Robots

Inventors of Tomorrow
In books and movies, you may have seen robots that walk, talk, have feelings, and look cute.
Real robots are not quite that advanced. Here are some real robots, doing the jobs they were designed for.

These robots are designed to assemble cars, pick fruit, get books from library shelves or move large boxes around a warehouse.
What is a Robot?

Robots are machines that humans build to do something.
Why do humans build robots?

We invent robots to do jobs that humans can’t do or don’t want to do.

This robot explores the ocean and takes pictures underwater.
What does a robot do?

A true robot can sense information about its environment, “think” about that information, and take an action.

This Gita robot is like a shopping cart or backpack bot. You load it with your stuff, then it follows you around. Its sensors tell it when you stop, start or turn, so it can stay close behind you.
Sensors

Robot sensors act like our senses. Some “see” with light sensors, some have “touch” sensors that notice pressure or temperature, some can “smell” chemicals or “hear” sounds.
Processors

Robot sensors take in information, then a computer processes the information and makes a decision about what to do. This is like when our brains think about what we learn from our senses.

INPUT:
Sensors feed data into the computer.

OUTPUT:
The computer turns on or off output devices called actuators.

The computer processes the input data by following a set of instructions.
A computer program tells the robot how to respond. Common directions are if-then-else. A robot vacuum may have a program that says “If your bumpers run into a wall, then turn. Else, just keep vacuuming.”

Another program says “If your sensors show you’re at a cliff, then back up and turn around. Else, just keep vacuuming.”
Actuators

Robots need to be able to move or to do something. They might move on legs or on wheels, or may have “arms” that move.

This Lego Mindstorm robot can solve a Rubik’s cube puzzle.
Robots need a source of energy. Many plug into electricity or have batteries. Some have gas engines like a car. Some robots are solar-powered—they get their energy from the sun.

This solar-powered robot weeds a garden.
Humans build robots to do boring jobs that humans don’t like to do...

This robot cleans swimming pools.
… and also to do jobs that are dangerous for humans to do.

Like fight fires...

Clean windows on high rise buildings...

... or explore Mars
When an engineer designs a robot, they first decide what job they want it to do. That helps them decide what material to make it out of, what shape to make it, and what types of sensors and actuators to include.
If you wanted to build a robot nurse to take care of people who are sick, what would it be like?
Bio-Mimicry

Inventors often look to nature for ideas on how to design a robot. For example, fighting forest fires is a very dangerous job for humans. Scientists wanted to invent a robot firefighter. It needed to be able to move over rough ground and to not be damaged if tree branches fell on it. They had the idea to model a robot on a pill bug (a roly poly).
The pill-bot would have 6 legs, and could crawl across the forest floor faster than a human can run. It would have heat sensors to help it find the fire, water tanks and fire extinguishers. If it was in danger, it could roll up in a ball to protect itself.
Imagine you were going to design a robot. You would need to decide how it would move. It could roll on wheels like a car, or on treads like a tank.

Or you could look to nature for ideas. Your robot could…
Creep like a spider.

Crawl like a salamander.

Or run like an ostrich.
Would your robot jump like a kangaroo?

Or jump like a bushbaby?

Or like a sand flea?
If your robot needs to go in water, would they swim like a fish?

Or a manta ray?

Or a jellyfish?
What would your robot need to be able to do? Fly like a bat?

Climb steep walls like a gecko?

Or climb trees like a python?
Act like a dog?

Swing through trees like a sloth?

Or hold on like octopus tentacles?
What Would You Build?

Imagine you could build any kind of robot. What would you build?

Goals: First, think about your goals: what job would you want your robot to do? (Try to think of something that you can’t do or that you don’t want to do yourself.)

Habitat: What environment will your robot be working in: cold? hot? wet? What have you learned about habitats that you could use in designing your robot?

Structure: Human beings (and many animals)
have a skeleton (or internal structure) that helps them stand up. Insects have a hard exoskeleton to protect them and help them move. What does your robot need?

**Anatomy:** How many legs will your robot have? In animal classification we learn that birds have 2 legs, mammals have 4 legs and insects have 6. But your robot could have 3 legs like a tripod, which is nice and stable, even though few animals stand that way. Or they could have wheels and axles. Or no legs, if they will swim in the water.

**Senses:** What kind of sensors does your robot need to do its job? Does it need to hear? See? Feel temperature? Sense light?

**Tools:** What tools would they need? Different animals have evolved different adaptations, like the right bird beak to eat the available food. You could take ideas from any animal or any human-made tool. How would you equip your robot for the job they need to do?

Can you draw a picture of your robot design? Or write a story about it? Or build a model with some materials from the recycling bin and art supplies?
For Parents and Teachers—

**Hands-On Activities to Inspire the Inventors of Tomorrow**

**Brainstorming and Design Exercise.** The last two pages of the book encourage kids to design their own robot. When reading the book, you can lead your child(ren) through a brainstorming discussion, answering these questions. Then have them either draw a picture, write about their design, or build a model robot at the “robot factory.”

