Robotics Badges: *Designing Robots*

Robot Build Plan

Overview: Use the Design Thinking Process to build a working model of a robot that solves an everyday problem.

STEP ONE: Pick a challenge

Robots don't get bored, and they don't get tired. That's why robots are used to do things that humans can't do for themselves, or things they don't want to do. These can include challenges you or people you know may face when going about ordinary activities.

Here are some ways robots help people every day:

- **Assistive technology –** robotic limbs help people who are missing arms or legs; exoskeletons help people or have weak or paralyzed muscles move around
- **Home care aides –** companion robots keep elderly people company and record their vital signs like temperature and blood pressure
- **Education –** telepresence mobile robot cams let students go to class remotely
- **Household –** robot vacuums and mowers do chores that people find boring
- **Farming –** dairy farm robots can milk cows all day long
- **Search and rescue –** shockproof robots go into disaster areas to look for survivors

What challenge will your robot solve? _____

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A typical set of steps in the Design Thinking Process consists of:

- Pick a challenge or define a problem that is important and interesting.
- Research the problem by talking to the people affected by it and finding out what's already been done to address it.
- Brainstorm possible solutions—no matter how odd or unusual they may seem—and choose a solution to test.
- Design and build a prototype that shows how the solution might work.
- Test the prototype with the people who would be using it.
- Iterate, or repeat, the design and testing phase as many times as is needed.
- Share your project with the world.

A good challenge will:

- Be interesting to the members of your team
- Take place in a situation that is easy to demonstrate or make a model of
- Have one or more solutions that could be carried out by robots

(continued)

STEP TWO: Explore Possible Solutions

Now that you've chosen a challenge to work on, spend a minute or two brainstorming possible solutions and writing each idea down using just a few words. Test how well each solution might work by acting out the roles of robot and human, and note how well each solution worked.

POSSIBLE SOLUTION	TEST RESULTS

(continued)

STEP THREE: Plan Your Prototype

Robot Forms: Robots can take many forms. For example:

- **Some scientists borrow ideas from nature to make robots work more efficiently.** For instance, a design for a wall-climbing robot used adhesive foot pads modeled after that of an iguana. Robots have also been designed to crawl like snakes or fly like bees. This is called biomimicry.
- **Some robots are shaped like humans.** They may have human-like arms, and walk like humans on two legs. This allows them to work in places designed for people.
- **Some have faces that react and show emotion, to make them more appealing for people to work with.** Robots with a cartoony design can look "friendlier" than life-like robots, which can look creepy.
- **Robots can also look like machines, vehicles, geometric shapes, or even sculpture.** For example:
  - Educational/toy robots like Sphero and Ozobot are round. Primo and Cubelets toy robots are square.
  - Tensegrity robots are made of rods held together with elastic cord, which makes them bouncy and collapsible.
  - A set of legs that spin around like a wheel—known as a wheg—are used by some kinds of robots get over stairs and rough terrain.
- **Simple robots can work together in groups to complete complicated tasks,** such as assembling buildings. These are called swarms.

DON'T FORGET!

- Deadline – How much time do you have to produce a working model?
- Tools and materials – What supplies do you have access to? Which will you use in your protoype?
- Possible substitutions – If you can't build a complete working prototype, how can you show where electronic sensors, controllers, wheels, etc. will go on the finished robot?

(continued)

Here are some details to consider as you plan:

- What is your project's name?
- How does your robot get around?
- What kind of sensors will it need?
- Does it have grippers, claws, or other tools to move things around in the outside world?
- What kind of materials is it made of? (Light or heavy, big or small, hard or soft)?
- How does it interact with people? Do people need to feel comfortable talking to it?
- What safety features will it need? Does it need to be compliant (safe for people to use when it is in action)?

Building Robot Prototypes:

When developing robot prototypes, researchers often go through several stages. For instance, to create a robotic arm that responds to thought commands, here are some of the prototypes that might be built:

- To start, they may just build a working mechanical version of a hand.
- Next, they may attach the hand to an arm.
- When those parts are working together, they may add remote control that shows how the hand opens and closes and how the arm moves around.
- Finally, when they have the kinks worked out of the other parts, they would add electronic sensors and programming that would make it respond to the user's thoughts.

Write the plan for your robot prototype here.

MATERIALS:

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Robotics Badges: *Designing Robots 2*

STEP FOUR: Build a Prototype

Before you begin to build, review your plan, and think about which team member(s) will be in charge of different tasks involved in building the prototype.

TASK	WHO'S RESPONSIBLE
DOCUMENTATION Take notes, make drawings, shoot photos or record video of the build.	
LOCOMOTION Help the robot move around, if that will be shown in your prototype.	
FUNCTION Make sure the robot does what it is supposed to.	
PACKAGING Make the robot look appealing.	
PROJECT MANAGER Keep track of time and materials and make sure all the parts are coming together on schedule.	

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STEP FIVE: Get Feedback on Your Robot

With any engineering project, it's vital to get feedback from people outside your team. These can be other engineers or experts, potential users or potential salespeople for your project.

The best feedback comes from letting your testers try out your project under conditions that are as close to real life as possible. While they are testing your project, watch what they say and do—and take notes. Notice where they have trouble using your project and where they are successful.

Afterwards, ask questions to gather feedback, such as:

- How well does the robot solve the problem it was designed for?
- What worked and what didn't?
- What would you add or improve?

OBSERVATIONS FROM TESTING	FEEDBACK FROM TESTERS

(continued)

After the test, go over the results to see how well the robot worked, and look over the feedback to see what people said about it.

What are three changes you could make to improve your robot?

1. _____

2. _____

3. _____

PLAN FOR IMPROVEMENT: