STEM Connections

T-Bot (syringe robot)

Below are ideas for connecting the T-Bot (syringe robot) activity to STEM concepts and principles. For more ideas and detailed STEM lessons, consult the *T-Bot II Teacher's Guide*.

ACTIVITY OVERVIEW

Students build and operate the T-Bot II to accomplish various tasks.

SCIENCE

Incompressibility of Fluids

Hydraulics (the use of fluid power to do work) is based on the principle that fluids are incompressible. In this activity, students are going to investigate basic hydraulic concepts.

Students construct a hydraulic system from two 12 cc syringes and one foot of 1/8" vinyl tubing. One syringe is filled with water by pushing the syringe completely in, inserting the end of the syringe in a glass of water, and pulling the syringe out to its stopping point.

Attach the tube to the end of this syringe and place the free end of the tube into the cup of water. The syringe is pushed in, forcing air out of the tube and into the water. Pull the syringe back out to its stopping point while leaving the free end in the water. This should fill the syringe and tube. Insert the free end of the tube onto the second syringe that is pushed in.

Have students move the syringes in and out, observing and recording the action and reaction on a worksheet. Have students move one syringe a distance of five major marks on the syringe. Observe and record the distance the second syringe moves. Repeat this operation, moving the syringe three marks and eight marks. Repeat, moving the other syringe the same distances. Record all results.

ENGINEERING

Sumo Wrestler Machine Design

Hydraulics are used in many machines to provide control and power.

In this activity, students will use a group of components to design and construct a Sumo Wrestling Machine. Their machine can use up to three syringes and should be configured to be able to flip, push, or otherwise remove another Sumo Robot Wrestler from a 36″ ring.

Students should use the Engineering Design Loop process as they go through this project, recording ideas, sketches, photos, and any data. Several iterations of the Sumo Wrestler should be done, with modifications between wrestling rounds based on performance in the ring.

Students should compare and contrast various robots (including their own), noting both positive and negative aspects of each and what factors go into making a high-quality Sumo Wrestler.

Components can include but are not limited to:

- Syringes (from 6 cc to 30 cc)
- Cable ties
- Balsa wood or basswood sticks
- Craft sticks
- Modeling clay
- 1/8" vinyl tubing
- Bamboo skewers
- Cool melt glue gun and slugs

TECHNOLOGY

Programming

Programming did not start with the advent of computers; it is really a step-by-step set of instructions on how to get a specific job done. For computer programming, it is a set of instructions telling the computer what to do, but you can also program simple machines, such as the T-Bot, to get a specific job done.

Students can research machines (outside of computers) that have had the capacity to be programmed. Some examples include player pianos, looms, and even vinyl records that would play back specific notes at specific times, creating a song.

Students can write a program for the T-Bot by recording each action to take and which syringe the action is to be taken with.

Ask students to write a program (set of instructions) that would enable another student to correctly pick up an object from a specified location and move it to another specific location. Students should work in teams to accomplish this and then share with other teams to determine how well they wrote their instructions – and then modify the instruction set (program) to operate more efficiently or to be more easily understood by the user.

MATH

Proportional Relationships

In dealing with the control of machines, proportionality is a critical factor. In most controls, a numeric value is usually related proportionately to a distance moved by the machine part.

In this activity, students will determine the proportionality of the syringe movement to the machine movement.

Have students build the T-Bot II if it is not already built.

Students will work with one axis of the robot at a time. Each syringe controls one axis of the robot.

Students will move the syringe three units at a time (for example, from three to six) and will measure and record the amount of movement that this causes from the robot. Students will repeat this for moving the syringe seven units and 10 units, measuring and recording the resulting movement of the robot.

This procedure is done for each of the four axes. Some brainstorming and problem solving might be required by students to obtain the measurement of the robot's movement. Some movements might be in the form of an arc, and students will have to find a way to accurately measure that movement.

PITSCO EDUCATION