Lesson 3 Using gears: Why? What do they do?

Objectives: Students will understand what gears are used for and why they are sometimes necessary.

Students will understand that gears can be used to slow the rotation speed available with a motor.

Students will understand that by using gears, they can increase the torque available from a motor.

Materials: Georello Gear Tech toys – one box per group (bring only gears, backing, gear connectors, cranks, and pegs)

Copies of "overdrive" example from Gear Tech manual

Motor connected directly to a wheel

Sample car with gearbox

Miscellaneous gears from real mechanisms

Initial Discussion: Show students motor with wheel attached. Notice how fast the motor is turning the wheel. Ask for suggestions on how you could build a car. Would it work to attach one wheel directly to the motor? Would it work to attach two wheels directly to two motors?

Introduce the concept of torque. Torque is a force that tends to rotate or turn things. Notice that if you place the wheel that the motor spins on the table, it slows or stops. There is not enough torque.

Show students a car built with a gearbox. The same type of motor has enough power to move the car. Using gears to slow down the rotation of the motor provides more torque.

Project: Give each group a bag of gears. Walk the students through the following introductory exercises:

- Put together three backing pieces.
- Add one gear connector and a large gear. Have students spin gear clockwise, counterclockwise.
- Add another gear connector and a small gear. Make sure that the teeth mesh. This is called a gear train.
- Spin the big gear clockwise. What direction does the small gear spin?

- When the big gear goes around one time, how many times does the small gear go around? (2.3 times) The gear ratio is 1:2.3.
- Add another gear connector and a medium gear. Spin the big gear clockwise. What direction does the medium gear spin? When the big gear goes around one time, how many times does the medium gear go around?
- Show how you can use the large gear connector and pegs to attach two gears on one axle. Show an example of a gear from a real mechanism that has two gears in one.

Challenge groups to make a gear train where the final gear spins as fast as possible. Figure out the gear ratio. (1:number of spins the final gear in the train makes with a single turn of the first gear).

Challenge students to build a gear train that slows down motion as much as possible – figure out gear ratio to see how much the motion is slowed down.

Provide students with instructions for "overdrive" gear train from Gear Tech manual and have them build this gear train. Have them explain how it works. Ask how to change "overdrive" to slow motion. (Put the crank on the opposite gear.)

Can students improve on the "overdrive" gear train? Allow students to experiment with the gears.

Vocabulary: Torque – A turning or twisting force
Gear train – A system of interconnected gears
Gear ratio – The ratio of the speed of rotation of the powered gear of a gear train to that of the final or driven gear.

Final Discussion: Have students write what they learned in their journals and discuss in their group. Each group presents to the class what they learned.

Clean up: Put small parts in ziplock bags.

Home Connection: Look around your house for objects that use gears.