# How to Make a Better Robot

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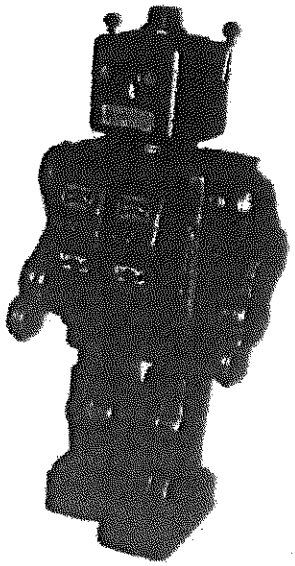
By ReadWorks



Many people think that robots are an inevitable part of the future. It would be pretty cool to have a droid friend around to save the day, or even just to keep you company when you got bored. While it may seem like something out of science fiction, researchers are already imagining a world in which robots become a more integrated part of our lives. We already have robots among us: some are designed to work in factories, creating uniform products continuously. You may even have one in your home, in the form of a little vacuum cleaner that self-drives itself around the floor.

But for robots to make it to the next level, scientists think they'll need to be a bit more versatile. The robots scientists are imagining look nothing like the stiff creatures you might be thinking of. No need for an awkward robot with stiff legs that attempts to walk and act like we walk and act—researchers are hoping to cook up something entirely different from what we're used to seeing.

## How to Design a Robot

A group of researchers at Cornell University thinks the future of robots will actually be full of softbots. A softbot is simply a robot made out of soft tissue, so it can move more flexibly than a hard-bodied robot. And with the rise of 3D printers, building softbots is easier now than ever

before. The question that remains is: what will these robots look like? How will they move? How will they carry things, or navigate small quarters?

These are precisely the questions these scientists are trying to answer. It's easy enough to build a robot that mimics a human. We already know what we look like and how we move. But how do we know this is the best way for robots to move? To put it simply, we don't.

The researchers are trying to figure out all the different ways robots could move. They're basically in the middle of a very long brainstorming session. Once they realize what the options are, they can figure out which motions are best suited to which actions, and create a final model that will perform the best in all scenarios.

In order to do this, they've built a computer program that simulates the growth and movement of several kinds of softbots. They can use animated tissue, muscle, and bone to build a large number of different kinds of softbots. Then the computer program runs the robots through tests, checking out things like balance, coordination, or noisiness. In one example, they're looking for speed, so the fastest robots get to stick around, while the slowest robots get cut.

## The Possibilities

We're going to take a look at all of the different options for how a robot can move from one point to another—this is the speed test. Scientists run a computer program several times, and each time, the robots are a little bit different. Sometimes, they focus on giving the robots legs—either two legs like humans have, or four, like many animals have. And sometimes they see if they can make a mover without legs.

The fastest robot they created has legs and runs in a bounding motion—the front legs move together and the back legs bound forward, similar to how a cheetah moves. Another robot was made to have long legs that were mostly made of bone. These legs became long and skinny, so it wasn't surprising when the robot started to gallop like a horse.

Other times, they try to make robots that can move in non-traditional ways. In one instance, they created a funny sort of robot that doesn't have very much structure, just a big blob of muscle. This robot moves by inching its body forward, pulling its body in tight, and then releasing it to go long, much like an inch worm. It's not a very fast robot, but it does have an advantage, the researchers realized. If they picked this robot up and dropped it randomly somewhere else, the robot would just keep on moving as if nothing had happened. The researchers realized this trade-

off—the bot may not be very fast, but it certainly is durable.

They even make some robots that seem almost silly from the outset. For example, some of their creations are designed to have no legs at all, but they still had to figure out a way to move them forward. One of the designs that resulted from this is a big robot that, instead of legs, has two large wings, and it flaps them back and forth to move. The design is almost like a gorilla relying primarily on its arms to move, but it's a bit bulkier. Another robot that came out of this is a little guy who looks like an open jack-in-the-box. The bottom of the body is box-shaped, but at the top, out pops two little arms. This robot moves by flailing its arms back and forth, which make the little guy slowly progress forward. It may seem silly, but an advantage this robot has is that it could easily hold things in its hands, or its empty lower-box while still moving forward.

**Putting Ideas into Action**

Now that the researchers have a number of ideas in mind, they can start performing other tests to see which robots perform better at tasks besides moving themselves along. Maybe they'll have to measure how much energy the robot requires to function for a long period of time, or how much space it takes up. All three of these aspects will play into the future success of the robot, so it's important to consider them all separately. Even if something ends up looking silly in a trial, the underlying reason behind its success may still warrant a characteristic to be considered for the final design.

