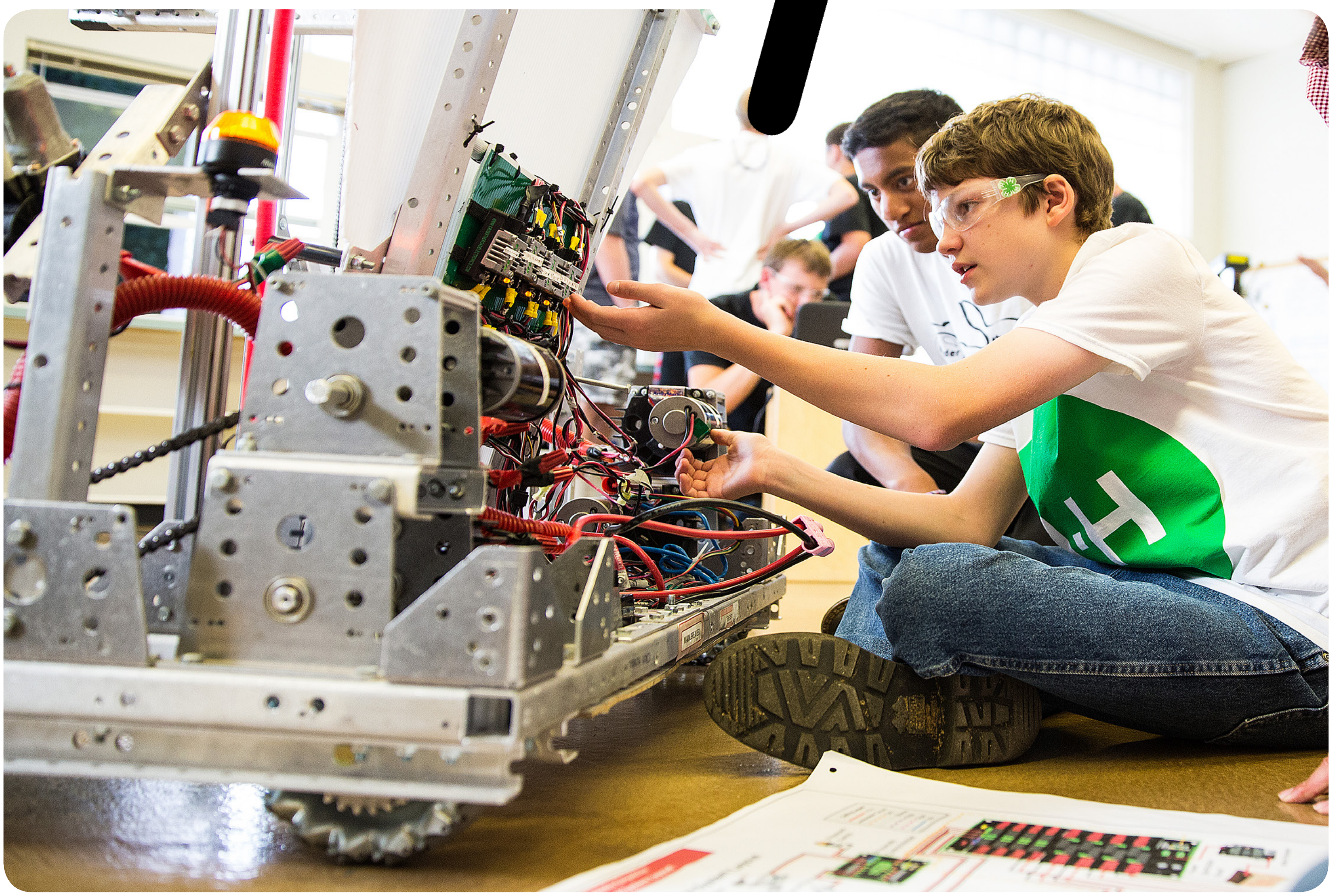
EXPLORE

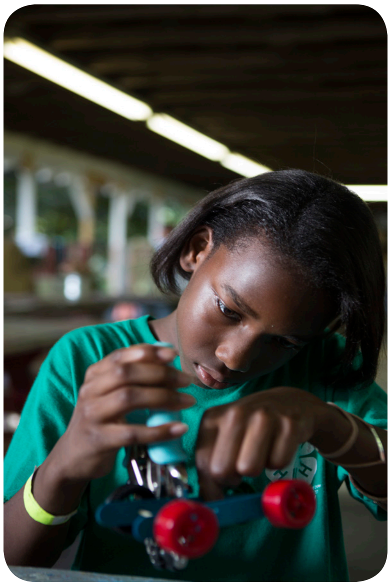


Robotics Project
Building Blocks of Bots

texas4-h.tamu.edu

EXPLORE

TEXAS 4-H ROBOTICS PROJECT



Description
The Texas 4-H Explore series allows 4-H volunteers, educators, members, and youth who may be interested in learning more about 4-H to try some fun and hands-on learning experiences in a particular project or activity area. Each guide features information about important aspects of the 4-H program, and its goal of teaching young people life skills through hands-on experiences. Additionally, each guide contains at least six learning experiences, which can be used as a project guide, or as activities for six different 4-H meetings.

Purpose
Texas 4-H is designed to develop the youth of our state into productive adult citizens. The 4-H Program uses a non-formal educational process of engaging youth in a "learning by doing" process. This includes hands-on opportunities, participation in workshops and clinics conducted by volunteer leaders or professionals, as well as competitive experiences which allow 4-H members to demonstrate the knowledge they have gained. Through this entire process, the youth are learning key life skills such as working with others, teamwork, cooperation, and goal setting. Through all experiences, youth get to interact with adult volunteers and county Extension agents.

What is 4-H?
4-H members across the nation are responding to challenges every day in their communities and their world.

As the youth development program of the Cooperative Extension System of land-grant universities, 4-H is the nation's largest youth development organization, empowering six million young people throughout the United States. Cooperative Extension of 1862 and 1890 land-grant universities provide leadership to engage young people in 4-H in all 3,007 counties of the United States. The impact of the Cooperative Extension partnership is profound, bringing together National Institute of Food and Agriculture of USDA, land grant universities and county government to resource learning opportunities for youth.

Through America's 110 land-grant universities and its Cooperative Extension System, 4-H reaches every corner of our nation—from urban neighborhoods to suburban schoolyards to rural farming communities. With a network of more than 6 million youth, 600,000 volunteers, 3,500 professionals, and more than 25 million alumni, 4-H helps shape youth to move our country and the world forward in ways that no other youth organization can.

Texas 4-H
Texas 4-H is like a club for kids and teens ages 5-18, and it's BIG! It's the largest youth development program in Texas with more than 550,000 youth involved each year. No matter where you live or what you like to do, Texas 4-H has something that lets you be a better you!

You may think 4-H is only for your friends with animals, but it's so much more! You can do activities like shooting sports, food science, healthy living, robotics, fashion, and photography.

Look for 4-H clubs at your school, an after-school program, a community center, or even on a military base or through the reserves for military families.

Texas 4-H is part of the Texas A&M AgriLife Extension Service and the Texas A&M System. Founded in 1908, 4-H is the largest youth development program in Texas, reaching more than 550,000 youth each year.

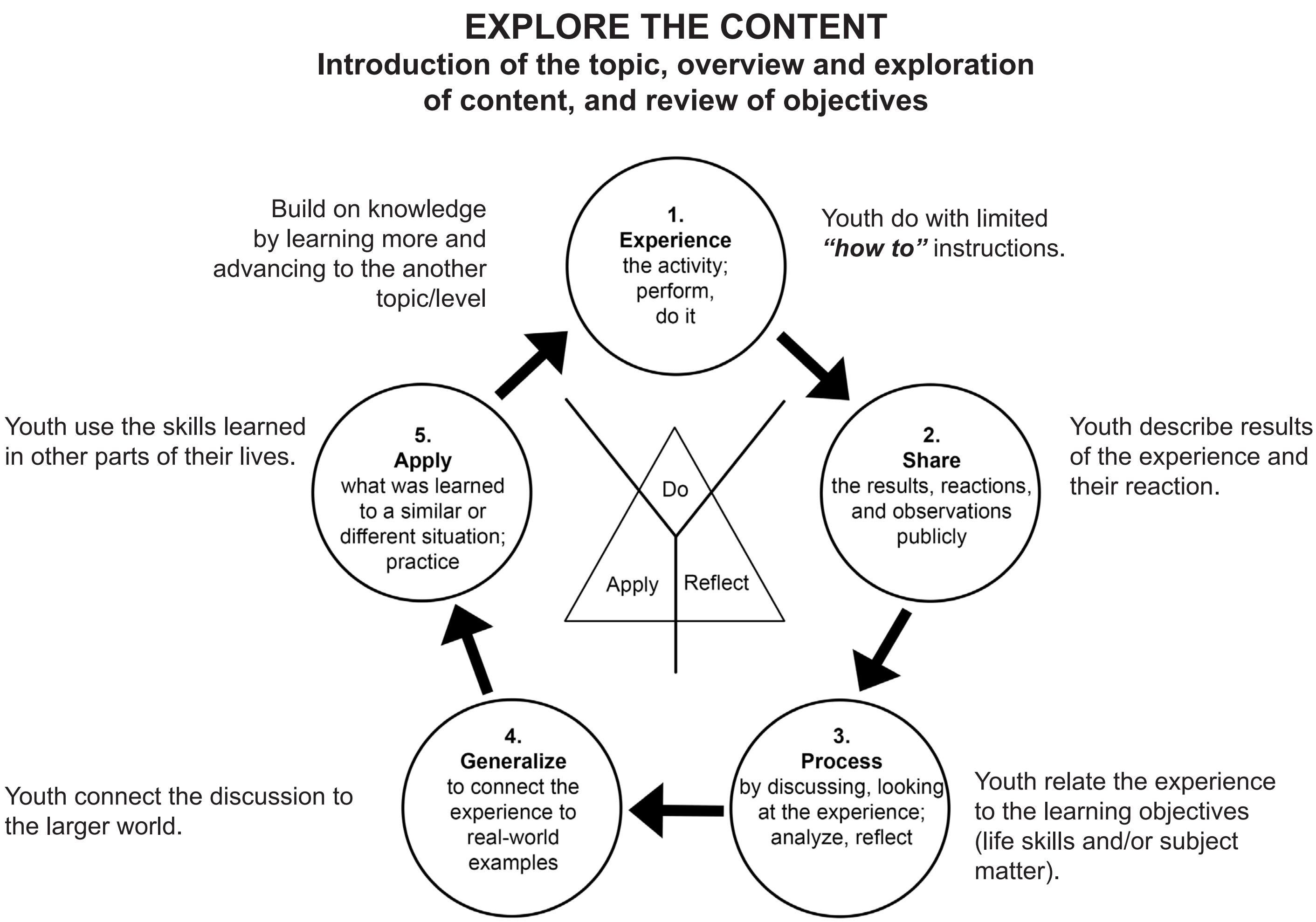
The 4-H Motto and Pledge
"To Make the Best Better!"

I pledge: My HEAD to clearer thinking, My HEART to greater loyalty, My HANDS to larger service and My HEALTH to better living, For my Club, my Community, my Country, and my world.

Participating in 4-H
4-H is a great program because it provides options for young people to participate. From a 4-H club located in your community, a SPIN club that focuses on one particular project area, or participating in 4-H through your classroom at school, 4-H allows youth to learn in many different environments. If you are interested in joining 4-H, contact your County Extension Office and ask for a list of the 4-H clubs in your area. If you are a school teacher/educator and would like to use 4-H curriculum or these project guides in your classroom, contact your Extension Office as well for assistance.

4-H "Learning by Doing" Learning Approach

The Do, Reflect, Apply learning approach allows youth to experience the learning process with minimal guidance from adults. This allows for discovery by youth that may not take place with exact instructions.



Developed by:
Derrick Bruton
Dr. Tamra McGaughy
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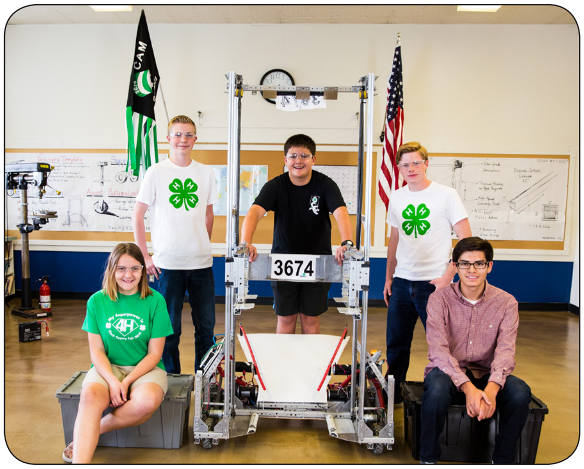
EXPLORE
Robotics Project

Bot or Not?



TIME:
Pre-Activity: 10 minutes
Activity 1: 15-20 minutes
Activity 2: 15-20 minutes

MATERIALS NEEDED:
- Engineering Notebook, pages 1-3
- Pens/Pencils/Markers
- 1 copy of robot pictures
- 1 copy of "Robot or Not" cards per group
- Craft sticks (optional – to attach to Robot or Not cards)
- 1 copy of Robot Application/Function cards

OBJECTIVES:
The 4-H member will:
- Be introduced to robots.
- Identify characteristics of robots
- Research the types of robots and the roles they play in our everyday lives

Fun Facts:
The term comes from a Czech word, robota, meaning "forced labor."

The word robot first appeared in a 1920 play by Czech writer Karel Capek

EXPLORE THE CONTENT:

***NOTE:** Before sharing any of the content information have the 4-H members complete the Activity below*

Activity 1:
- Have students draw, name, and list functions/characteristics of a robot in their Engineering Notebook. Provide minimal instruction to allow for student creativity.
- Students will share their robot drawing with the group and describe the purpose, characteristics and capabilities of their robot

In our everyday lives, robots are around us performing all sorts of tasks. In this series, youth will learn about the many types of tasks that robots perform, how they make human lives more efficient or safer, and what motivates new designs.

Explore Content for Activity 1
Definition and Characteristics of Robots
A robot can be defined as a mechanical device that is capable of performing a variety of tasks on command or according to instructions programmed in advance. It may also gather information about its environment (senses) and use that information (thinks) to follow instructions to do work (acts).

Three main parts of a robot are the Computer (to make decisions), Input ports (connected to sensors), and Outputs (connected to motors or screens, as an example).

Robots may have some of the following characteristics: sensing, movement, energy source, and intelligence. Think about whether these characteristics are different than human traits? Can you think of a sense that a human and a robot have in common?
- Sensing (much like human senses)
- Light sensors (eyes)
- Touch and pressure sensors (hands)
- Chemical sensors (nose)
- Hearing and sonar sensors (ears)
- Taste sensors (tongue)

Some robots may move across the ground, through the water, or in the air. Some may even be stationary, but have arms that move. Can you think of movement that humans and robots have in common? What movements can robots do that humans cannot do without assistance?
- Movement

- Rolling
- Walking
- Propelling
- Bouncing
- Jumping
- Hovering
- Flying
- Gliding
- Running

In order to function, a robot must have a source of power. The sensors, motors, and computers all need power in order to operate. Power comes from different types of energy sources. What is a source of human energy? Give some examples What types of energy do you think powers a robot?

- Energy Source
- Solar (photovoltaic cell - converts sunlight directly into electricity)
- A/C power
- Battery
- Air Pressure (pneumatic)
- Fuel Cells
- Chemical Fuel (gasoline)

A robot cannot perform without some type of instruction or "intelligence". Humans must give the robot a set of commands to carry out various tasks. That set of commands is called a language. All of the language combined gives the robot an intelligence of sorts. What human organ gives us intelligence? How do we gain intelligence?

- Intelligence
- A robot "brain" is the computer processor or chip
- The robot can only operate by following a set of commands created by a programmer
- The robot will have to have some way to receive the program so that it knows what to do
- Some robots may be controlled by humans through an input device (game controller, keyboard, etc.)

DO:

- Students use their Engineering Notebook to record exploration content (definition, characteristics and types) provided by instructor.
- Divide the class into groups of 3-4 students.
- Provide each group with a "Robot" and "Not" card.
- Show the group(s) each of the provided "robot or not" pictures one at a time.
- Ask each group to hold up the card indicating if they think the picture is a robot or not.
- Place photos of "Not's" in a stack for later discussion.

REFLECT:

Activity 1

- Review each picture that was placed in the "Not" stack. Have students refer back to their Engineering Notebook on the definition and characteristics of a robot. Ask students:
    - What is the function of the item in the picture?
    - Does the definition of a robot apply to the object in the picture? If not, why?
    - Does the object in the picture have any characteristics of a robot (computer, sensor, input, output, etc.)?
    - Would any group like to change their answer to "Robot or Not"?

Explore Content for Activity 2 - Types of Robots and Their Applications/Functions
We have discussed one definition of robots, but there can be many different types of robots. Some may perform industrial work, or some could be for fun. Can you name any robots that you have seen today? What purpose does that robot serve?

Robots can be grouped by their application and function. In other words, "what does it do?" and "how does it do it?. In general, robots may be divided into the following application types:

- **Industrial robots** - Industrial robots are used in manufacturing products. When we think of this type of robot, we usually envision those with mechanical arms performing tasks like welding, drilling, packaging, lifting, etc. This type of robot could also include self-driving vehicles or unmanned delivery robots.
- **Domestic or household robots** – This type can be found in the home. It may include products like self-cleaning litter boxes, security systems, washing machines, ice makers, programmable thermostats, robotic vacuum cleaners, and others that can do different chores.
- **Medical/Emergency robots** – This type includes robots that can be used to perform various tasks in hospitals and surgical centers. Most commonly, it is used in surgery to assist the doctor in performing minimally invasive procedures. Other robots may be used as a virtual presence to assist doctors in communicating with their patients. Other tasks may include automated bedding or dispensing patient medicine.
- **Military/Law Enforcement robots** - This type of robot assists military personnel in combat or humanitarian efforts. Most commonly, robots are used to detect, transport, or diffuse dangerous explosive devices. Others such as unmanned aerial vehicles (UAV), also known as drones, can assist in scouting territory or potential targets. Robots that were originally designed for military purposes may also be repurposed for use in law enforcement, search and rescue, and related fields.
- **Entertainment robots** - This robot type can vary quite a bit in form and function. An example is a humanoid or animal robot that can move, speak, respond to commands, etc. It can be any size, shape, or design, and fulfill a variety of entertainment purpose. These robots may be modeled after popular TV or movie robots.
- **Space robots** – Robots that assist humans in the exploration of space are included in this type. Robots can be used to help transport/house personnel, deliver payloads, perform experiments, take photos, etc. This type would include robots used in or on the International Space Station, satellites, shuttles, and rovers.
- **Hobby and competition robots** – These robots can be designed/built for educational, recreational, or competitive purposes. Examples include robots sold by such companies as Lego and VEX.

DO:

Activity 2

- Have participants use their Engineering Notebook to record exploration content (definition, characteristics and types) provided by instructor.
- Place pictures of robots around the learning environment/classroom
- Distribute Application/Function cards to students (some students may get more than one, depending upon class size)
- Have students place their Application/Function card on/by the robot picture they think best depicts the application or function listed on their card. Use your best judgement to determine if students are correct. Ask students to defend their assessment. The intent of this activity is to investigate machines and generate discussion.

REFLECT:

Activity 2

- Review each picture with the Function/Application card(s) which students placed beside them. Have students refer back to their Engineering Notebook on the different applications of robots. Ask students:
    - Do you agree with the cards that were placed with this picture? (review each picture individually) Why or why not?
    - Are there other cards that could have been placed with this picture?

- Are there cards that should not have been placed with this picture?
- What type of service do you think this robot provides?

REFLECT:

- How do you think understanding the definition of a robot can assist you with your 4-H robotics project?
- How do you think understanding the characteristics of a robot can assist you with your 4-H robotics project?
- How do you think understanding the functions of a robot can assist you with your 4-H robotics project?
- How do you think understanding the application of a robot can assist you with your 4-H robotics project?

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- http://www.galileo.org/
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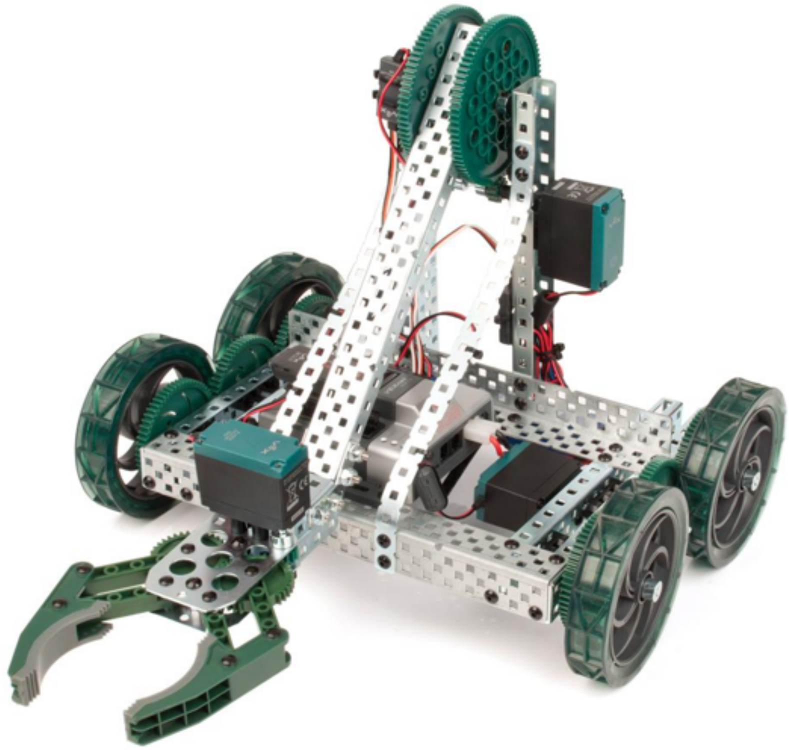
ACTIVITY 1.1: Robot or Not

ROBOT

NOT

ACTIVITY 1.1: Robot or Not (Application/Function Cards)

Industrial	DOMESTIC or HOUSEHOLD	MEDICAL/ EMERGENCY
MILITARY	ENTERTAINMENT	SPACE
HOBBY/ COMPETITION	LIGHT SENSOR	TOUCH SENOR
ROLLING	WALKING/ RUNNING	HOVERING
SOLAR POWERED	FLYING	BATTERY POWERED



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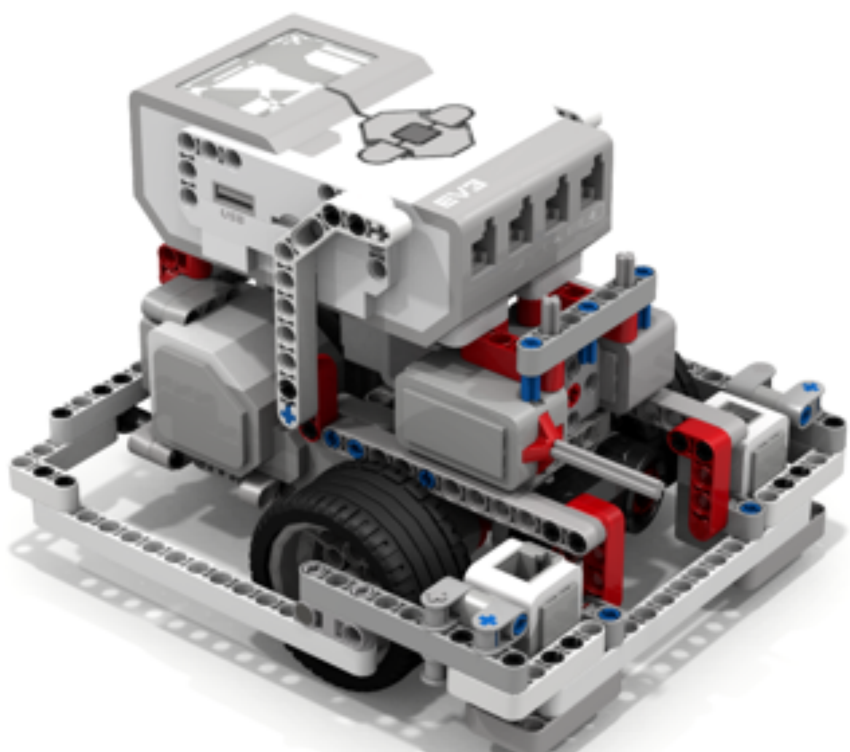

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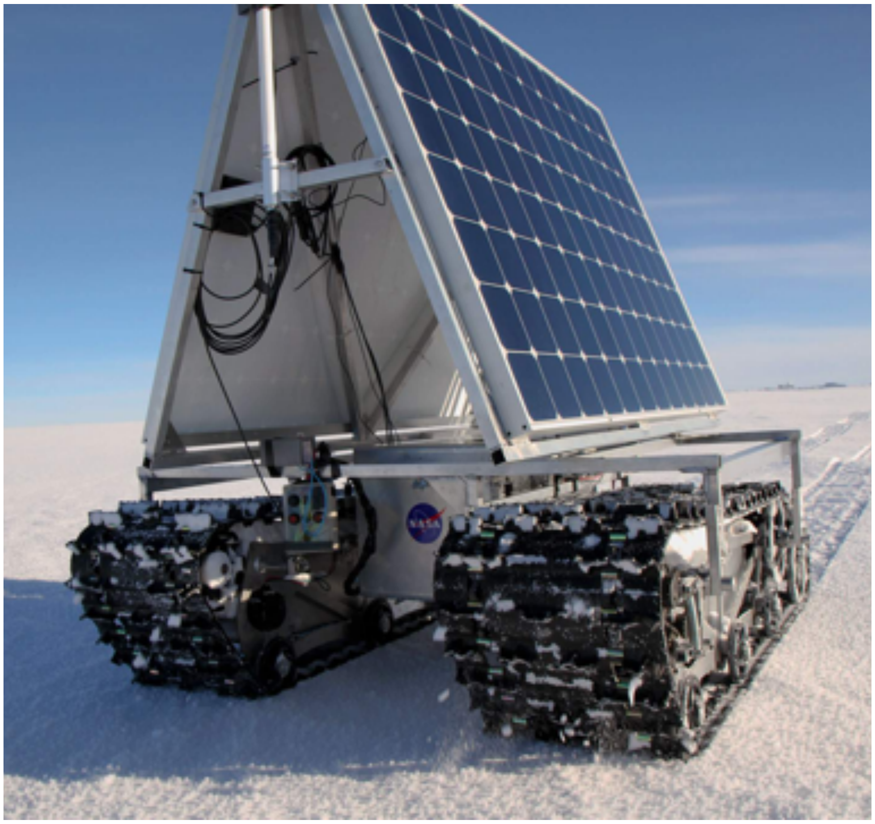

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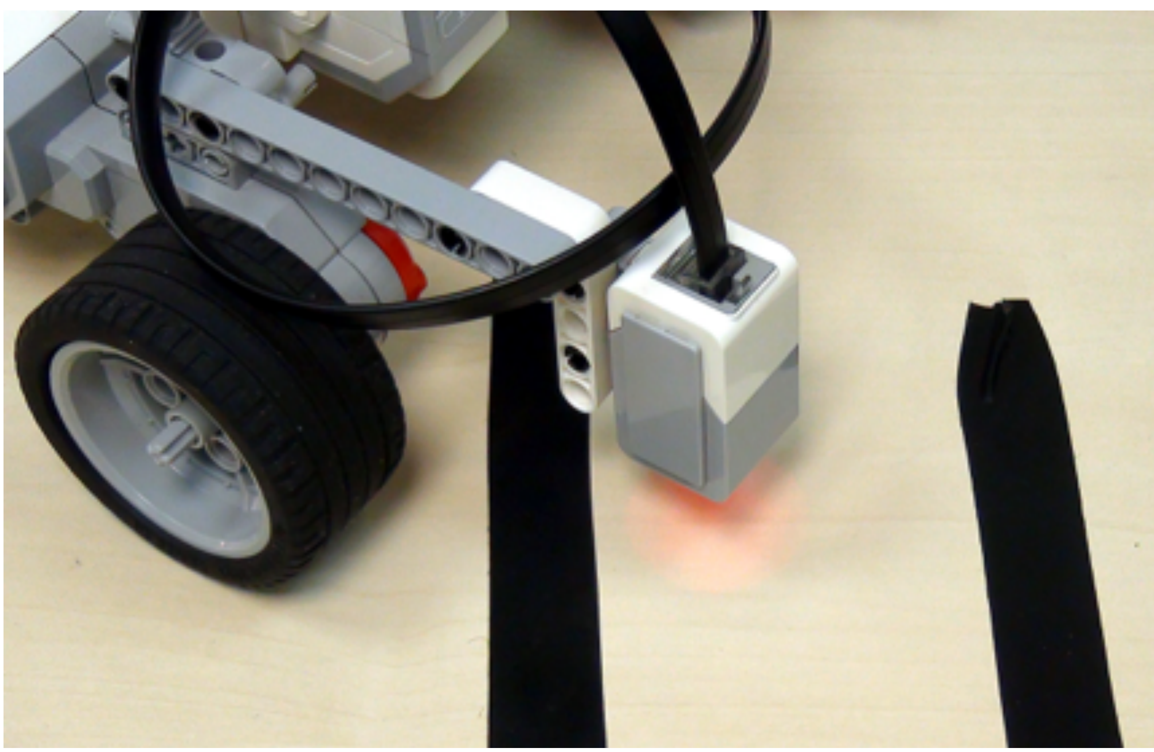

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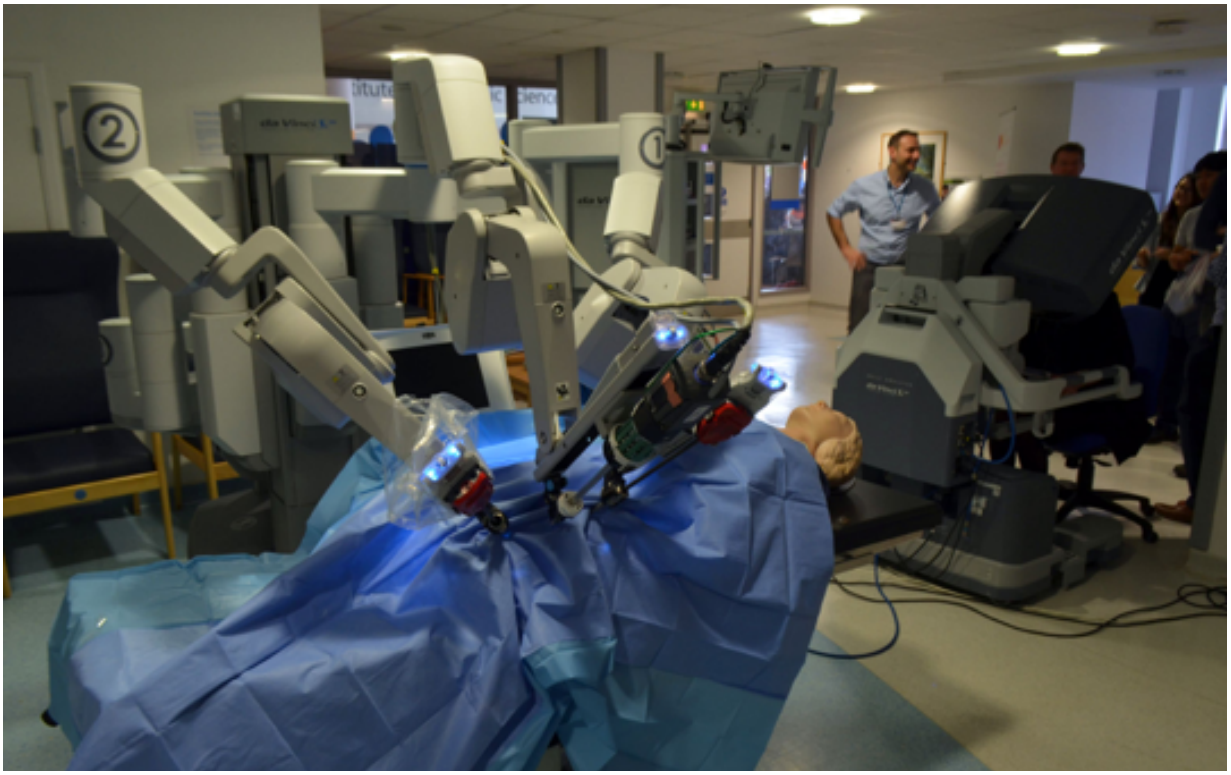

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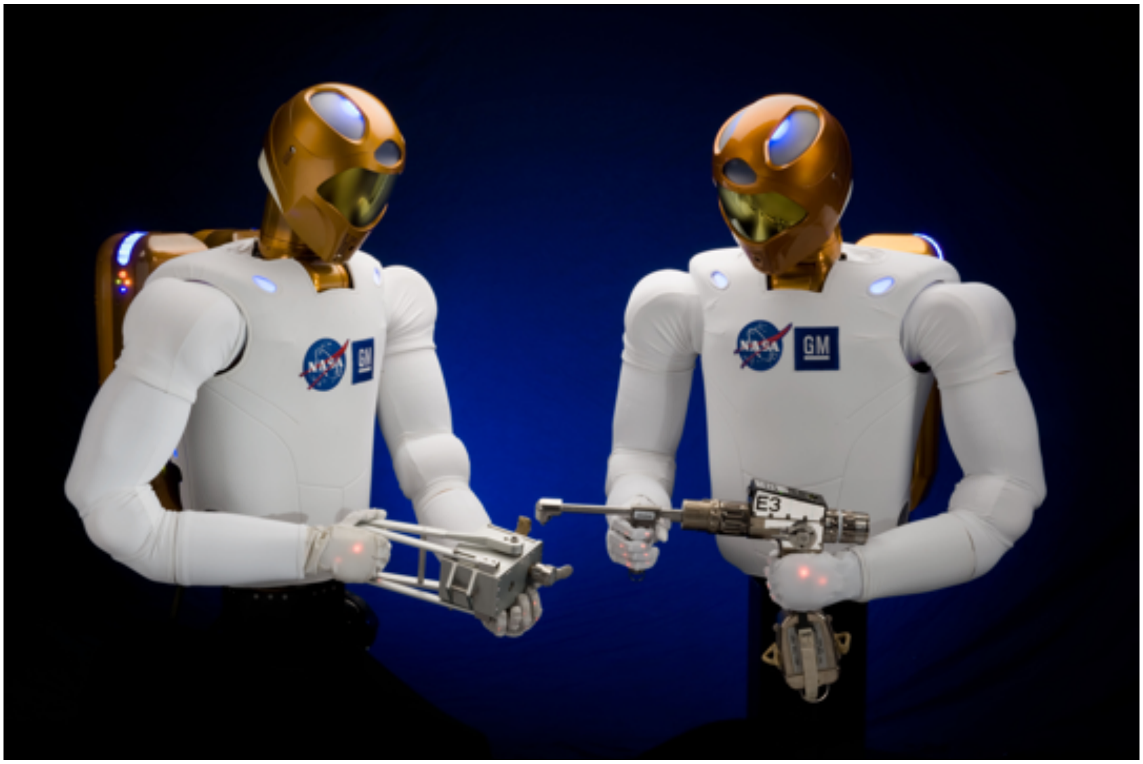

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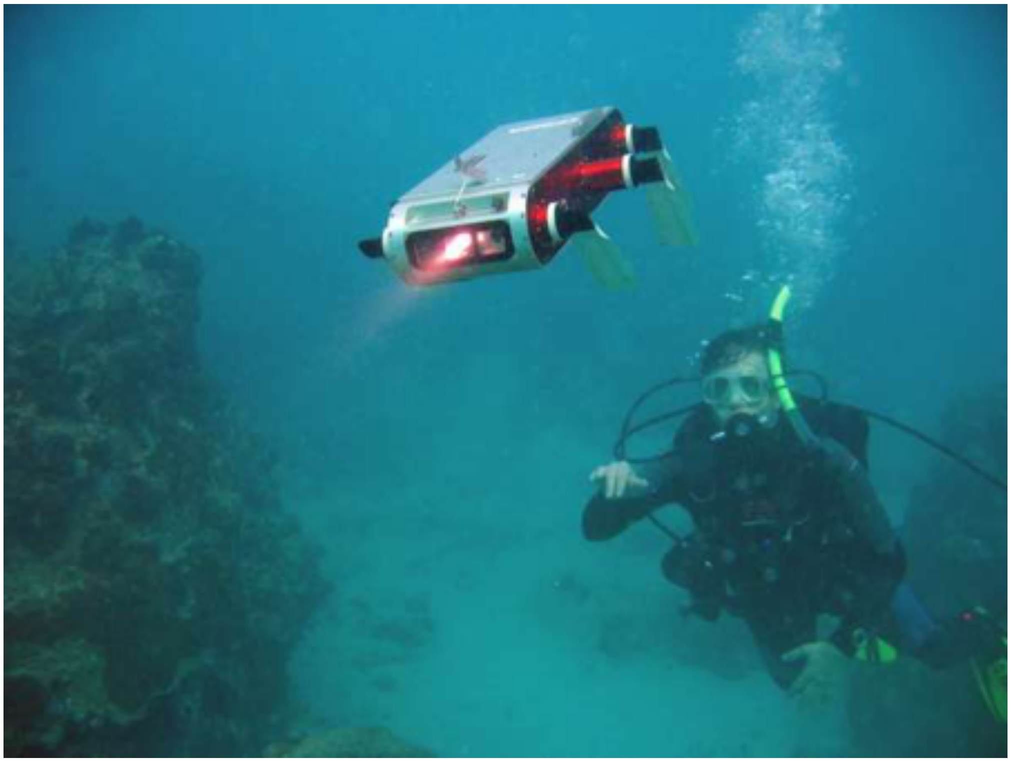

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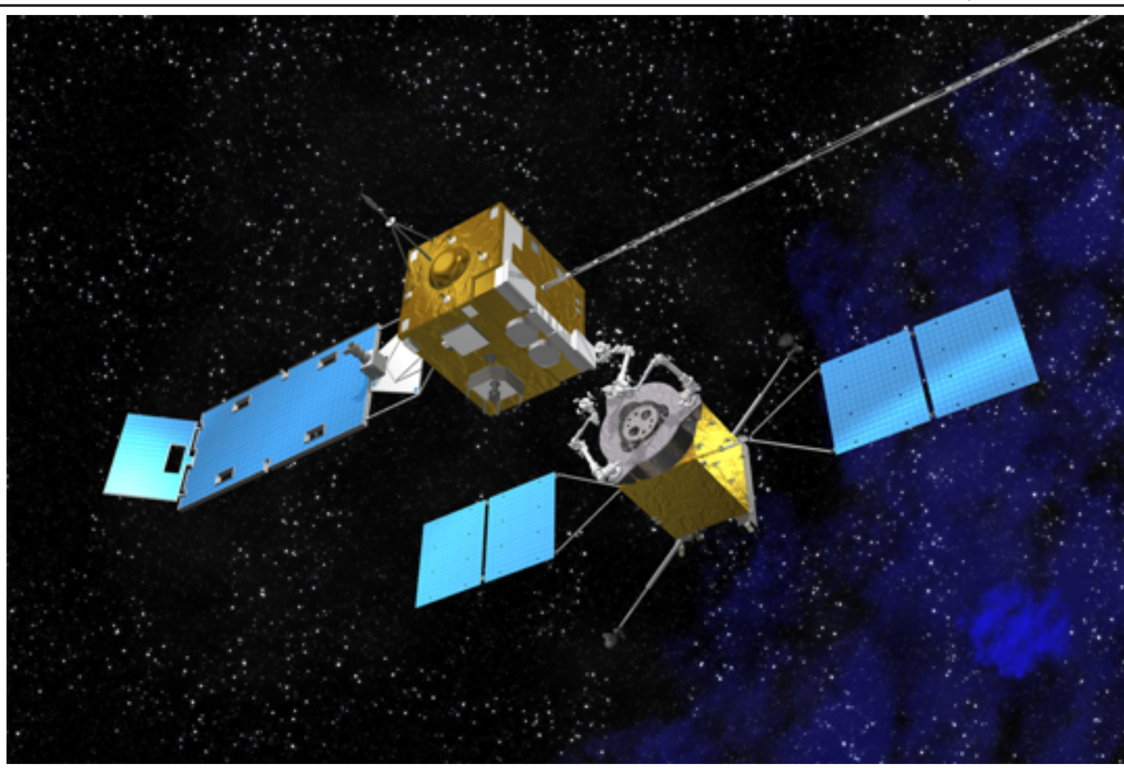

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#25

ACTIVITY 1.1: Robot or Not - KEY

Picture #	Name of Item	Robot or Not
1	VEX	Robot
2	Lego Mindstorm EV3	Robot
3	NASA rover	Robot
4	Toaster oven	Not
5	Laptop	Robot–depending on hardware and features
6	Lego Mindstorm with color sensor	Robot
7	Typewriter	Not
8	Virtual presence doctor	Robot
9	da Vinci Surgical System	Robot
10	Analog clock	Not
11	Mechanical movie characters	Robot
12	Piano	Not
13	Robonaut (astronaut robot)	Robot
14	Remote controlled quadcopter	Robot
15	Mars rover	Robot
16	Military rover	Robot
17	Aquatic autonomous vehicle	Robot
18	Autonomous vacuum cleaner	Robot
19	ATM machine	Robot
20	Automatic sliding doors	Robot
21	Car factory “workers”	Robot
22	Food packaging machine	Robot
23	Interactive toy	Robot
24	Space satellite	Robot
25	Lawnmower	Not

Spaghetti-Engineering

TIME:
45 minutes

MATERIALS NEEDED:
- Engineering Notebook
- Poster board
- Paper fasteners (5)
- Spaghetti (uncooked)
- String
- Masking tape
- Marshmallow
- Paper lunch bags
- Measuring tape
- Stopwatch

OBJECTIVES:
The 4-H member will be able to:
- Be able to explain the engineering process.
- Understand that triangles are the strongest shapes for building.

