



## Curiosity Guide #708

### Gears

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

#### Speedy Gears

Investigation #4

#### Description

Grab some gears and get going in this great demonstration of how spur gears work together.

#### Materials

- Three pairs of spur gears of equal and unequal sizes
- Axles or bolts
- $\frac{1}{4}$ -inch plywood
- Drill
- Drill bit
- Wood file
- Measuring tape
- Pencil
- 2 blocks of wood
- Fine-tipped marker
- Small washers
- Can opener for Explanation

#### Procedure

- 1) Mesh the teeth of a pair of similarly sized gears.
- 2) Place the meshed gears on the plywood and mark the center of each gear. Label the marks "Same Size."
- 3) Repeat the process on another part of the plywood with a pair of two different sized gears. Label this pair "Different Size."

- 4) Mesh three gears together and mark the centers. Label this grouping "Gear Train."
- 5) Thread the bolts through the centers of the spur gears.
- 6) Drill out each of the marked center holes.
- 7) Rest the board on the wood blocks at each end.
- 8) Insert a pair of gears and test that the gears can rotate in the holes. Adjust as necessary with a wood file. Repeat with each pair or group of gears.
- 10) Draw a straight radius mark on each of the gears with a fine-tipped marker.
- 11) Try rotating one of the similar sized gears. What do you notice?
- 12) Try using the pair of different sized gears. What do you notice when rotating the smaller gear?
- 13) Count how many rotations the smaller gear rotates with one rotation of the larger gear. What do you notice?
- 14) Thread a small gear on top of a large gear on one bolt. This is *Gear Stack #1*. Thread several washers (the thickness of a gear) below one of the large gears on another bolt. This is *Gear Stack #2*.
- 15) Assemble a gear train: Mesh or connect a single small gear to *Gear Stack #1*. Mesh the small top gear of this stack to *Gear Stack #2*.
- 16) Rotate the small gear and count the number of rotations in the small gear compared to the large gear in *Gear Stack #2*. What do you notice?

My Results

## Explanation

When parallel gears of similar size are driven, they rotate at the same speed. Changing the size of the gears changes the speed of the driven gear. If the driven gear has double the teeth, the driven gear rotates at half the speed of the smaller driver gear. You can see this by counting the complete rotations of the gears. In the time the smaller gear rotates twice, the larger gear rotates only once. This is called the gear ratio, and in this case, the gear ratio is 2 to 1. Changing the gear sizes and gear ratio increases or decreases the speed of the driven gear. When gears are added to the same axle, the grouping becomes a compound gear train and can not only multiply the gear ratio potential but also reduce the amount of friction between the teeth.

**Look more closely. Examine a can opener.** Watch the gears work together and think about how these gears send power to the can opener. Spur gears are a kind of cylindrical gear that connect to parallel shafts. As one wheel or gear rotates, the friction force of the rolling teeth causes the second gear to turn in the opposite direction. Spur gears are a great choice when objects need to move at slower speeds, so engineers choose them for things like music boxes, wind-up clocks, or power winches. Other parallel gears include the helical, internal and gear rack. I'm all geared up!

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