ROBOT LESSON 2: FEEDBACK AND SENSORS
OAKWOOD FLL

"Move Forward For 2.5 Seconds"

WHAT WE WANTED...

WHAT ACTUALLY HAPPENED.

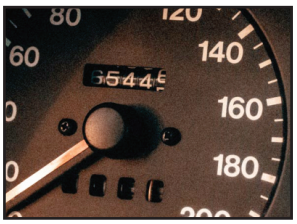
When we interact with the world, we use feedback.

To catch a ball, we use our eyes in conjunction with our brain to **control** our body. We don't remember an exact set of motions to do, because there are unpredictable differences each time we try to catch.

The same applies to a FIRST LEGO robot. Every run on the table will likely be a little different. The robot will need to work correctly on different competition tables, too. The robot needs ways to correct for **error**.

Of course, it's also important that the robot's mechanical performance be as predictable as possible, and that the attachments work even when the robot is slightly out of place. Combined with feedback, the team can build a robot that is **robust** against error.

Odometry is one simple form of feedback (the least reliable).



The LEGO motors have encoders. This means they can measure how far they have rotated. Therefore, the robot's program can know approximately how far the robot has moved. Measuring distance using how far a wheel has spun is called **odometry**.

Odometry is easy to include in LEGO programs. However, odometry is fooled by many types of error. If the wheel slips, the distance measured will be incorrect. Or, if the robot is pointing the wrong direction, moving the correct distance does not get to the correct place. However, odometry is still a useful tool.

Mechanical feedback is also important. Bumpers can be used to line up against walls. Some teams even put wheels on the side of the robot to help track along walls.

Color sensors can be used to follow or align with lines.

There are thick black lines that lead to important locations on the playfield. The color sensor cleverly measures the amount of light reflected and can be used to build a **line follower**. With a pair of color sensors, it is also possible to align with these lines.

Finally, there are other sensors that may be used. A **gyro** sensor can precisely measure the robot's rotation. **Touch** sensors and the **ultrasonic distance** sensor may also be useful. We'll learn more about these in future lessons.

```
// Drive forward, rotating wheels 360 degrees (1 turn)
forward ( 360 , degrees , 40 );
// Reset the left wheel's odometer
resetMotorEncoder ( leftMotor );
// While the left motor has gone less than 540 degrees (1.5 turns)...
repeatUntil ( getMotorEncoder(leftMotor) >= 540 ) {
  // Follow the left side of a line.
  // Fast motor goes speed 30, slow motor goes speed 10
  // Turn right when light sensor sees white, left when it sees black
  lineTrackLeft ( colorSensor , 50 , 30 , 10 );
}
```