EXPLORE THE CONTENT:
Have you ever crossed a bridge, made a phone call or flown somewhere in a plane? If you have, then you've experienced the work of engineers firsthand.

Engineers make things possible! Basically, they use math and science to create and build most of the products, buildings and structures we see every day. It is fun to create and build things!

Engineers design and build all sorts of things. To be an engineer, you need to have a college degree.

Background information for facilitator:
Engineers are trained to use "The Engineering Process" in designing and constructing. It includes the following steps:
1. Brainstorm
2. Design
3. Build/prototype (a prototype is a model of the first design)
4. Test
5. Redesign

DO:
Activity 1
Have students draw and label the engineering design process cycle in their Engineering Notebook.

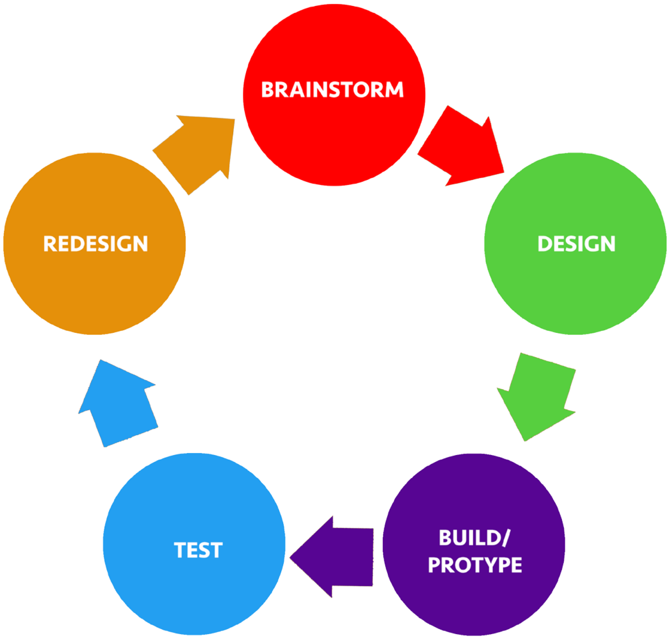


Figure 1. Engineering Design Process

Engineers use basic shapes to design structures. Have students draw and label the following basic shapes in their engineering handbook:

Triangle Square Pentagon Hexagon

The strongest shape is a triangle. Other polygons, like squares and rectangles, can "rack" or move from 90-degree angles. A triangle has fixed angles that cannot move, making it a stronger shape.

Most students will recognize the great pyramids of Egypt as examples of buildings made in a triangle shape. In most building construction, square shapes are reinforced with triangles.

Opening Questions:

- What is an engineer?
- What is the engineering process?
- What do engineers do?

Explain:

Today, you are going to be the engineer and get a chance to build a marshmallow tower. You will be using basic shapes to build your tower. Before you get started, lets look at how we can make stronger shapes.

Demonstrate:

Make a square using four pieces of poster board (5 1/2" long x 1" wide), held together at the corners with a paper fastener in each corner (see Figure 2). Ask one student to come up and, by holding the square in opposite corners, show how easily it can be moved back and forth (even flattened to some extent). Now, demonstrate how to make the square stronger by creating triangles within the same square. Remove the fasteners on the corners and add two new strips (7.75" x 1" each) in a crisscross pattern to opposite corners of the square. Attach a fastener to all three corners and to the center intersection of the two new pieces. Let your student hold the new square (Figure 3) and demonstrate how much stronger it is now. Point out how adding these diagonal pieces made four triangles in the square. This idea of making structures stronger by adding cross pieces to form triangles is often used in engineering and construction.

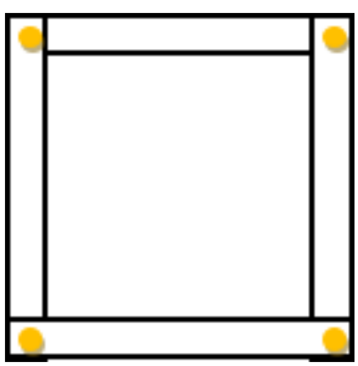


Figure 2

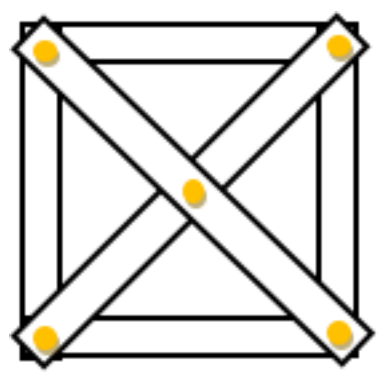


Figure 3

Say:

Now, are you ready use this new knowledge to be an engineer and build a strong marshmallow tower? The city where you live and work floods often. City officials are asking engineer teams to help design a rescue tower. This tower will need to be as tall as possible so that it can hold all the citizens and be higher than the flood. Build the frame of a tower that could allow residents to escape to safety during a flood. Be sure to build it as tall and as stable as you possibly can.

DO:

Activity 2 - The Marshmallow Challenge - Let's Build Something!

Divide class into teams. Give each team a paper bag filled with their building materials, or if you have time, have the team members measure the tape and string to add math and measuring skills to the lesson.

Materials each team will need:

- Uncooked regular spaghetti (not fine or fettuccini) - 20 pieces per team
- 1 - 36" string
- 1 bag of marshmallows; use regular-sized marshmallows, not jumbo or miniature (teams can share bags if necessary)
- 36" of Masking tape

You will also need:

- Paper lunch bags or plastic sandwich bags — 1 per team if you make the kits ahead of time
- Measuring tape — A contractor's retractable measuring tape would be best
- Stopwatch — The actual marshmallow challenge takes 18 minutes, but adjust if needed.

The challenge:

1. Design and build the tallest tower possible. It will be measured from the tabletop surface to the top of the tower.
2. The entire marshmallow must be on the top of the structure. Cutting or eating part of the marshmallow disqualifies the team.
3. The team can use as many or as few of the 20 spaghetti sticks as needed and as much or as little of the string or tape. The team cannot use the bag as part of their structure.
4. Teams are free to break the spaghetti and cut up the tape and string to create new structures.
5. The challenge lasts 18 minutes. Teams cannot hold on to the structure when the time runs out. Those touching or supporting the structure at the end of the exercise will not be measured.

*****Ensure everyone understands the design guidelines. Don't worry about repeating the rules too many times. Repeat them at least three times. Ask if anyone has any questions before starting.*

REFLECT:

- What part of this activity was the hardest to do?
- Did your team work well together?
- Did you apply all parts of the engineering design process? If not, why?
- How did your team decide on the design you used?
- Did you have to build your tower more than once?
- How successful do you think you were? Why or why not?

APPLY:

- What do you think works best when engineers construct buildings?
- Do you think some shapes work better than others?
- What did you learn about using different building materials?
- Can you use the idea of building and testing a prototype for other situations?

REFERENCES:

- "Imagine, Design, Build – Engineers Make the Best Better", copy permission granted from The University of Tennessee Extension, Dr. Richard Clark, 12/12/16. (https://agwebv01.ag.utk.edu/4h/exploring4h/engineering/ImageDesignBuildFacilitatorGuide.pdf)

Armed with Knowledge

TIME:
45 minutes

MATERIALS NEEDED:
- 3" wide x 22" long strip of corrugated cardboard (1 per team)
- 3" wide x 11" long strip of corrugated cardboard (1 per team)
- 3" wide x 6" long strip of corrugated cardboard (1 per team)
- Binder clips (various sizes) per team
- 2 medium brass fasteners per team
- Fishing line (3-4 ft. per team)
- Hole puncher per team
- 10 paper clips (various sizes) per team
- Rubber bands – several per team
- Straws (cut into 1-in. lengths) - several per team
- Clear or masking tape per team
- Twine or kite string per team
- Scissors per team
- Paper or Styrofoam cups (3 oz.) how many per team

(Divide students into teams and place materials on each team's table for later discussion)

OBJECTIVES:
The 4-H member will:
- Learn design concepts
- Demonstrate problem-solving techniques
- Learn about simple machines
- Learn how to work as a team

EXPLORE THE CONTENT:

Robots are often designed to look and sometimes move like a human. Think of an example of a robot or part of a robot that moves or acts like a human? When we base a design on an existing object, it is called reverse engineering. For example, many robots have arms that are similar in structure to that of a human arm.

