GUIDEBOOK

UVU
CREATIVE LEARNING STUDIO
SCHOOL OF EDUCATION

UVU School of EDUCATION
UTAH VALLEY UNIVERSITY

STEM ACTION CENTER
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Lucid for Education

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MICRO STEM FEST KIT

Thank you for participating in the Micro STEM Fest Kit project. Our hope is that this experience will promote students' 4 C skills: communication, collaboration, creativity, and critical thinking, as well as their interest in STEM!

Each activity in the kit has been aligned to at least one SEEd standard. While the standard(s) might not reflect your specific grade level, exposure to these concepts can only benefit students' understandings and background knowledge.

Participant Directions (1st-5th Graders)

- Divide students into pairs.
- When you arrive at the fest, pairs will be directed to their first station in groups of 10-14. The facilitators (6th graders) at the table will explain to the students what the engineering or technology challenge is and they will have 20 minutes to explore.
- Participants will explore three stations over the course of the hour.

Facilitator Directions (6th Graders)

- Divide students into 10 groups. There will be 10 tables at the fest.
- Pass out the table directions to each group. Have students read through the directions and explore the materials. Make sure the students memorize the vocabulary. Students should think about and plan appropriate questions they might want to ask the participants during the challenge.
- Make sure the Code and Go Mice work, Coding Critters, LittleBits, Snap Circuits all work (extra batteries are provided).
- On the day of the fair, students should set up the supplies on the table.
- The students will facilitate the activity three times for 20 minutes each.
- When the participants arrive, students will share the challenge and then provide support, use the vocabulary, and ask guided questions as the participants work.
- After each session, make sure all materials are placed back on the table for the next group.
- After the fair, place all the materials back in the kit.

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Table 1: Code & Go Mouse Challenge

Materials

Code and Go mouse, maze grids, maze walls, coding and activity cards, cheese wedge, batteries.

Vocabulary & Definitions

- Coding - the process of creating instructions.
- Program sequencing - an ordered sequence of instructions to achieve a solution.
- Algorithm - a set of logical steps carried out in order.

Challenge

Step 1: Create your own maze using the grids and walls. Program a sequence of steps using the arrows for the mouse to follow to get the cheese.

Step 2: Use the yellow button to reset and the arrow keys to program the path. Press the green button to start. Remember the left and right arrow keys only turn the mouse, it does not move it forward. Use the red dot to cancel the code.

***make sure the mouse is turned off before putting it back into the box!*

Table 2: Tetris Puzzle Challenge

Materials

40 Wooden Tetris pieces, diagram of the puzzles to choose from.

Vocabulary & Definitions

- Tetris – derived from the Greek prefix *tetra* meaning 'four' referring to each block having four sides.

Challenge

Step 1: Choose a puzzle to solve from the diagram. Create different Tetris puzzles using the various shapes to match the diagrams.

Step 2: Begin solving the puzzle by placing the pieces in the correct order to match the image. Check to see if the puzzle is correct!

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Table 3: Magnets Challenge

Materials

14 Magnet pieces, paper clips, metal rods, paper plates.

Vocabulary & Definitions

- Magnetic polarity – the orientation of north and south poles in space.
- Magnetic field – the space around a magnetic material or a moving electric charge.

Challenge

Step 1: *Paper clip walk.* Put one paperclip on a paper plate and use a magnet underneath the plate to make it walk from one side to the other. How many paper plates can you add while still allowing the magnetic field pass between the paper clip and magnet?

Step 2: *See how many paper clips can attach to one magnet*. Attach one paper clip to the bottom of a magnet. Begin adding more and more to the end of each paper clip- make sure they are not overlapping. How many paper clips can the magnet hold before they fall?

Step 3: *Build a tower only using three magnets.* Choose three magnets and construct a stable tower with those only. Remember that opposite poles attract and similar ones push away.

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Table 4: LittleBits Code Kit Challenge

Materials

P4 blue power bit, 9V Battery, i5 slide dimmer, o11 Servo, white cord, plastic case, grid, ball, white band, glue dots.

