EXPLORE THE SEVEN STEM TRAILS OF THE LANCASTER SCIENCE FACTORY!

ACOUSTICS AND SOUND

XYLOPHONE: Pick one of the songs to play with the mallet. Play the same song through a few times. *Was it easier to play after two or three times*? **YES or NO**

-What notes are on our Xylophone?

WHISPER TUBE: Stand at one end of the Tube and have a friend or parent stand at the other. Talk and listen to one another. *Is there a delay in when you speak?*

-What is the speed of sound?

BONGOPHONE AND BOOMWHACKERS: Try hitting different colored tubes with the mallet at the Bongophone station. *Which red tube has a higher sound?* **Longer or Shorter**

-Hit the tubes in order from lowest sound to highest sound

-Arrange the Boomwhackers in front of you. Play shortest to tallest, play A-G-F-E-D-C. Now play, from shortest to tallest, C-B-C-G-F-E. Play both sequences together at once.

A-B-C-D-E-F-G-A is called the Key of A Minor, when played with the C Major scale, it creates major chords.

-What sound made up of?

ELECTRICITY AND MAGNETISM

LIGHT IT UP: Press the buttons to make each light bulb light. Looking at the voltmeter, *which light bulb uses the most power? Which uses the least?*

MAGNETIC SCULPTURE: Use the little hex-nuts to build a sculpture. *How many hex-nuts high can you build, counting from bottom to top?*

-As you stack the hex-nuts, does the magnetic force grow **stronger** or **weaker** the higher you go?

CIRCUIT BENCH: Use the metal bars and crank to power up one of the devices or rows of lights. Draw the circuit you created below.

-The word circuit is similar to circle. Why?

-What tiny particle is responsible for electricity flowing?

CRANK POWER: Using the color-coordinated plugs and cranks, supply power to all five devices one at a time. *Can you alone power more than one device or did you need help? Why or why not?*

-What happens when more than one person connects to the same device?

-What kind of energy is converted to Electrical Energy to give the devices power?

MINIMAL SURFACES: Try to make the biggest bubble you can with all three disks. *What is a bubble?*

-Can you make a square bubble? How about a hexagon shaped one? *What happens to the shape when you pop one side of the bubble?*

AIRPLAY: When the air is off, place a ball into a tube. *What happens when you press the white button to turn the air on?*

-Go to the Airplay station with three tubes. Put a ball into each tube. *When you turn the air on, do the balls come out of each tube or from only one?*

-Put three balls into one tube. Cover that tube with your hand as well as one other tube. *What happens to the balls when you turn the air on?*

PARACHUTE LAUNCHER: Launch a parachute and try to catch it was it falls down. *Could you catch it?* YE**S or NO**

-What is a parachute supposed to do?

*-Did your parachute fall **quickly** or **slowly?***

-Place the parachute in the launcher in the following orientations. *Circle the way(s) that work best. Working best means that the parachute opens the quickest and falls the slowest!*

*Parachute first

*Weight first

*Folded in half, parachute and weight first

*Folded in half, parachute mesh first

FLIGHT ZONE PAPER AIRPLANES: Build a paper airplane. Using the launcher, try to get your airplane through one or more of the hoops. *How many points did you earn?*

How far did you plane fly?

-Try angling the launcher differently. *Now how many points did you earn?*

-Go back to the table and add some weight to your airplane. *Test your plane again. How many points did you earn this time?*

*-Does your plane fly farther with a **high** or **low** angle?*

-Repeat all of the above with a new paper airplane using a different design.

*-Which airplane did better, your **first** or your **second**?*

LIGHT AND VISION

COLOR FILTERS: Start by holding the green disk up to your eyes at the Color Filter Exhibit. Look at each picture. *What numbers can you read?*

*-Now try it with the red filter. Was it easier to see with the **red** or **green**?*

-What is in the bottom right picture?

-How does a filter work?

BENHAM DISK: Choose a disk and Velcro it to the spinner. Press the button and watch the center as it spins. *What colors do you see on the black and white disk?*

-Does speed affect what you see? **Yes** or **No**

-Our eyes have cones for which color combination? **red, blue, and yellow** or **red, orange, yellow** or **red, blue, green?**

KALEIDOSCOPES: Step inside the Duck-Under Kaleidoscope. *How many physical mirrors are there?*

-The mirrors are set up in what shape? **Square, Rectangle, Triangle, Octagon**

-The mirrors are set up at what angle? **30^o, 40^o, 90^o, 60^o**

-*What type of angle is this?* **Obtuse, Acute, Right**

-Sit down in front of the **DISGUSTOSCOPE**. Press the button to turn on the light. Look into the small hole while putting **one thumb** into the larger end. *How many of your thumb do you see?*

-*Look into each one of the colored Kaleidoscopes. Draw or describe what you see inside.*

*Blue Scope:

*Green Scope:

*Yellow Scope:

SAND PENDULUM: Start with a clean, sand-free, surface. Fill one of the Pendulums with sand while holding your finger over the hole at the bottom. Angle the Pendulum, still covering the hole, and then release it. *Draw the picture that the sand makes.*

-Fill both Pendulums then try to make them make the same picture. *Could you do it?* **Yes** or **No**.