What are the main structures that make up a human arm?
- Bones – rigid structure that gives support to human tissue
- Muscles – flexible tissue that expands and contracts to move
- Tendons – connective tissue that helps guide muscles and movement
- Joints – a hinge between bones which allows movement

Ask students (as a team) to answer the following questions in their Engineering Notebook (page 5).
If you were building a robot using the material on your table:
- Which of the item could best function as bone?
- Which could represent muscles?
- Which could represent tendons?
- Which items could create a joint?

DO:

In the Engineering Notebook, have students sketch a design for their robot arm, which must meet the following criteria:
- Must include only the materials provided
- Must have two flexible joints
- Must be at least 20 inches in total length
- Must be able to pick up a cup

Members of each team must come up with one single design to build. Give students 20-30 minutes to build, test, and redesign the arm.

For examples of how the arm can be designed and function, see: http://www-tc.pbskids.org/designsquad/pdf/parentseducators/DSN_NASA_MissionSolarSystem_RoboArm.pdf

REFLECT:

- Did you use all of the material provided? Why or why not?
- Did your arm work correctly the first time you tried it? What did you have to change to make it work?
- Which item was most critical to your team's design?
- How did working on a team help or hinder the design process?
- What did you learn from the design of other teams?

- Name 3 types of robot tasks/jobs where arms are used.

APPLY:

- How can learning the design process help you work with other teams and individuals in the future?
- How can simple machines improve the quality of life for humans?

REFERENCES:

- http://pbskids.org/designsquad/build/robo-arm/

Buddy-bot Programming

TIME:
30 minutes

MATERIALS NEEDED:
- Paper – how much?
- Pencil – 1 per person?
- Common item(s) found in learning environment (chair, table, tennis ball, etc.)

OBJECTIVES:
The 4-H member will:
- Learn the basics of robot programming

EXPLORE THE CONTENT:
Programming is an essential step in making a robot function. Without programming, the robot is just a non-functional machine. Programming is a computer language that provides step-by-step commands to make the robot perform a given task(s). Some common programming languages are:
- Java
- Python
- JavaScript
- C#

DO:
Pair up students.
Have students decide who will be the programmer and who will be the robot (they will switch roles after the first activity). Choose a task that the programmer will write in the Engineering Notebook for their Buddy-bot to complete in six steps or less.

Examples of tasks the teacher assigns (you may choose to give the task in written form so that only the programmer knows what the task is):
- Pick up a ball put on the other side of the room.
- Walk around a table and sit in a chair.
- Walk around obstacles in the learning environment.

To the Buddy-bot: Be very careful to do exactly what the programmer says to do and nothing more.

To the Programmer: With your back to your Buddy-bot, give your written commands to your Buddy-bot one line of code at a time. You may only say what is written in your notebook.

Allow for each team to complete this exercise as time permits.

Reverse the roles and then allow more lines of code to be written. Encourage teams to think about the environment, measurements, space, colors, movements, direction, etc.

Repeat the above exercise with the Buddy-bot and Programmer.

Programmer: In the space provided in your handbook, rewrite the commands so your robot can better understand and do it. Robot:

Extension:
Switch program code between two different teams.

REFLECT:
- Was your Buddy-bot able to accomplish the task? Why or why not?
- What was difficult about writing the code?
- Why was the code difficult to understand?
- Did the code provide enough information or details?
- Were you able to follow the program exactly?
- What techniques helped you write better code the second time?

APPLY:
- How does writing code help you communicate better with other people?
- Is there an advantage to speaking a common language?

REFERENCES:
- Platform Robotics, National 4-H

SEMOR Draws, Paints, and Races

TIME:
60 Minutes

MATERIALS NEEDED:
(No company or product endorsement implied or intended.)
SEMOR kit (items per team):
- 9 volt (V) battery (1)
- 9 V battery holder (1)
- 9 V DC motor (1)
- These specialty items can be purchased from electronic supply stores such as: Science Buddies Store.

Other items (per classroom/group):
- Plastic cup, 16 oz. (1)
- Cork (1)
- Popsicle stick (1)
- Thin-size washable markers (3)
- White posterboards (3)
- Double-sided foam tape
- Electrical tape
- Hobby knife
- Scissors
- Small Phillips head screwdriver
- Large googly eyes (2)
- Other arts and crafts materials to decorate your robot (pipe cleaners, etc.)

OBJECTIVES:
The 4-H member will:
- To design plans for a simple, motorized robot
- Build a simple, motorized robot

EXPLORE THE CONTENT:
In this activity, participants will design and build a Simple Electric Motor Operated Robot (SEMOR). When constructed, it will draw shapes onto paper, paint, or even race.

An electrical flow or path is needed from the positive (+) battery contact through the electrical item (such as a light bulb or motor) and back to the negative (-) contact of the battery. Using a motor as an example, when the path is complete, the electricity will flow from the battery to the motor making it turn.

DO:
Activity 1
Have students look around the learning environment and identify in their Engineering Handbook components they believe run on electricity. Have them describe what they think the electricity is doing (heat/light, turning a motor, etc.)

Activity 2
- Gather materials and tools.
- Divide students into the same number of teams as you have SEMOR kits
- Follow the step-by-step instructions found in this video: https://www.youtube.com/watch?v=daWU2Oh_xlg&feature=youtu.be

REFLECT:
- Were you surprised by how many things around you run on electricity?
- How would your life be different without electricity?
- Did your SEMOR work like you thought it would?
- What changes or additions would you make to SEMOR work better or differently?

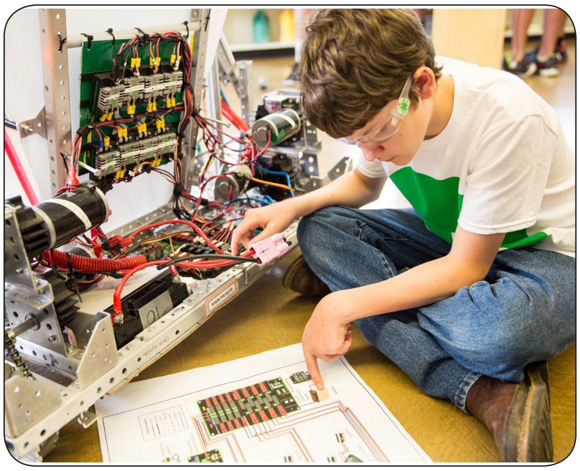
APPLY:
- How can you use the engineering design process to make something better?

REFERENCES:
- Wire Stripping and Soldering Instructions http://www.4-h.org/Robotics/Resources/Documents/JunkDrawerRoboticsToolbox.dwn (pages 6-7)
- Examples of SEMOR or other “bristle bots”:

http://www.4-h.org/Robotics/Resources/Documents/FacilitatingJunkDrawerRobotics.dwn (p. 16)
http://www.sciencebuddies.org/science-fair-projects/project_ideas/Robotics_p014.shtml#summary

- https://www.sciencebuddies.org/

Taste Mapping Sensor



TIME:
30-45 minutes

MATERIALS NEEDED:
- Pitchers to prepare salt water and sugar water solutions (2 total)
- Water (for mixture described below)
- Lemon juice (for mixture described below)
- Sugar (for mixture described below)
- Tonic water (for mixture described below)
- Salt (for mixture described below)
- Paper cups (4 per participant)
- 1 marker
- Tongue diagram handout (1 per participant)
- Cotton swabs (4 per participant)
- Unsalted crackers (4 per participant)

OBJECTIVES:
The 4-H member will:
- Describe how the five human senses work
- Compare human senses to the those found in robots

EXPLORE THE CONTENT:
Humans have 5 basic senses. They are: smell, taste, sight, hearing, and touch. The human nervous system is the part of the body that carries signals from certain body parts to be processed by the brain. For example, the skin in your fingers contain millions of sensitive nerve endings that can detect physical stimuli such as temperature. The stimuli are then converted to electrical impulses sent through the nervous system to the brain, which then processes the stimuli as being hot or cold. Humans use their senses to make decisions.

In the mechanical world, what is a sensor? It is a device that can measure or detect a signal. A signal is a form of energy that a mechanical device can detect and convert into another form of energy. This conversion is called transducing. As such, another name for a sensor is a transducer. For example, a microphone (a type of sensor) converts sound waves to electricity. The electrical signal is then sent to a computer for processing.

Sensors can measure such things as light, temperature, distances to another object, sounds, and more. To some degree, they mimic human senses. In robotics, we use sensors to gather information within the robot's environment and then program it to act upon that information in some way.