Vocabulary & Definitions

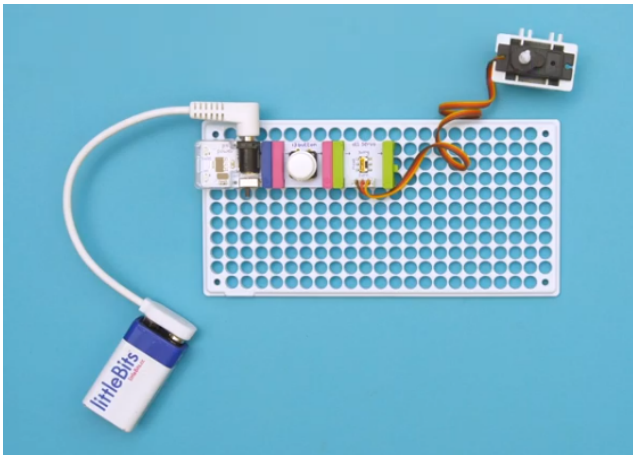
- Coding – telling a computer what to do by giving it instructions.
- Branch – the branch takes the incoming signal from a power source and sends it equally to all three outputs of the bitSnaps. This is similar to how a power strip works, and looks like a tree branch or fork in a river.
- Input – what is put into a device, a place where energy or information enters a system.
- Output – a place where power or information leaves a system.
- Serial communication – a way to send complex information between computers and other devices. This communication works through “on” and “off” signals.

Challenge

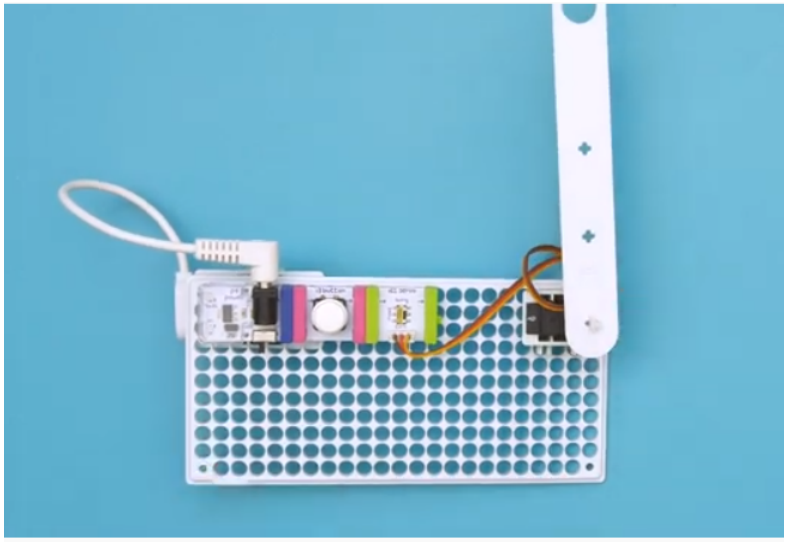
Step 1: Your goal is to design a waving arm with the circuit parts.
Step 2: Start by connecting the battery pack to the white cord. Then connect the other end of the battery cord to the p4 blue power bit.

Step 3: Next connect the pink i5 slide dimmer to the p4 blue power piece. Attach the o11 green server to the end of the pink bit. Pieces connect easily with magnets. Make sure to insert the black swing motor attached to the green o11 servo into the white case. The white rod that sticks out will be used as the waving arm (See image example).

Step 4: Next, place your circuit and battery pack onto the mounting board. Turn on the battery switch on the blue power bit and a red light should appear (See example images).



Step 5: Lastly, attach the long white band onto the white turning rod through the first notch. Then practice rotating the band by sliding the dimmer to the right. Attach the ball inside its case onto the arm with the red tape piece or glue dots, now turn on the slider to watch it rotate the ball through the air! (See example image).



How to put everything back:

Table 5: Hot Wheels Racetrack Challenge

Materials

Racecar, car track parts, and connectors.

Vocabulary & Definitions

- Trajectory - the path of a moving object.
- Velocity - the rate and direction of an object's movement.
- Acceleration - a vehicle's capacity to gain speed within a short time.

Challenge

Step 1: Your goal is to design a race track for the Hot Wheels car to stay on without falling off the track!

Step 2: Start creating your track by connecting the orange track pieces into the blue connectors. The pieces connect by sliding them together with the large blue circle in the middle.

Step 3: When you have created your desired car track, test it out by placing the car at the starting location and watch it zoom! Keep trying if the car falls off.

