Figure out how your bike really works by making gears! Ask your teacher for two gear templates. Use them to draw a large and small gear on a piece of foam or cardboard. Carefully cut out your gears and pin them to a sheet of cardboard. Pin the gears in their centers so that they can rotate and so that the teeth are firmly interlocking.

Draw a dot on the top tooth of each gear. Work in teams. Slowly turn the large gear once all the way around while counting how many times the small gear turns all the way around. Record your results.

Now design your own set of gears on paper. Try to make a pair of gears in which the smaller one turns exactly the number of times you want it to when the larger gear turns once.

Use the Internet to research the kinds of bicycles that riders use in the Tour de France or other bike races.
Today’s bicycles are complicated. They have gears, pulleys, wheels and axles, and levers. Bikes are designed for different surfaces. They are fast and comfortable, but bicycles were not always this way!

Did you know that the first bike had no pedals? The rider had to straddle it and walk. It was called a walking machine.

The velocipede (vuh-LOSS-uh-peud) came later. The front wheel had an axle attached to the pedals. The rider pushed on the pedals to make the axle and wheels turn. Another name for this bike was the boneshaker. Its wooden wheels made for a bumpy ride!

Let’s Ride a Bike!

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The High-Wheel Bike

A strange-looking bike replaced the velocipede. It had a gigantic front wheel and a tiny rear wheel. This was called the high-wheel bike. It was hard to ride and dangerous, too. The smallest bump could send riders flying headfirst onto the ground. Yet it was more popular than the velocipede. Why did people like it so much?

The larger front wheel on the high-wheel bike worked better than the smaller front wheel on the velocipede. For each turn of the pedals, the larger wheel went farther. This made the high-wheel bike faster than the velocipede.

Riders could go farther with the same amount of work. When someone makes an object move, they are doing work.

The Drive Chain Makes It Go!

Have you noticed that early bikes did not have chains? Many chains at that time were made of heavy metals. By the late 1800s, stronger and lighter metals had been made. This lighter metal was used to make an improvement to the bicycle. The drive chain was created.

A drive chain is a pulley system with a chain that wraps around a gear. The gear, called a sprocket, has teeth to hold the chain as it turns.

Invented in 1880, the first bikes with chains were called safety bikes.
A lever is a stiff bar that turns around a point called the fulcrum. A kickstand is a lever that props up the bike. A handlebar is a lever that steers the bike. The pedals on a bike are also levers. The extra force gained by using a lever is called leverage (LEV-ur-ij).

Levers, gears, wheels, and axles work together to make the bicycle move. When a rider pedals, energy moves through the bike. It moves from the pedals to the front sprocket, to the chain, to the rear sprocket, and to the rear wheel. The rear wheel moves the bike, which also makes the front wheel move.

The drive chain transfers energy from the pedals to the axle and rear wheel. Here is how it works. The pedals turn the sprocket at the front of the drive chain. This large sprocket moves the chain. The chain moves a smaller sprocket connected to the rear axle. The rear axle rotates, and the back wheel turns. The whole bike rolls forward.

The large sprocket is similar to the high-wheel bike’s large wheel. For every turn of the large sprocket, the rear sprocket turns faster because it is smaller.
A lever also controls a bike’s hand brakes. When you squeeze the levers, cables pull the brake pads against the wheels. *Friction* between the brake pads and the wheel stops the wheel. Friction is the force that builds up when two objects rub against each other.

Friction not only stops a bike—it also helps it go. Bicycle tires are built to create friction. They grab the riding surface. The contact between the surface and the wheels pushes the bike forward.

Some parts of a bike need to be very slippery. The pedals, chain, and wheels must move easily. Oil reduces friction and makes it easier to pedal.

Some bikes are built for speed. Others are built to ride on rough trails. Road bikes have thin, smooth tires. These tires create just the right amount of friction—just enough to move the bike forward without slowing it down. Mountain bikes have fat tires with bumpy treads. Thick treads on the tires grip uneven surfaces for more friction.

BMX bikes are used to perform tricks, so their wheels have to absorb shocks without bending or breaking. Like cars, some bikes have *shock absorbers*. They make a bumpy ride smoother.

Machines • Let’s Ride a Bike!
Get It in Gear

The drive chains on BMX bikes and beach coasters are very simple. They usually have only one gear. Road bikes have many gears to make riding easier.

Suppose you are going uphill and it gets harder to pedal. You can switch to a lower gear. It will be easier to pedal, but you must pedal faster to keep the same speed.

Switching gears means the bike uses different-sized sprockets to drive the chain. Some bikes have three different-sized sprockets in the front and seven different-sized sprockets in the back. This gives the bike 21 different gears ($3 \times 7 = 21$). The rest is up to you!

Read-Think-Write

Write your answers on separate paper. Use details from the text as evidence.

1. Why did high-wheel bikes replace velocipedes?
2. How is the front wheel of a high-wheel bike similar to the front sprocket on a modern road bike?
3. Look at the diagram on page 9. Why do some bikes have so many sizes of sprockets?
4. The tires on a racing bike that rides on paved roads are most likely _______________.
   A. fat and bumpy
   B. narrow and smooth
   C. small and soft
5. If you were designing a new kind of bike, how would you use or limit friction to make your bike function better?

FOCUS Question

How do the parts of a bicycle work together to make it move and stop? Discuss the simple machines found in a bicycle and how they work together to make the bicycle move.