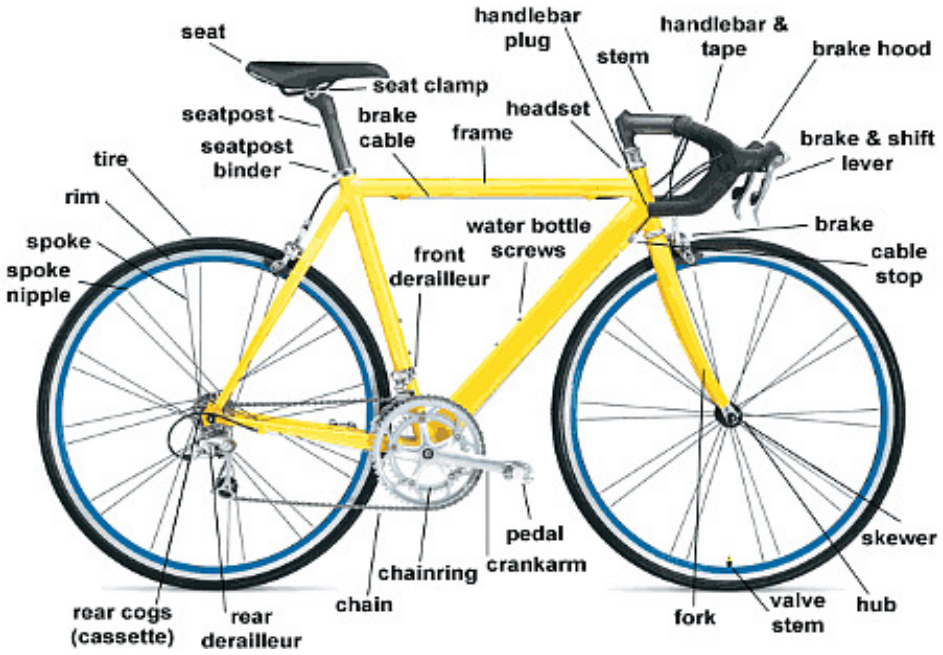
Eric’s bike information*



Rear **cogs**

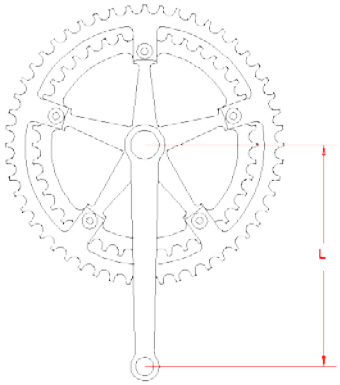
9-speed **cassette**
11, 12, 14, 16, 18, 21, 24, 28, 32 teeth

Front **chainrings**

48 teeth

36 teeth

Crank length 170mm



Wheel diameter = approximately 678mm
(622mm plus twice 28mm tire)

*These images aren’t to scale

Mathematics of Bicycle Gears: Questions for a September 2018 CAMI meeting

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Note: Use the separate page with bicycle information to answer the questions below:

1. The front gears between the pedals are called the *chainrings* and the gears on the back wheel are called cogs. Which of the following actions increase the difficulty of pedaling? Which decrease the difficulty of pedaling?
   - increase chainring size
   - decrease chainring size
   - increase cog size
   - decrease cog size

2. Evaluate these combinations: 36-tooth chainring x 32-tooth cog or 32-tooth chainring x 36-tooth cog.
   A) Both combinations provide the same resistance
   B) 36x32 is a higher gear (harder to pedal)
   C) 36x32 is a lower gear (easier to pedal)

3. If a bicycle has a 45-tooth chainring and 15-tooth cog, how many rotations of the back wheel will you get for one rotation of the pedals? How many rotations of the back wheel do you get with the combination of a 45-tooth chainring and a 20-tooth cog?

4. What is highest gear combination on the bike described on the other page?

5. What is lowest gear combination on the bike?

6. Why does the front chainring on a bike usually have more teeth than any of the back cogs?

7. If an F-sized chainring turns a 20-tooth cog 1 ½ times, how big is the chainring? If a 40-tooth chainring turns a B-sized cog 2 ½ times, how big is the cog?

8. How many possible gears are there on a bike with 2 chainrings in front and 9 cogs in the back? There are three ways to count the total gears on a bike: possible, distinct and usable. Can you imagine how each of these counts might differ?

9. As a shorthand, the chainring/cog combination is often listed in this way: 36/28. If you were riding a 36/28 gear combination and your friend was riding 24/14, how fast would you have to pedal in order to maintain the same speed as your friend?

10. A popular Shimano 9-speed cassette (set of cogs for a back wheel) includes the following gear sizes: 11, 12, 14, 16, 18, 21, 24, 28, 32. Why do you think the difference in the number of teeth isn't the same?

11. “Fixies” are single-speed bikes with one chainring and one cog. Since the back wheel on a fixed-gear bike doesn't have a freewheel, the back wheel doesn't turn without the pedals and crank turning at the same time. This means that a fixie can be ridden without a brake. In order to stop, the rider locks their legs and skids the back wheel. With certain gear combinations, this can create a problem since riders usually skid with their legs in the same position each time, right foot back, for example. Certain gear combinations result in skids happening in the same positions on the rear tire, which greatly reduces the lifespan of tires. What gear combinations would help avoid this problem?

12. Road bicycles (what we used to call “10-speeds”) have wheels with a rim diameter of 622mm. The full diameter of the wheel depends on the width of the tires used. A rule of thumb calculates the full diameter as 622mm plus twice the tire width. If you have a bike with 28mm tires, what is the circumference of the wheels?

13. If you have a road bike using 25mm tires, what speed would you get with a 36-tooth chainring and 21-tooth cog at a cadence of 80 rpm (revolutions per minute)? Recreational and utility cyclists typically pedal around 60–80 rpm.

14. Mountain bikes tend to have wheels with a smaller diameter than road bikes. If a mountain bike and a road bike had the same chainring/cog combination, would you see any differences in the distance traveled for each revolution of the crank?

15. There are different ways to compare bicycle gear combinations. One common measure is called gain ratio and is calculated in the following way: (radius of the drive wheel divided by the length of the crank) x (number of teeth in the chainring divided by the number of teeth in the cog). Why?