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Table 6: Keva Contraptions Challenge

Materials

600 Pine planks, 2 Keva balls.

Vocabulary & Definitions

- Contraption – a mechanical device that is often unusual or strange.
- Chutes – basic way to move the ball with two side rails along the track for stability.
- Trestles – a framework of horizontal beams supported by two pairs of sloping legs.

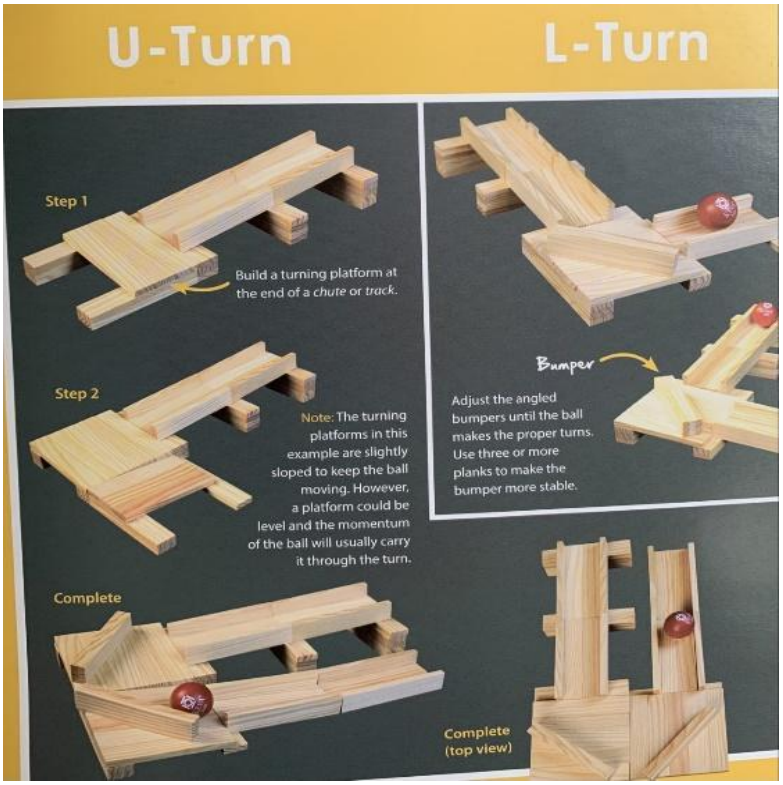
Challenge

Step 1: Show the students the example images. Say “Think about how you could build a Keva Contraption using just wooden blanks!”

Step 2: *Try the U-turn model*. Build a chute or track angled down as a ramp. Build a turning platform at the end of it. Use a bumper to make the ball U-turn and then add a slide to have the ball follow the path down (see example picture 1).

Step 3: *Domino Effect*. Use the Keva ball to start a domino-chain reaction. Build a ramp that will lead the ball to hit a series of blocks to be knocked down. Use gentle slopes and slower speed to have more control of the ball movements.

Step 4: *The Shaft*. Start with a dispenser to get the ball out of the bottom, make sure to angle it down. Next, build a basic shaft- a tower of blocks to drop the ball through. Try a zig-zag shaft or a rickety shaft (See picture example 2).


U-Turn
L-Turn
Step 1
Build a turning platform at the end of a *chute* or *track*.
Step 2
Note: The turning platforms in this example are slightly sloped to keep the ball moving. However, a platform could be level and the momentum of the ball will usually carry it through the turn.
Bumper
Adjust the angled bumpers until the ball makes the proper turns. Use three or more planks to make the bumper more stable.
Complete
Complete (top view)


The Shaft
Step 1
Dispenser
Any time you build a *shaft*, you must plan how you will get the ball out of the bottom. Usually, you will want a *dispenser* at the bottom of the *shaft*.
Step 2
A basic shaft
Try building a *shaft* from the floor to the edge of a table and let the ball take a long ride straight down.
"Rickety" shaft
A free form, rickety *shaft* works just as well as a perfectly straight one. In fact, a narrow irregular *shaft* makes the ball take more time on its descent.
Almost any tower style can become a *shaft* ... and can be several feet high.
Zig zag shaft
Not only visually interesting, this *shaft* style increases the ball action, as well.
Drop Hopper
Ball goes in here.
A *drop hopper* basically is a mini *funnel* that gets the action started with style.
Baffle bounce
Add *baffles* in the *shaft* to make the ball bounce around even more on its way down.
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Table 7: Coding Critters Challenge

