**What’s a Robot?**

A robot is a machine, but not everyone agrees about which machines are robots and which aren’t. Here’s a list of some robot features. If a machine has most or all of them, you can be pretty sure it’s a robot.

- A robot works by itself or by remote control.
- A robot interacts with its environment, for example by moving around or handling objects.
- A robot follows instructions. They might be as simple as “go forward,” “turn left” or as complicated as the software programs for self-driving cars or space probes.
- A robot senses its environment. Most robots have sensors for detecting features of the world around them. A sensor might be as simple as a bumper switch or as complicated as a 3-D camera system.
- A robot repeats itself. Many, such as factory robots, are made to do the same tasks over and over.

**How Gears Work**

When two gears work together, they send power from one place to another. Gears can change speed and direction.

The motor turns the drive gear. A gear turned by the drive gear is called a driven gear.

In the build below, the drive gear spins quickly clockwise. The large gear doesn’t spin as fast and it’s going counterclockwise.

**Now Try This!**

1. Slide the screw-on gear into the gear side of the box.
2. Add the gear assembly into the box.
3. Turn the bot over and place a small gear onto the bottom chassis.
4. Attach the arm to the center hole in the box.
5. Attach the arm to the box.
6. Turn the bot over and place a small gear onto the bottom chassis.
7. Attach the arm to the center hole in the box.
8. Add a screw on gear into the gear side of the box.
9. Attach the arm to the center hole in the box.
10. Add a screw on gear into the gear side of the box.
11. Attach the small gear onto the bottom chassis.
12. Add the arm to the center hole in the box.

**What does your bot balance on its four wheels?**

- Try the bot on its back wheels.
- Try the bot on its front wheels.
- Try the bot on its end wheels.
- Try the bot on its back wheels and the bottom chassis.

**Now Try This!**

Does your bot balance on its four wheels?

- Try the bot on its back wheels.
- Try the bot on its front wheels.
- Try the bot on its end wheels.
- Try the bot on its back wheels and the bottom chassis.

**What can you do to change how your bot behaves?**

- Can you make your bot turn right just by adding a small gear? Add a small gear to the wheel that is on the right.
- Can you make your bot turn left just by adding a small gear? Add a small gear to the wheel that is on the left.
- Can you make your bot turn with one of its wheels? Add a small gear to the wheel that is on the right or left.
- Can you make your bot turn with one of its wheels? Add a small gear to the wheel that is on the other side.

**Now Try This!**

Does your bot balance on its four wheels? Try the bot on its back wheels.

- Can you make your bot turn right just by adding a small gear? Add a small gear to the wheel that is on the right.
- Can you make your bot turn left just by adding a small gear? Add a small gear to the wheel that is on the left.
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Tiny Walking Robots

How Robots Walk

Walking is all about balance. With each step, the robot has to pick up one foot, step forward, shift its weight from one foot to the other, and then do it over again and again without falling over.

Your robots don't have to shift their weight from one side to another, even on gears with specially shaped feet, one foot is always on the ground.

BUILD Build steps 1–5 of the WalkBot 3000.

WalkBot 3000

1. Set the bottom gear assembly in the bottom chassis, gear on the right. Make sure the + on the side is straight (not tilted to either side).
2. Attach the motor box, with the drive gear on the right.
3. Set the long gear assembly in the motor box, gear on the right. Make sure the + on the side is straight (not tilted to either side).
4. Add the top chassis and the head.
5. Set the right leg to the gear-side axle. The top of the leg fits over the top axle.
6. Add another gear, thread the gear to the gear-side axle and the fixed wheel to the other side. Set the built chassis aside for now.
7. Use the full Walker chassis. Can your Walker roll? (You don't have to!) Switch on your bot.

Walk Challenges: Can your Walker roll? Can it walk up or down a slight incline without falling? Can it walk up or down a slight incline and turn? Can it walk up or down a slight incline and turn around? Can it walk straight? Can it walk up or down a slight incline and walk up or down a slight incline without falling? Can it walk up or down a slight incline and walk forward, shift its weight, and then walk back without falling? Can it walk up or down a slight incline and walk forward, shift its weight, and then walk back and forth without falling? Can it walk up or down a slight incline and walk forward, shift its weight, and then walk forward, shift its weight, and then walk back and forth without falling?

Dancing Bot

Dancing Bot 2000

1. Build steps 1–5 of the WalkBot 3000.
2. Add the extension chassis, top chassis, and head.
3. Add legs in the walking position (pivot points opposite).
4. Add arms.
5. Switch on your bot.

Inside challenge: Does adding height change the sports' center of gravity? Does a robot's weight have to be more than the robot's height (no box)? Does the weight have to be more than the robot's height (a box and a head)? Does the weight have to be more than the robot's height (a box)? Does the weight have to be more than the robot's height (a box and a head)? Does the weight have to be more than the robot's height (a box)?"