

Name: _____ Class: _____ Date: _____



Bicycle Gears

Learner Objectives:

- Investigate and describe the transmission of force and energy between parts of a mechanical system
- Analyze mechanical devices to determine speed ratios and force ratios

Key Terms:

Linkage

Gears

Speed ratio

Transmission

Sprockets

Force ratio

Background Information:

When a bicycle is in high gear, the back wheel rotates faster and more times per pedal rotation than when the bicycle is in low gear. However, it takes more force to rotate the pedals. This type of gear is good for flat ground and for going downhill, when you want to go fast.

When a bicycle is in low gear, the back wheel rotates slower and less times per pedal rotation, but less effort force is needed to move the pedals. It is easier to pedal in this gear, but you can't go as fast. This gear is good for going uphill.

Research question: What are the differences among three different gears on a bicycle?

Materials:

Multi-geared bicycle

Meter-stick

Procedure:

1. Observe the two sets of gears on the bicycle - front and rear. Record the differences between the front and rear gears.
2. Select three gears that you will study. Count the number of teeth on the front and rear sprockets for each gear. Record this information in your data table.

This investigation / activity has been adapted from:

Mah K, Martha J, McClelland L, et al. *Science in Action 9*. Toronto, ON: Addison Wesley.

3. Measure the radius of the rear wheel and the radius of the circle the pedal makes when it moves.
4. Set the bike to the first gear you will investigate. Apply just enough force to turn the pedal for one complete revolution. Note how difficult it is to turn the pedal on a scale of 1-5 (1= easy, 5 = difficult).
5. Record how many times the back wheel turns when you make one turn of the pedal.
6. Repeat steps 4-5 for the other 2 gears and record your results.

Observations:

Front Gears

Rear Gears

Radius of the back wheel _____

Circumference of back wheel _____

Radius of the pedals _____

Circumference of pedal _____

Gear	# of teeth on front sprocket	# of teeth on rear sprocket	Gear Ratio (teeth on front sprocket / teeth on rear sprocket)	Difficulty to turn pedal (1-5)	Distance back wheel travelled with one turn of the pedal	Distance Ratio (pedal circumference / distance rear wheel travelled)
Lowest						
Middle						

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Highest						
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Analysis:

1. Complete the calculations described in the data table.
2. Compare the gear ratios for each gear and determine what those ratios tell you about mechanical advantage.
3. How do the distance ratios between the pedal circumference and distance the back tire travelled compare to the gear ratios? Is there a relationship between these two ratios and how the bike performs?
4. What gear should you use to make the back wheel go faster? Why?
5. Which gear should you use when you are:
 - a. Riding uphill. Explain.

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- b. Riding on a flat surface. Explain.
6. Which was the driving gear on the bicycle? What is the function of the driving gear?
7. How do gears control the transfer of energy when you are riding a bicycle?
8. How do gears make riding your bicycle easier? What kind of mechanical advantages do they give you?

Conclusion: Describe the differences among the three gears you investigated on the bicycle.

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Extension:

1. One way to improve the performance of a road bicycle is to change the size of the sprockets. If you wanted to use your bicycle for street racing, what kind of sprocket should you use and where would you put it on your bike (rear or front). Explain your answer using the concepts you have learned in this investigation.
2. You have saved your money to purchase a new bicycle for a bicycle road race you plan on entering this summer. The race is a few months away but you want to start training soon. You also really want to win this race so you are looking for the very best bike to get you across the finish line first. Create a list of criteria you will use to select your new bicycle. Do some research to find the specifications on at least two bicycles you would consider buying and use your criteria to make and defend your choice.

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