Materials

DOG: Ranger, Zip, toy ball, toy house, Ranger storybook (optional)
CAT: Scamper, Sneaker, toy ball, toy house, toy fish, Scamper storybook (optional)

Vocabulary & Definitions

- Coding – the process of creating instructions, telling something what to do.
- Program sequencing – an ordered sequence of instructions to achieve a solution.

Challenge

(Dog) Step 1: Place the ball away from Ranger and use the forward, left, and right commands to help Ranger find his ball. Press the middle button once the code has been set.

Step 2: Turn on play mode and press his nose, press the right turn arrow to make Ranger dance! Code Ranger with the arrow keys to make a circle around his house and then meet up with his friend, Zip.

(Cat) Step 3: Place the ball of yarn far away from Scamper and program her arrow keys to find her ball. Press the middle button once the code has been set.

Step 4: Turn on play mode and press the forward arrow to feed Scamper and Sneaker with the toy fish. Use the arrow keys to guide Scamper back to her house. Turn on play mode and press the right arrow key to make Scamper dance!

***make sure the dog and cat are turned off before putting them back into the box!*

Table 8: K'Nex Challenge

Materials

Connectors, spacers, chains, and cups.

Vocabulary & Definitions

- Architecture - the practice of designing and building structures for a specific purpose.
- Base - the bottom foundation of a solid object, or the bottom line of a shape such as a triangle or rectangle.

Challenge

Step 1: Your challenge is to use the connector pieces to build a model that can hold up the plastic cup.

Step 2: Start by connecting the rods into the connectors and create a base shape. Next, work on building upward by connecting pieces vertically into the connectors. Create a design that can hold and balance a cup.

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Table 9: Snap Circuits Challenge

Materials

B1 battery, green S2 switch, blue connectors size 3, M1 motor, fan blade, grid, alkaline batteries

Vocabulary & Definitions

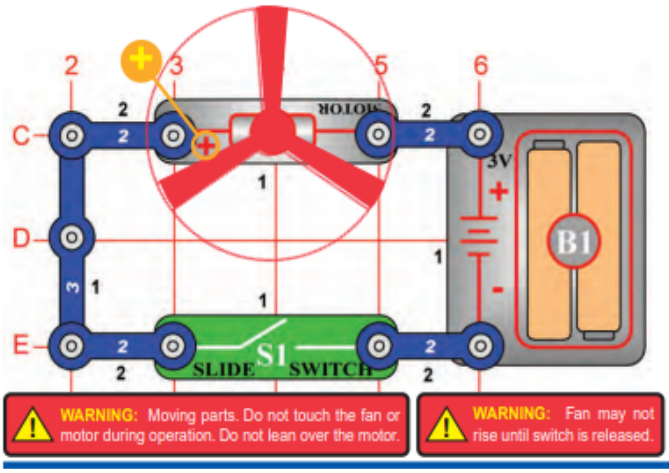
- Polarity - the condition of having positive and negative poles.
- Propeller - a mechanical device that propels an object forward with a revolving shaft and two or more blades.
- Circuit - complete path around which electricity can flow.

Challenge

Step 1: Build the circuit from *Project #4- Flying Saucer*! Place the battery and blue connector 3 on the grid two spaces apart. Then add the M1 motor piece at the top with the positive side connecting to the blue piece. Place the green S2 switch at the bottom connected to the battery and blue piece (See example picture).
Step 2: Make sure the negative (-) side of the M1 motor goes to the positive (+) on the battery (B1). Turn the switch (S1) on, the motor will slowly increase in speed. When the motor has reached maximum rotation, turn the slide switch off. The fan blade should rise and float through the air like a flying saucer. Be careful to not look directly down at the fan when it is spinning!
Step 3: If the fan does not fly off, then turn the switch on and off several times rapidly when it is at full speed.

Next choose any challenge from the Instruction Manual to try out!

☐ **Project #11**



Flying Saucer

OBJECTIVE: To make a circuit that launches the fan blade to simulate a flying saucer.