SUPER BOUNCE: Gently **lift** all of the balls as high as you can and the drop them. *Which ball goes the highest?*

-Now only lift three of the balls. *What changed?*

- Try it again, now only lifting two of the balls. *What changed?*

NEWTON'S CRADLE: Lift the handle on one of the end balls and then release it. *How many balls are pushed up on the opposite side?* **1 2 3 4**

Now lift two balls and release.

- *How many balls are pushed up on the opposite side this time?* **1 2 3 4**

-*What law of motion does this Exhibit demonstrate?*

SIMPLE MACHINES: Pull on each colored rope and try to lift the weights. *Which rope(s) where you able to successfully lift 100lbs?* **Red Yellow Green Blue**.

-*Each rope is attached to a* _____.

How many of these does each rope have?

*Red:
*Yellow:
*Green:

*Blue:

-In order to lift the weights with the rope-system, you end up only needing to apply about 17lbs of force to the rope.

*-How many pounds of force do you need to exert to lift the weights while using the **Blue** rope?* **50lbs 100lbs 25lbs 10lbs**

What about while using the **Green** rope? **50ls 100lbs 25lbs 10lbs**

PENDULUM LAB: For this section of the Activity guide, you will be using the Scientific Method to answer a proposed question. The Scientific Method has six steps: *Purpose, Research (if necessary), Hypothesis, Experiment, Analysis, and Conclusion*.

Purpose: The purpose of this experiment is to determine what variable affects the swing rate of the pendulum.

Hypothesis: Write a hypothesis (good guess) using this outline:

- *I predict that the variable (circle one) **mass, pendulum length, angle of release** will cause the pendulum to swing faster or slower*.

Experiment: Test all three variables (mass, length, and angle) using the various pendulums in the lab.

Analysis: *Did the angle of release (what you tested using the Amplitude pendulum) affect the swing rate?* **Yes** or **No**

-Did the mass at the end of the pendulum (tested at the mass pendulum) affect the swing rate? **Yes** or **No**

- Did the length of the pendulum (tested at pendulum snake) affect the swing rate? **Yes** or **No**

Conclusion: Write a conclusion statement on your own. Be sure to include the **variable** which affected the swing rate and how it affected the swing rate (such as heavier made it slower).

Find the following 3 puzzles and solve them. Time yourself with a clock, watch, or phone and record your times.

-Army of Ants

-Square Deal

-Color Match

CIRCLE PACKING: Arrange all the colored disks within the circle so that they all lay flat. Try drawing the arrangement once you've solved it.

-What is a practical application of circle packing?

STRUCTURAL ENGINEERING

BLUE BLOCKS: Using the pictures on the wall as examples, build a Dwelling, a piece of Furniture, and either the **Playground Pinball** or the **Spinning Wheels** (circle one).

-Engineers use blueprints in order to build bridges, houses, cars, and so one. *Draw a design that you could build with the Blue Blocks and then build it.*

SHAKE TABLE - BUILDINGS: Build a skyscraper like one of the ones in the pictures. *Test your building on the shake tab Does your building shake?* **Yes** or **No**.

- *What shape reinforcements will give your building stiffness?* **Square, Hexagon, Triangle.**

-*What shape reinforcements will give your building flexibility?* **Square, Hexagon, Triangle.**

-*Do we want our buildings to have some flexibility?* **Yes** or **No.** Why or why not?

SHAKE TABLE – BRIDGES: Build a beam bridge and test it with cars, pedestrians, or trains. *What do trusses do?*

- Build an Arch Bridge and test it with cars, pedestrians, or trains. *What presses into the curve of the arch into the supports?*

-Draw a design for your own type of bridge, either using one of the pictures as reference or coming up with one entirely of your own. Build this bridge and test it with cars, pedestrians or trains. *Does it hold up?* **Yes** or **No**.

-*Why or why not?*

CATENARY ARCH: Follow the directions to build and raise your catenary arch. *Does the arch stand?* **Yes** or **No**.

-*If not, describe what went wrong.*

-*What force keeps the pieces of an arch together?*

GIANT ARTCH: With the help of some friends, follow the directions to build the Giant Arch. When finished let go. *How long did your arch stand?*