DO:
Activity 1 - Human Senses
Ask students to list (in their Engineering Handbook) the 5 human senses and the corresponding organs that is used to sense (for example: sound / ears). Have a discussion with students about why we need our senses and how they think each one works.

Activity 2 - Taste Mapping
ALERT: Individually ask each student if he/she has any known food allergies. Refrain from using any of those food items listed above if it may cause an allergic reaction to any student.

Mix up the following ahead of time and pour a small sample of each into paper cups for each student (each student will end up with 4 different cups/flavors):
1. Sugar water
2. Salt water
3. Tonic water
4. Lemon juice

With a marker, label each cup with the corresponding number. Do not tell the students what the liquids are. Pass out the tongue diagram handout to each student. Provide each student with 4 or more cotton swabs.

Introduce the four different taste types: sweet, salty, bitter and sour.

Ask students to dip a cotton swab into cup #1 and then taste the liquid by placing it on their tongue. Ask students to record the taste type in their Engineering Handbook, and then indicate which region of their tongue the taste is strongest.

Have the students cleanse their pallet by eating a cracker, and then repeat the process for the 3 other cups.

Ask students to share their findings. Note any commonalities or differences. Bring to their attention that human sensors are all different and that no two are exactly alike.

Activity 3
Describe mechanical sensors and generally how they work. Next, have students search their learning environment for sensors. (depending on the learning environment, examples could be sensors such as: thermostat, "eyes" on a hand towel dispenser, garage door "eyes", bar code reader, microphone, video camera, infrared receiver on a television, etc.). Challenge students to find examples of sensors that mimic the 3 or more human senses.

REFLECT:

- What is the purpose of our human senses?
- What did you learn from the taste mapping activity? Were you surprised by the results?
- Do all robots have sensors?
- Why do robots need sensors?

APPLY:

- What type of robotic sensors could be used in the medical field?
- How could farmers use sensors to help them better manage their crops?
- In a 4-H robotics competition, what sensors might help your robot's performance and accuracy?
- Explore in greater detail:
  https://www.teachengineering.org/lessons/view/umo_ourbodies_lesson02
  https://www.teachengineering.org/curricularunits/view/umo_sensorswork_unit

REFERENCES:

- http://wikieducator.org/Terrific_Tastebuds

Student's Name: ___________________________

Texas 4-H
Engineering Notebook

Lesson 1 – Bot or Not

Activity 1

In the space below, draw a robot of your own design.

What is the name of your robot? ___________________________________

What does your robot do or what are some of its cool features?

1. ____
2. ____
3. ____
4. ____
5. ____

Activity 2

In your own words, write the definition of a robot.

List the 3 main parts of a robot.

1. ____
2. ____
3. ____

List the 4 common characteristics that most robots have and give an example of each one.

Characteristics	Examples
1. _____________________________________	_____________________________________
2. _____________________________________	_____________________________________
3. _____________________________________	_____________________________________
4. _____________________________________	_____________________________________

Activity 3

Name the 7 types of robots and give an example of what each one does.

1. ______________________________ ______________________________

2. ______________________________ ______________________________

3. ______________________________ ______________________________

4. ______________________________ ______________________________

5. ______________________________ ______________________________

6. ______________________________ ______________________________

7. ______________________________ ______________________________

Lesson 2 – Spaghetti Engineering

Draw and label the Engineering Design Process cycle.

Draw and label the 4 basic engineering shapes. Circle the one that is the strongest.

Lesson 3 – Armed with Knowledge

What is the definition of reverse engineering?

What are the 4 main parts of an arm?

If you were building a robot using the material on your table:

- Which item could best function as bone?
- Which could represent muscles?
- Which could represent tendons?
- Which items could create a joint?

Draw your design of a cardboard arm that uses the material you have been provided.

Lesson 4 – Buddy-bot Programming

Write your six lines of code for your Buddy-bot program.

1. ____
2. ____
3. ____
4. ____
5. ____
6. ____

Rewrite the lines of code for your Buddy-bot program.

1. ____
2. ____
3. ____
4. ____
5. ____
6. ____
7. ____
8. ____
9. ____
10. ____
11. ____
12. ____
13. ____
14. ____
15. ____

Lesson 5 - SEMOR Draws, Paints, and Races

List components or devices that run on electricity and the type of activity it is doing (example: bulb / emitting light)

Component **Activity**

1. ________________________/______________________________
2. ________________________/______________________________
3. ________________________/______________________________
4. ________________________/______________________________
5. ________________________/______________________________

Lesson 6 - Taste Mapping Sensor

Human Senses: List the 5 human senses and the body part that is used.

<u>Sense</u> <u>Body Part</u>

6. ________________________/______________________________
7. ________________________/______________________________
8. ________________________/______________________________
9. ________________________/______________________________
10. ________________________/______________________________

Taste Mapping – circle your answers for each sample.

Cup 1.	Sweet	Salty	Bitter	Sour	Tongue Location: A B C D
Cup 2.	Sweet	Salty	Bitter	Sour	Tongue Location: A B C D
Cup 3.	Sweet	Salty	Bitter	Sour	Tongue Location: A B C D
Cup 4.	Sweet	Salty	Bitter	Sour	Tongue Location: A B C D

Mechanical Sensors – List or describe as many sensors as you can find in your learning environment. What human sense does it mimic?

<u>Sensor</u> **<u>Sense</u>**

1. ___________________________/______________________________
2. ___________________________/______________________________
3. ___________________________/______________________________
4. ___________________________/______________________________
5. ___________________________/______________________________
6. ___________________________/______________________________
7. ___________________________/______________________________
8. ___________________________/______________________________
9. ___________________________/______________________________
10. ___________________________/______________________________

MARKING INSTRUCTIONS

CORRECT: ● INCORRECT: ☑ ⊠ ◒ ⊙

4-H Explore
Project Book Evaluation - Robotics

1. Please read the statement in the left column of the table below. Bubble in the circles that describe your level of understanding **BEFORE** attending this program. In the section on the far right, bubble in the circles that describe your level of understanding **AFTER** attending this program. You will have two bubbles per row.

LEVEL OF UNDERSTANDING: 1 = Poor, 2 = Average, 3 = Good, 4 = Excellent	BEFORE				AFTER			
As a result of participating in the Water project lessons and activities…	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
I understand the characteristics that makes up a robot.	○	○	○	○	○	○	○	○
I understand the different types of robots and the roles they play in our daily lives.	○	○	○	○	○	○	○	○
I understand the engineering process.	○	○	○	○	○	○	○	○
I understand how to design something from a set of instructions or objectives.	○	○	○	○	○	○	○	○
I understand that programming is a sequence of detailed commands.	○	○	○	○	○	○	○	○
I understand the basic purposes of robotic sensors.	○	○	○	○	○	○	○	○

2. For each statement below, fill in the bubble that best describes you.

INTENTIONS TO ADOPT: **As a result of participating in the Water Project lessons and activities…**	**Yes**	**No**	**Unsure**
I can identify different characteristics that make up a robot.	○	○	○
I can build the stronger structure by using triangular shapes in my design.	○	○	○
I can identify problems and create a plan to fix it.	○	○	○
I can write a successful set of program commands.	○	○	○
I can design and build a functioning robot.	○	○	○
I can identify different types of robot sensors.	○	○	○

3. For each statement below, fill in the bubble that best describes your level of agreement with the following statements.

BEHAVIOR CHANGES: **As a result of participating in the Water Project lessons and activities…**	**Strongly Disagree**	**Disagree**	**Agree**	**Strongly Agree**
I am more comfortable working in a team.	○	○	○	○
I am more willing to listen to others.	○	○	○	○
I am more comfortable speaking with others.	○	○	○	○
I am more confident in my abilities as a leader.	○	○	○	○

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Please continue on the back.

MARKING INSTRUCTIONS

CORRECT: ● INCORRECT: ☑ ☒ ◒ ◓

3. What is the most significant thing you learned in the Water project?

Please tell us about yourself.

Gender: ○ Female ○ Male

I consider myself to be: ○ African American ○ Asian American ○ Native American ○ White ○ Other

I consider myself to be: ○ Hispanic ○ Non-Hispanic

Grade: ○ 3rd ○ 5th ○ 7th ○ 9th ○ 11th ○ 4th ○ 6th ○ 8th ○ 10th ○ 12th

Most of the time, you live . . .

○ Farm or ranch
○ Town less than 10,000
○ City between 10,000 - 50,000
○ Suburb of city between 50,000
○ Central city/urban center with more than 50,000

Please provide any additional comments below.

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Thank you!