Rebuild the circuit from Project #2, but reverse the polarity on the motor (M1) so the negative (–) on the motor goes to the positive (+) on the battery (B1). New alkaline batteries are recommended for this project.

When you close the slide switch (S1), the motor will slowly increase in speed. When the motor has reached maximum rotation, turn the slide switch off. The fan blade should rise and float through the air like a flying saucer. Be careful not to look directly down on fan blade when it is spinning.

The air is being blown down through the blade and the motor rotation locks the fan on the shaft. When the motor is turned off, the blade unlocks from the shaft and is free to act as a propeller and fly through the air. If speed of rotation is too slow, the fan will remain on motor shaft because it does not have enough lift to propel it. The motor will spin faster when both batteries are new.

If the fan doesn't fly off, then turn the switch on and off several times rapidly when it is at full speed.

How to put everything back:

Table 10: Marble Run Challenge

Materials

Marbles, solid bases, marble run building pieces (85 pieces in set)

Vocabulary & Definitions

- Architecture – the design of buildings with a function or as a work of art.
- Engineering – the process of creating and building structures, and systems by using math and science.
- Speed – how fast an object is moving.

Challenge

Step 1: Use the building pieces to create a complex structure for the marble to run through.

Step 2: Start the design with the base pieces at the bottom and build up from there. Test out your structure by placing the marble at the top and watch it make its way through your design!

Micro STEM Fest Kit Inventory

Table 1: Code & Go Mouse Challenge

- 5 Code & Go Mice
- 80 Green Maze Grid Pieces
- 20 Double-sided Activity Cards
- 15 Orange Tunnels
- 110 Purple Maze Walls
- 150 Small Green Cards
- 5 Cheese Wedges
- 2 Manuals
- 1 Small Screwdriver

Table 2: Tetris Puzzle Challenge

- 200 Tetris Puzzle Pieces
- 5 Tetris Puzzle Frames
- 5 Laminated Tetris Example Instructions

Table 3: Magnets Challenge

- 70 Magnet Pieces
- 35 Paperclips
- 15 Metal Rods
- A Stack of Paper Plates

Table 4: littleBits Code Kit Challenge

- 5 littleBit Kits
- Table 5: Hot Wheels Challenge
- 30 Long Orange Pieces
- 60 Small Orange Pieces
- 5 Cars
- 90 Blue Pieces

Table 6: Keva Contraptions Challenge

- 600 Wooden Blocks
- 6 Orange Plastic Balls

Table 7: Coding Critters

- 3 Ranger Robots
- 3 Zip Critters
- 3 Toy Tennis Balls
- 3 Toy Dog Houses
- 3 Ranger Storybooks
- 2 Scamper Robots
- 2 Sneaker Critters
- 2 Toy Balls of Yarn
- 2 Toy Fish
- 2 Toy Cat Houses
- 2 Scamper Storybooks
- Additional Components

Table 8: K'nex

- 3 K'nex Sets
- 8 Plastic Cups
- 2 K'nex Instruction Manuals

Table 9: Snap Circuits

- 5 Complete Snap Circuit Kits
- 10 AA Batteries

Table 10: Marble Run

- Marble Run Components
- 1 Small Container of 30 Marbles
- 3 Instruction Manuals

Additional Items

- Laminated Lesson Plans for Each Activity
- 10 Laminated Table Signs
- 1 Copy of Teacher Directions

