Curiosity Guide #708
Gears
Accompanies Curious Crew, Season 7, Episode 8 (#708)

Manual Transmission
Investigation #8

Description
Chugga-Chugga-Choo-Choo! How do these engines work?

Materials
• A car with a manual transmission
• Toy gear-shifting car
• A friend

Procedure
1) Look at the manual transmission of a car.
2) Compare the manual transmission to that of the toy car.
3) Do you see some similarities?
4) How does the manual transmission work?

My Results
Explanation
The purpose of the transmission is to convert the engine power into wheel rotation. A car’s engine has a rotational speed of 600 to 7000 revolutions per minute, or RPM’s. The rotational speed needs to get geared down to provide more torque or force to the wheels that have a range of 0 to 1800 RPM’s. Shifting gears allows the car to speed up or slow down without hurting the engine or the wheels. To find the gear ratio, count the number of rotations the input gear has, compared to a single rotation of the output gear. These ratios are expressed by using a colon between the two numbers you are comparing, like this: 3:1. Here’s how the gears in a typical manual transmission might relate to each other:

- 1st gear might have a ratio of 3:1 (3 rotations of the input gear to 1 rotation of the output gear)
- 2nd gear 2.07 to 1 (the input gear rotates a little more than twice for every rotation of the output gear)
- 3rd gear 1.43:1
- 4th gear 1:1 (which is called Direct Drive)
- 5th gear .84:1
- Reverse 3.38:1.

Most transmissions use helical gears because of the angle of the teeth. Helical gears run more smoothly, quietly, and can generate a lot of thrust. Imagine a motor is connected to a 12-tooth driver gear that is meshed to a follower gear with 24 teeth. Because the follower gear has double the teeth, the follower gear rotates at half the speed. In the time the smaller gear rotates twice, the larger gear rotates only once. This is called the gear ratio, and in this case, it is 2 to 1 and will produce more torque or force. If a larger gear drives a smaller gear, the output will have more speed. Now it’s time to shift gears!

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