a **gear** important?
- A. **Gears** allow us to change **force** and **energy** into motion
 - B. **Gears** transfer **force** to different parts of objects that move
 - C. **Gear** ratios allow us to move things easier or faster

INTEREST APPROACH

OBJECTIVE 1. | Identify three common objects that use **gears**.



Before the lesson, place the bicycle, picture of a clock and picture of an electric drill in an area to develop student interest as they enter. If you can find a real drill and clock, use those instead. You can print out PALS1.32.SG.TM.A on blue paper and fold them in half before attaching to the item.



Hello everyone! Before you walked in, I hid some cool things around the room – three to be exact. Each of the things I hid has a big blue tag attached to it that contains a really cool clue as to what we are going to talk about today! When you hear FIND IT, you can find those items and bring them back to our table.

FIND IT!

Revised Go Get It e-Moment®

The Go Get It e-Moment® engages students' intrapersonal, interpersonal and bodily-kinesthetic intelligences. In this adapted Go Get It e-Moment®, you will place the stated items around the room with important pieces of information tied to each one. Students will retrieve the item and the information, and then share it with the group. With young children, you may need to assist in sharing the information.



You found the items fast! Let's look at what you found to discover what we will be talking about today. Who will share their card first? *Choose one of the students. The cards contain clues and questions with regard to each of the items and how **gears** are important for those items to work. Allow the student to read the question and then begin guessing the answers to the clue. You are ultimately leading students to discover that each of the items uses **gears** to help them do their job.*



So, the first card reads that today we are going to study something inside this clock that helps it move the hour and minute hands. What do you think that might be?

Take students guesses.



Those are good guesses. Let's look at the next card.

Have another student read their card.



This card reads that something inside this machine helps the screwdriver turn. What do you think that could be?

Take student answers.



Great ideas! There is one more item and card. It reads that something on this item lets us go fast without working too hard. What could that be?

Take student guesses.



You came up with some great ideas! Let's see how close we were!

Use the pictures provided in PALS1.32.SG.TM.B for the following part of the interest approach.



Look at this picture of the clock. What do you see that helps the clock turn the hands?

Allow students to respond.



These are called **gears**, and they help turn the hands of the clock. How many of you knew these were inside a clock? Let's look at another picture. Look at what the inside of a screwdriver looks like. What do you see that is the same as the clock?

Students respond.



Exactly! **Gears**. When the motor turns, the **gears** help spin the screwdriver. There is one more item. Does the bicycle have **gears**? Who will show me where there are **gears** on a bicycle?

*Choose a student. Challenge them to identify the **gears** on both tires of the bicycle.*



You are exactly right! Who will tell me why there are **gears** on a bicycle?

Allow students to share.



Correct! If we didn't have **gears**, pushing the pedals wouldn't make the tires turn. **Gears** are all around us. We use things with **gears** in them all the time. Today we are going to not only learn what a **gear** is and how it works, but we're also going to make our very own **gears** that we can make turn ourselves! If you're excited, give a friend a high five! Cool. Let's get started by figuring out exactly what is a **gear**.

SUMMARY OF CONTENT AND TEACHING STRATEGIES

OBJECTIVE 2. | Define what is a **gear**.



Now, we have all seen **gears**, but what exactly is a **gear**? The definition of a **gear** is: A toothed machine part, such as a wheel or cylinder that meshes with another toothed part to transmit motion or to change speed or direction. This definition has a lot of big words! Let me show you what a **gear** is.

Grab two of the bottle caps to use as a demonstration. Give each student two bottle caps as well.



A **gear** is first a round wheel that has teeth or grooves. Everyone rub your fingers over the grooves of your **gear** and say, "ooooohhhhhh." Now take the two bottle caps and put them together. Now the grooves or teeth are touching. Holding both **gears**, try to turn one and see what happens to the other. What happened?

Allow students to explain.



Exactly right! So, two things make something a **gear**. First, there must be grooves that match with other grooves, and second, when you turn one, it causes the other to move. This makes clocks work, bicycles go fast, cars go even faster and drills help us build things. Next, we will figure out why **gears** are so important.

OBJECTIVE 3. | Describe why a **gear** is important.



*Grab the bicycle and place it upside down on its handlebars and seat. You will help lead the students in a quick experiment using the **gears** of a mountain bicycle. Place a piece of masking tape around the back tire to use as a visual checkpoint. The students will turn the pedals one full turn and then record how far in inches the tire moved using a tape measure.*



How many of you have a bicycle?

Have students raise their hands.



If you had to go from your house to the store, which would be faster: walking or riding your bike?

Students respond.



Of course your bike would be faster. Why is that?

Allow students to respond.



Right, bikes have wheels and when we push the pedals we go faster and further than walking. Why does this bike have so many different **gears**?

Allow students to respond.