Appendix 1 - SEEd Standards

- Magnets
    - **Standard K.3. Plan and conduct an investigation** to compare the effects of different strengths or different directions of forces on the motion of an object. Emphasize forces as a push and pull on an object. The idea of strength should be kept separate from the idea of direction.
    - **Standard 3.3.1 Plan and carry out investigations** that provide evidence of the effects of balanced and unbalanced forces on the motion of an object. Emphasize investigations where only one variable is tested at a time. Examples could include an unbalanced force on one side of a ball causing it to move and balanced forces pushing on a box from both sides producing no movement.
    - **Standard 3.3.4 Ask questions** to **plan and carry out an investigation** to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other. Emphasize how static electricity and magnets can cause objects to move without touching. Examples could include the force an electrically charged balloon has on hair, how magnet orientation affects the direction of a force, or how the distance between objects affects the strength of a force. Electrical charges and magnetic fields will be taught in Grades 6 through 8.
    - **Standard 3.3.5 Design a solution** to a problem in which a device functions by using scientific ideas about magnets. *Define the problem, identify criteria and constraints, develop possible solutions using models, analyze data from testing solutions, and propose modifications for optimizing a solution.* Examples could include a latch or lock used to keep a door shut or a device to keep two moving objects from touching each other.
- Tetris Puzzle
    - **Standard 2.3.3 Develop and use a model** to describe how an object, made of a small set of pieces, can be disassembled and reshaped into a new object with a different function. Emphasize that a great variety of objects can be built from a small set of pieces. Examples of pieces could include wooden blocks or building bricks.
- Hot Wheels Track
    - **Standard K.3.2 Analyze data** to determine how a **design solution** causes a change in the speed or direction of an object with a push or a pull. *Define the problem by asking questions and gathering information, convey designs through sketches, drawings, or physical models, and compare and test designs.* Examples of problems requiring a solution could include having a marble or other object move a certain distance, follow a particular path, or knock down other objects.
    - **Standard 3.3.2 Analyze and interpret data** from observations and measurements of an object's motion to identify patterns in its motion that can be used to predict future motion. Examples of motion with a predictable pattern could include a child swinging on a swing or a ball rolling down a ramp.
    - **Standard 4.2.1 Construct an explanation** to describe the cause and effect relationship between the speed of an object and the energy of that object. Emphasize using qualitative descriptions of the relationship between speed and energy like fast, slow, strong, or weak. An example could include a ball that is kicked hard has more energy and travels a greater distance than a ball that is kicked softly.

    - **Standard 4.2.2 Ask questions** and make observations about the changes in energy that occur when objects collide. Emphasize that energy is transferred when objects collide and may be converted to different forms of energy. Examples could include changes in speed when one moving ball collides with another or the transfer of energy when a toy car hits a wall.
- Code & Go Mouse
    - **Standard 2.3.3 Develop and use a model** to describe how an object, made of a small set of pieces, can be disassembled and reshaped into a new object with a different function. Emphasize that a great variety of objects can be built from a small set of pieces. Examples of pieces could include wooden blocks or building bricks.
- Keva Contraptions
    - **Standard K.3.2 Analyze data** to determine how a **design solution** causes a change in the speed or direction of an object with a push or a pull. *Define the problem by asking questions and gathering information, convey designs through sketches, drawings, or physical models, and compare and test designs.* Examples of problems requiring a solution could include having a marble or other object move a certain distance, follow a particular path, or knock down other objects.
    - **Standard 2.3.3 Develop and use a model** to describe how an object, made of a small set of pieces, can be disassembled and reshaped into a new object with a different function. Emphasize that a great variety of objects can be built from a small set of pieces. Examples of pieces could include wooden blocks or building bricks.
    - **Standard 3.3.1 Plan and carry out investigations** that provide evidence of the effects of balanced and unbalanced forces on the motion of an object. Emphasize investigations where only one variable is tested at a time.
    - **Standard 3.3.2 Analyze and interpret data** from observations and measurements of an object's motion to identify patterns in its motion that can be used to predict future motion. Examples of motion with a predictable pattern could include a child swinging on a swing or a ball rolling down a ramp.
- Snap Circuits
    - **Standard 2.3.3 Develop and use a model** to describe how an object, made of a small set of pieces, can be disassembled and reshaped into a new object with a different function. Emphasize that a great variety of objects can be built from a small set of pieces. Examples of pieces could include wooden blocks or building bricks.
    - **Standard 4.2.3 Plan and carry out an investigation** to gather evidence from observations that energy can be transferred from place to place by sound, light, heat, and electrical currents. Examples could include sound causing objects to vibrate and electric currents being used to produce motion or light.
    - **Standard 4.2.4 Design** a device that converts energy from one form to another. *Define the problem, identify criteria and constraints, develop possible solutions using models, analyze data from testing solutions, and propose modifications for optimizing a solution.* Emphasize identifying the initial and final forms of energy. Examples could include solar ovens that convert light energy to heat energy or a simple alarm system that converts motion energy into sound energy.
    - **Standard 6.2.4 Design** *an object, tool, or process* that minimizes or maximizes heat energy transfer. *Identify criteria and constraints, develop a prototype for iterative testing, analyze data from testing, and propose modifications for optimizing the* ***design***

solution. Emphasize demonstrating how the structure of differing materials allows them to function as either conductors or insulators.