**Robot from Recyclables.** Using a cardboard box (like a cracker box), and materials such as TP tubes, toothpaste boxes, plastic cups, straws, and popsicle sticks, assemble a pretend robot. Decorate with paint or markers, stickers, pompoms, buttons, balloons, or other items. You could choose to incorporate LED lights or a motor or other electronic components into this.

**Sensors.** If you have access to an electronics kit such as littleBits, Snap Circuits or Cubelets, they all have sensors. You can also purchase individual electronic components. Set up a basic circuit with a light or a motor that is switched on and off by a light or sound sensor. Let the kids explore that.

**Robot Toys.** If you have access to any robot toys, play with those. Talk about whether they meet the definition of a robot: do they have sensors? Can they make a decision based on input from their sensors? Can they move?

If you’re interested in buying a robot toy, I recommend Code and Go Robot Mouse.

**Scribble-Bot.** Try making a scribble-bot. All you need is a plastic cup or Styrofoam bowl, three markers, a 1.5—3 V motor, and a battery pack that holds 1 AA battery. Find full instructions at www.InventorsOfTomorrow.com or elsewhere online. (Note: these are not true robots... they don’t have sensors or processors. But they are a fun parent-child project!)

**Flip Book.** Design (or find online) a robot flip book, where each page is split into three parts. The top third of each page is options for robot heads. The middle third is robot bodies. The bottom is robot legs. Kids can flip between pages to assemble their own crazy robot.

**Programmer Game:** Play a Simon Says style game. Explain that robots can only understand certain commands given to them by their computer program. They don’t understand and can’t follow other commands. So, if you say “program says jump up and down” they should jump. But if you don’t say program says, then they shouldn’t follow the command.

**If-then-else** game. Remind them of the part of the book where it talked about how a robot vacuum is programmed. Mark out a series of squares on the ground. Tell them they have one program. Whenever you say “go”, they execute it. Their program is: “If at edge of board, turn. Else, move forward one square.” If kids are about to run into each other, add a command “If about to run into someone, turn away from them. Else, if at edge of board, turn. Else, move forward one square.” Note: this game ties in nicely with the Code and Go Robot Mouse toy, or with the board game Robot Turtles.
Recommended Kids’ Media About Robots

Non-Fiction Books

Zoobots—Wild Robots Inspired by Real Animals by Becker, illustrated by Ries. About biomimicry and how nature inspires roboticists. This is for 10—12 year olds, so the text is too sophisticated for younger ones—I’ve written a short version of the text I used with 3—6 year olds—you can find it at www.InventorsOfTomorrow.com. But the photographs and illustrations are great.


Fiction Books

Clink by DiPucchio and Myers. Age 4 – 7. Sweet story about an unwanted robot in a toy store (“the world was no longer interested in a robot who had been programmed to play music and make toast.”) Eventually just the right boy arrives. Illustrations evoke the robot’s strong feelings.

Awesome Dawson by Gall and Wendel’s Workshop by Riddell both tell a story of a young inventor who builds great robots, then one rampages out of control, so he builds other robots to defeat it. Ages 4 – 7. Oh No! (Or How My Science Project Destroyed the World by Barnett tells a similar tale, but was frightening for one of our students, so use with caution if you have a sensitive child.

Rolie Polie Olie by Joyce is a delightful book about a family that happens to be robots. It provides a little lesson about misbehavior and forgiveness. Ages 2 – 6.

Boy and Bot is also a cute book. A boy and robot become friends, The robot accidentally gets turned off, and the boy becomes very worried and tries to “cure” him. It’s a nice story for explaining that different beings need different things to do well. Ages 3—6.

The Trouble with Dad by Cole is an entertaining tale of a dad with a boring job who spends his spare time building wild robots. Ages 5—7.

Videos

Watch our companion video of the robots featured in the biomimicry section from page 18—22: www.youtube.com/watch?v=A5dE_clRhdo

SciShow Kids has a video called Real Life Robots which is a nice overview www.youtube.com/watch?v=8wHjLMnikU; and Crash Course Kids has a video called Robot Challenge, which addresses process of engineering, using robots as an example: www.youtube.com/watch?v=0GMBJFqgHfc.

App

Tinybop has an app for IOS called the Robot Factory, which allows kids to assemble and test a wide variety of robots.
What is a robot? When a human designs a robot, where do they get their ideas, and how do they decide what their robot needs? Learn more in this book from the Inventors of Tomorrow laboratory.

The robot on the cover is Cosero, developed in 2010 at the University of Bonn. This service robot can remember locations, fetch items, recognize people, follow spoken commands, and cook an omelet.