Interesting ideas. Let's do an experiment with the bike to figure out why **gears** help things move faster and further. Everyone take an experiment sheet.

Hand out PALS1.32.SG.AS.B to each student.



We can turn the tires of the bike by pushing the pedals. We are going to measure how far we can go if we are using different **gears**. I have a piece of tape on the tire so you can see how far the tire goes. Let's try the first **gear**.

*Ensure that the bike is in the highest **gear** setting so you can work backward in **gear** ratios.*



Who will turn the pedals first?

Choose a student.



Great. Your job is to turn the pedals one exact turn.

Work to help the students. Make sure there is no slack. When the pedal turns, the tire should turn as well.



Who will be the tape watcher?

Choose a student.



Great. Your job is to remember where the tape started and where it ended. Who will be the measurer?

Choose a student.



Great, thanks! Your job is to measure how far the tire moves. OK let's do this. Is everyone ready?

Make sure each student has his or her job covered.



Turner can turn the pedal one full turn.

Help the students conduct the experiment ensuring it is done correctly. Do this a number of times allowing students to ask questions, switch jobs and mold the experiment to their inquiries. Have fun in a scientific way with this. Each time, make sure students record their data on PALS1.32.SG.AS.B.



Great job! Which smart scientist will share what you figured out?

*Allow a number of students to share their ideas. Lead them to the fact that different **gears** lead to different lengths of the tire turning.*



That is exactly right. Different **gears** make the tire go different lengths. The easier it was to pedal, the less the tire moved. The harder it was to pedal, the more the tire moved.



Gears allow us to change **force** and **energy** into motion. For example, when you apply **force** or push on the pedal, it makes the tire move because of **gears**. **Gears** transfer **force** to different parts of objects that move!



REVIEW / SUMMARY



Now that we have learned so much about **gears** today, let's review. Who will share what makes something a **gear**?

Choose students to respond. Look for round, grooved and makes something move.



Who will show us how we exert **force** on our **gears**?

Choose a student to demonstrate.



That is right. We use our **energy** to put **force** on the **gears** with our hands. What are some examples of things that use **gears**?

Students respond.



You are all **gear** experts now.

When you leave and see a bicycle, a car, a windmill or even a clock, you will know how those things work. **Gears** cause those things to work.

APPLICATION



Large Group Idea

This lesson would work for a large group as well. You would need to reduce the number of bottle caps in the gear boards to three instead of five and provide more support. Add instructors to help build the boards. Also, utilize the resources listed earlier to show videos of how a clutch, engine, clock and other items work. There are great videos on www.howitworks.com.



One-on-One Idea

If this lesson is done with one student, you could make the board activity more challenging by starting with one bottle cap already placed on the board labeled the engine and two other caps labeled the wheel. The student would have to work to connect the power source to the wheels in order to make them work. The shop engine activity would also be fun with one student. One final suggestion is to bring your vehicle to the classroom, open the hood and ask the student to look for gears around the car's engine. You could then start your engine and connect the student's board to a real car's engine.

PALS1.32.SG.ASSESS.A | EVALUATION ANSWER KEY

1. Look for the following elements:
 - a. Round
 - b. Grooved
 - c. Cause things to move
2. Look for the student to use their hands to move one of the gears causing the others to move.
3. Look for the following elements:
 - a. Gears cause things to move
 - b. Transfer energy from an engine or source of motion
 - c. Make it easier for things to move
 - d. Other answers you may have discussed during the lesson



PALS1.32.SG.ASSESS.A

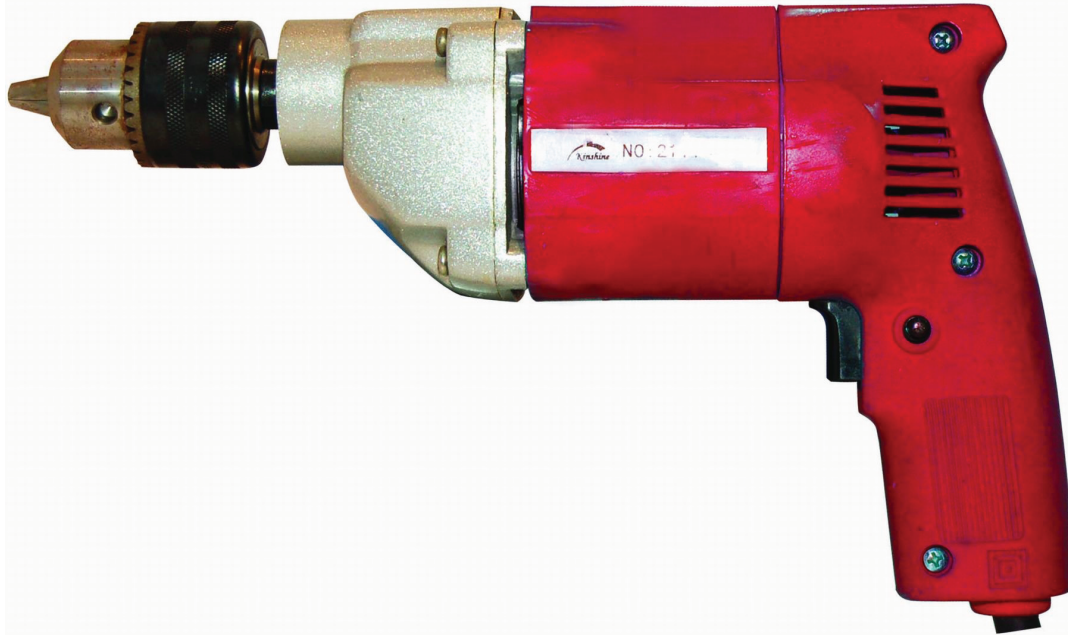
This assessment is an oral assessment. You will ask the students the following questions, and they must answer using their gear board.