- K'Nex
  - **Standard 3.3.1 Plan and carry out investigations** that provide evidence of the effects of balanced and unbalanced forces on the motion of an object. Emphasize investigations where only one variable is tested at a time. Examples could include an unbalanced force on one side of a ball causing it to move and balanced forces pushing on a box from both sides producing no movement.
  - **Standard 2.3.3 Develop and use a model** to describe how an object, made of a small set of pieces, can be disassembled and reshaped into a new object with a different function. Emphasize that a great variety of objects can be built from a small set of pieces. Examples of pieces could include wooden blocks or building bricks.
- Code & Go Animal Critters:
  - **SEEd Standard: Standard 2.3.3**
    Develop and use a model to describe how an object, made of a small set of pieces, can be disassembled and reshaped into a new object with a different function. Emphasize that a great variety of objects can be built from a small set of pieces. Examples of pieces could include wooden blocks or building bricks.
- Marble Run:
  - **SEEd Standard: Standard 2.3.3**
    Develop and use a model to describe how an object, made of a small set of pieces, can be disassembled and reshaped into a new object with a different function. Emphasize that a great variety of objects can be built from a small set of pieces. Examples of pieces could include wooden blocks or building bricks.
  - **Standard 3.3.1 Plan and carry out investigations** that provide evidence of the effects of balanced and unbalanced forces on the motion of an object. Emphasize investigations where only one variable is tested at a time. Examples could include an unbalanced force on one side of a ball causing it to move and balanced forces pushing on a box from both sides producing no movement.
  - **Standard 3.3.2 Analyze and interpret data** from observations and measurements of an object's motion to identify patterns in its motion that can be used to predict future motion. Examples of motion with a predictable pattern could include a child swinging on a swing or a ball rolling down a ramp.
  - **Standard K.3.2 Analyze data** to determine how a **design solution** causes a change in the speed or direction of an object with a push or a pull. *Define the problem by asking questions and gathering information, convey designs through sketches, drawings, or physical models, and compare and test designs.* Examples of problems requiring a solution could include having a marble or other object move a certain distance, follow a particular path, or knock down other objects.
  - **Standard 4.2.2 Ask questions** and make observations about the changes in energy that occur when objects collide. Emphasize that energy is transferred when objects collide and may be converted to different forms of energy. Examples could include changes in speed when one moving ball collides with another or the transfer of energy when a toy car hits a wall.
- LittleBits Code Kit:
  - **Standard 4.2.4 Design** a device that converts energy from one form to another. *Define the problem, identify criteria and constraints, develop possible solutions using models,*

analyze data from testing solutions, and propose modifications for optimizing a solution. Emphasize identifying the initial and final forms of energy. Examples could include solar ovens that convert light energy to heat energy or a simple alarm system that converts motion energy into sound energy.

- **Standard 3.3.4 Ask questions** to **plan and carry out an investigation** to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other. Emphasize how static electricity and magnets can cause objects to move without touching. Examples could include the force an electrically charged balloon has on hair, how magnet orientation affects the direction of a force, or how the distance between objects affects the strength of a force. Electrical charges and magnetic fields will be taught in Grades 6 through 8.
- **Standard 3.3.5 Design a solution** to a problem in which a device functions by using scientific ideas about magnets. *Define the problem, identify criteria and constraints, develop possible solutions using models, analyze data from testing solutions, and propose modifications for optimizing a solution.* Examples could include a latch or lock used to keep a door shut or a device to keep two moving objects from touching each other.

Appendix 2 - Table Signs

The following pages are the ten table signs in case you need to print any signs in addition to the laminated signs provided in the Micro STEM Fest Kit.

Table 1

Code & Go Mice

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Table 2

Tetris

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Table 3

Magnets

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Table 4

LittleBits Code Kit

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Table 5

Hot Wheels

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Table 6

Keva Contraptions

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Table 7

Code & Go Critters

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Table 8

K'Nex

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Table 10

Marble Run

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