For example, perhaps one of the softbot's tasks will be to take out the garbage (wouldn't that be nice?). For that, you'd want a robot that could carry things and one not likely to fall. You'd also want a robot that was pretty quick, but you'd have to balance your desire for speed with steadiness. If the bot drops its load half the time, on average, it won't be so fast. Therefore, you have to incorporate a number of skills.

When making the robot, the researchers will have to look through all of the ideas they've created in their computer program, and pick and choose which characteristics will work best together to create a robot that can easily take out the garbage. They'll have to balance their desire for speed with a steady hand, and the ability to carry heavy loads with a desire to make the robot light enough for a human to move around if the robot's turned off.

A good way to think about it may be through imagining yourself picking out your favorite clothes to wear. One day you may be torn between wearing the T-shirt that's extra soft, so it's

really comfortable to wear, and another shirt that's your favorite color. Having to pick between these options will probably convince you to eventually find a new shirt that is both the fabric that you like and the color that you like. Now this new shirt will probably be your favorite, since it has all of the positive qualities you love.

**The Final Product**

Going back to designing our robot that will help take out the trash, it might be nice for the robot to be fast, but is that really the most important thing? It might be better to have a slower robot take out the trash. That way, there's less of a chance the robot will fall and drop the trash (making it necessary for you to clean it up). In that case, let's go back to the robot that moves sort of like an inchworm. That robot had a lot of body mass on the ground, so it was tough to tip over —think about tipping over a butter dish versus a candlestick.

Maybe when the robot has taken the trash out, you will want it to be fast. The best thing to do then is allow it to separate its front section into two legs, and its back section into two legs. Then it can move in that cheetah-like style, going faster. Perhaps the design of incorporating both ideas into one will result in a final product that isn't completely an inch-wormer, and isn't completely a cheetah either. The robot's body is a little too sleek to be a worm and a little too lumpy to be a cheetah. But the beauty of the final design is that the robot is more versatile, and can do everything you need it to do.

Hopefully, these types of robots will enter our lives soon. The Cornell researchers will just have to keep brainstorming different types of robot bodies, so we can always have the best selection of traits to pick from.

Name: _____ Date: _____

1. What are scientists at Cornell University trying to figure out?

A) how to build a computer program that simulates the movement of softbots
B) all the different tasks robots could perform
C) all the different materials robots could be made of
D) all the different ways robots could move

2. Why does the author describe the different robots scientists are creating with a computer program?

A) to show that scientists are unsure about what type of robot to build
B) to show how complex these computer programs can be
C) to show that the scientists' brainstorm session will take a long time
D) to show a variety of ways that robots could move

3. Scientists must consider a variety of factors when designing a robot. What evidence from the text supports this conclusion?

A) Researchers are already imagining a world in which robots become a more integrated part of our lives.
B) Scientists at Cornell University have built a computer program that allows them to simulate the movement of a robot before they develop a final design of the robot.
C) If a softbot is being designed to take out the trash, the softbot's ability to be steady must be balanced with its ability to be quick.
D) The fastest robot created by scientists runs in a bounding motion, similar to how a cheetah moves.

4. What can be concluded about the purpose many robots will have in the future?

A) Robots will be created to allow scientists to use computer programs.
B) Robots will be created to move in non-traditional ways.
C) Robots will be created to make life easier for humans.
D) Robots will be created to help scientists brainstorm.

5. What is this passage mainly about?

A) scientists who work at Cornell University
B) the process scientists are using to design robots
C) computer programs scientists are using to design robots
D) robots that can move like humans

6. Read the following sentences: "But maybe when the robot has taken the trash out, you will want it to be fast. The best thing to do then is allow it to separate its front section into two legs, and its back section into two legs. Then it can move in that cheetah-like style, going faster. Perhaps the design of **incorporating** both ideas into one will result in a final product isn't completely an inch-wormer, and isn't completely a cheetah either."
What does the word "**incorporating**" mean above?

A) crushing
B) eliminating
C) combining
D) explaining

7. Choose the answer that best completes the sentence below.
Scientists have built a computer program that simulates several kinds of softbots, _____ they can figure out which model works best.

A) however
B) so
C) although
D) after

8. After scientists have a number of ideas about robot movement in mind, what types of tests do they then perform?

_____
_____
_____
_____

**9.** According to the passage, what would be a good design for a softbot that would take out the trash?

**10.** Scientists need to test different abilities of the robots. While scientists perform these tests, they measure how much energy the robots require to function for a long period of time and how much space they take up.

Why do the scientists run these tests and track these measurements to create a final model?