1. Why are these caps gears?
2. Show me how you exert force to your gears.
3. What do gears do, and why are they important?

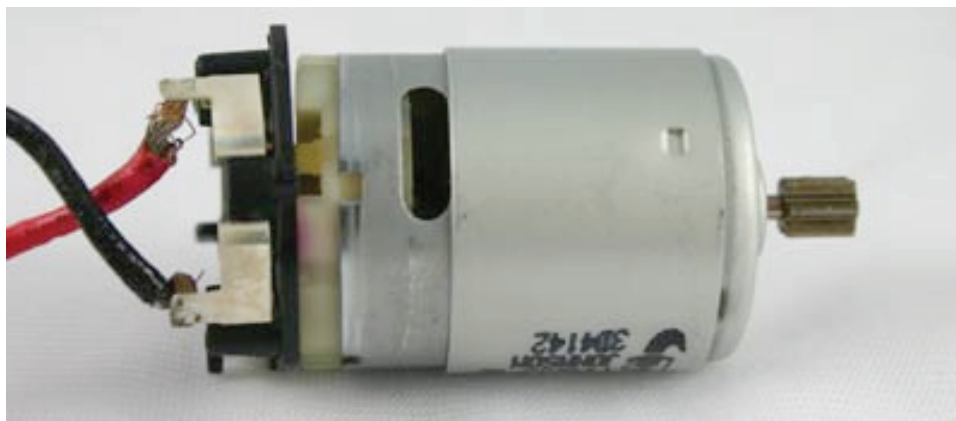
PALS1.32.SG.TM.A



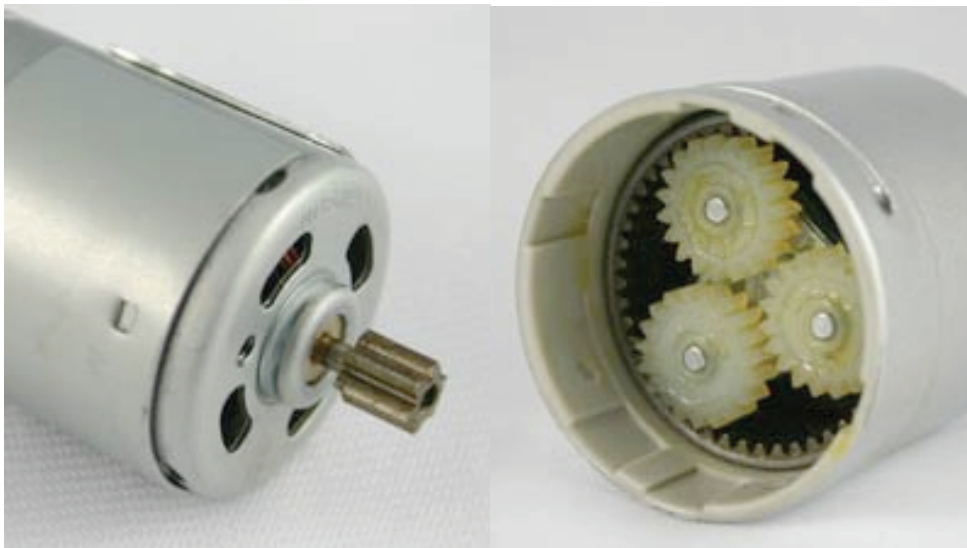
PALS1.32.SG.TM.B



PALS1.32.SG.TM.C



PALS1.32.SG.TM.D



PALS1.32.SG.TM.E



Today we are going to study something that is inside this clock that helps it move the hour and minute hands.

There is something inside this machine that helps the screwdriver turn.

There is something on this bicycle that helps us go fast without working hard.

PALS1.32.SG.AS.B

Bicycle Gear Experiment Sheet

Gear <i>(Write both the left and right gears)</i>	How Many Inches Tire Moved