Bicycle Gear Lab

When was the first bike race invented? When the second bicycle came rolling down the street!

Bicycles are fun to ride, and although the gears may look intimidating, they are one of the basic parts of a bike that enable you to win a race with your friends!

The image below shows the basic parts of a bicycle. Notice where the gears are located – the front gears (chainwheels) are attached to the pedals, and the rear gears are attached to the center of the back wheel.

Source: PBS Learning Media, 2007

If you have a bike with shifters on the handlebars and gears like the ones shown above, now is the time to walk to your bike and do this lab. If you don't have a bike, I've provided you with numbers you can use, or you can choose to wait until you have a bike and then do this lab.

Take your bike for a short ride and answer the following questions:

The left shifter controls: _____

The right shifter controls: _____

Each time the pedal goes all the way around in a circle, which gearset goes around once also? _____

When the rear wheel goes around once, which gear set also goes around once? _____

A) the rear derailleur for the freewheel

B) the front derailleur for the chainwheel

C) the steering for the front wheel

D) the bike seat

E) the freewheel

F) the chainwheel

If a bicycle has two gears in front and 5 in the rear, how many different combinations of the gears are possible? Draw a diagram to show your answer. Use the two gears below to get started (you may want to add more gears for other diagrams if it's too messy!)

Now park your bike for a minute and let's count teeth.

How many teeth does your chainwheel have?
If you have more than one gear, list each gear separately:

How many gears are on your freewheel in the back? _____

For each gear, write the number of teeth:

Now let's list all the pairs of possible combinations of gears using the table on the next page. The first is an example: if I count 30 teeth on the larger gear in the chainwheel, and 12 teeth on one of the rear gears, then one combination is (30,12) which is written in the 3rd column.

As soon as we have all the combinations of gears on our bicycle, we'll learn how the different gear ratios affect how we are able to pedal our bike!

If you don't have a bike, you can use these numbers:
chainwheel: 30 & 24 teeth, freewheel: 8, 12, 16, 20, 24.

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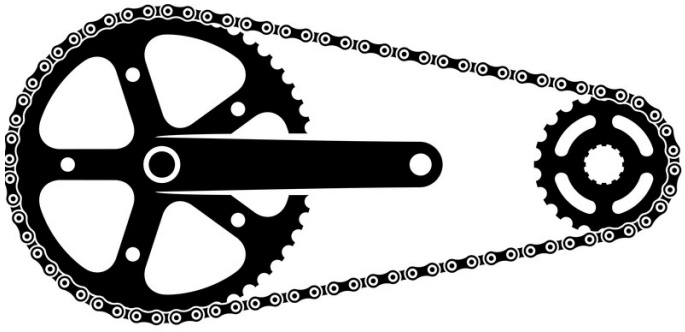
Possible Gear Combinations for your Bicycle

# teeth in front gear	***# of teeth in rear gear***	***Gear Combination***
Example: 30	*12*	*(30, 12)*

Let's look at a couple of the different gear combinations.

Suppose a front gear has 24 teeth and it's connected to a 12-tooth gear on the rear. Each time the pedal goes around once, how many times does the rear gear (and rear wheel) go around?



Each time the pedals go around twice, how many times will the rear gear go around?

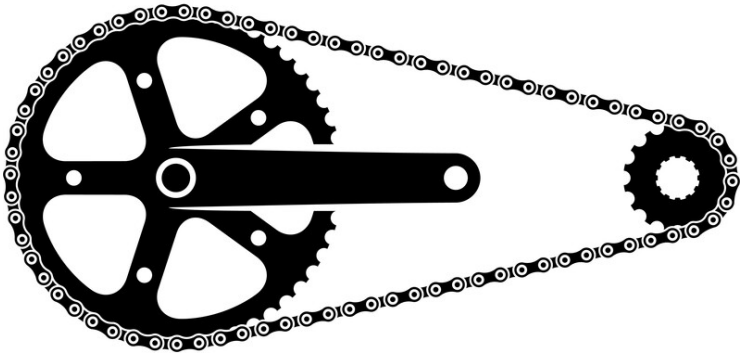
_____

What if the pedals go around 4 times?_____

10 times?_____

The ratio of the number of teeth in the front compared with the number of teeth in the rear is 24:12. This is our gear ratio. If we write this as a fraction, it looks like 24/12 which can be reduced to 2/1, or written as 2:1.

If a front gear has 24 teeth and it's connected to an 8-tooth gear on the rear, now how many times does the rear gear (and rear wheel) go around for every single revolution of the chainwheel?



What is the gear ratio now?

_____

Will this combination result in a higher speed than the 2:1 gear ratio or a lower speed?

Now let's look at your bike again. Complete the table below for your gear combinations.

# Teeth front gear	# Teeth rear gear	Ratio (front : rear)	Gear Ratio	# Turns of wheel for each pedal turn
Example: 24	*8*	*24:8*	*3:1*	*3*
Example: 24	*12*	*24:12*	*2:1*	*2*

If you don't have a bike, you can use these numbers:
chainwheel: 30 & 24 teeth, freewheel: 8, 12, 16, 20, 24

You may check your answers in the last column by flipping your bike upside-down and pedaling at different gear combinations.

Superbikes!

Suppose your new friend has a super bike with 2 front gears (56 and 42 teeth) and rear gears (14, 21, 28, 35, 42 and 56 teeth). How many gear combinations are possible with this new bike?

Complete the table below for the new gear combinations (only complete columns 1-4):

# Teeth front gear	# Teeth rear gear	Ratio (front : rear)	Gear Ratio	Speed rank (lowest = 1)

Circle the gear combinations that have the same gear ratio.

In the last column, rank the gear combinations with 1 being the *lowest* speed gear combination. The higher the rank, the higher the speed. Gear ratios that tie get the same rank.

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The table below shows all the possible combinations of front and rear gears for a 10-speed bike.

# Teeth front gear	# Teeth rear gear	Ratio (front : rear)	Gear Ratio	# Turns of wheel for each pedal turn
24	24	24:24	1:1	1
24	20	24:20	6:5	6/5 or 1 1/5
24	16	24:16	3:2	3/2 or 1 ½
24	12	24:12	2:1	2
24	8	24:8	3:1	3
30	24	30:24	5:4	5/4 or 1 ¼
30	20	30:20	3:2	3/2 or 1 ½
30	16	30:16	15:8	15/8 or 1 7/8
30	12	30:12	5:2	5/2
30	8	30:8	15:4	15/4 or 3 ¾

Circle the *highest* gear ratio on the table.

Box the *lowest* gear ratio on the table.

Double-circle any gear ratios that are the same.

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Use the table on the previous page to answer these questions:

1. What does it mean for a gear ratio to be 1:1?
   What would we see the pedals and back wheel doing?

2. What does it mean for one gear ratio to be higher than another?
   What would we see the pedals and back wheel doing?

   What does it mean in terms of effort you need to apply or how fast you can go?