Physics Workshop Description

Acoustics

- **Agilent Afterschool Thumb Pianos: Kalimba -** In this session, students explore the fundamentals of sound through the vibration of metal and wood. Each student builds their own thumb piano and has the opportunity to discover the concepts of vibration, frequency and pitch. Sheet music is provided near the end of the session to allow the students to begin to master their new musical instruments.
- **Sound Tooter Tubes-** Students will receive the instructions/materials and a model of a musical instrument that they can build. This instrument can be used for a wide range of exploration into the science of sound.
- **Sound Science** - Students participate in a musical acoustics workshop. Students learn about simple harmonics, standing waves, nodes and nulls, wavelength and amplitudes. Subjects covered are the following: sound travels in waves and is produced by vibrating objects; long = low pitch, short = high; pitch; sound intensity increases with amplitude; how to measure frequency.

Hydromechanics

- **Sink or Float** - students will be predicting whether various objects will sink or float, then testing their predictions, and classifying objects into two categories. Of course, students will want to do some additional, less structured explorations as well. Rest assured that what may seem like “just playing” is valuable, direct experience that can yield important lessons.
- **Agilent Afterschool Deep Sea Divers -** The principles of flotation, air pressure and density are introduced in this activity. Students build their divers using balloons, paper clips, and weights and place them in a one-liter bottle for ‘deep sea diving’. The session includes some measurement and data collection and produces great many questions for the students to take away with them.
- **Panama Canal Design Challenge -** We've all heard the term "uphill battle"; less often do we hear "upstream battle". The difference between the two is that when going uphill it is possible to stop and rest without losing your position or rolling back down. When swimming against the current, if you stop your efforts, or even decrease them, you will be swept downstream. A canal lock system is one way engineers have come up with to solve the problem of making a boat float "uphill". The most well known lock system in the world is the Panama Canal. Students will build a canal that has three sets of water-filled chambers (locks), which raise and lower ships from one level to another. The locks were built in pairs to allow ships to pass through in both directions at the same time.
- **Paper Boats -** workshop is devoted to an obscure subject in the history of technology: the manufacture of *full size* boats from paper during the later half of the 19th century. Not toy boats, but boats people could ride around in; racing shells, canoes and rowboats. There was even at least one steam launch built. This may seem like an extremely odd thing to be doing, but it made sense at the time. Students will celebrate the technology and strength of paper as we folded paper into boats.
- **Submarine Design Challenge -** In this workshop students create a remotely controlled submarine that will be used to collect mud and silt samples from the bottoms of lakes and other bodies of water.

Light

- **Bubbles** - What is so fascinating about bubbles? The precise spherical shape, the incredibly fragile nature of the microscopically thin soap film, the beautiful colors that swirl and shimmer, or most likely, a combination of all these phenomena? Why does a bubble form a sphere at

all? Why not a cube, tetrahedron, or other geometrical figure? Students will look at the forces that mold bubbles.

- **Bubble Maker Design Challenge** - We will be helping our students build their own bubble makers! There are lots of things around you which can be used to make bubbles. String formed into a loop, the plastic which holds a six-pack of pop together, cookie sheets, aluminum oven pans, plastic bowls, empty milk containers, buckets, old pieces of hose, garbage can lids, even just your hands held in the right position... well, you get the idea.
- **Lasers, Lenses and Light -** Laser Olympics, mirror and smoke boxes! This workshop studies the properties of light using lenses, prisms, cameras, enlargers, fiber optics and lasers.
- **Agilent Afterschool Lighthouse -** Students will assemble both house and lamp assemblies. With rays of light emerging from the sides of their houses, the children will set up experiments to discover properties of light including reflection, refraction, and conversion of light rays.
- **Agilent Afterschool Periscopes** - Our Agilent Periscope project will introduce students to the basic properties of reflection. They will experiment with mirrors, reflecting geometric shapes and symmetrical words and images. The children will construct their own periscope and have a great time finding ways to apply the tool.
- **Color Science: Pigments -** Students learn that the primary pigment colors are magenta, cyan and yellow.

Mechanics and Engineering

- **Balance** - Balance is the everyday word used to describe a state of equilibrium. Students know when something is in balance, because it doesn't fall over. A physicist would say that a state of equilibrium is reached when the net force acting on a body or system is zero. If there is a strong force pushing one way that is balanced by an equally strong force pushing in the opposite direction, the net force is zero, and a state of equilibrium is achieved. During our workshop, students will discover numerous ways to balance two-dimensional shapes made out of tagboard.
- **Balance: The Pencil Trick and Mobiles** - If a force is applied to a stable or balanced body or system, the net imbalance in force might cause the body to change position. If the system recovers and returns to its starting position, the system is stable. Students grapple with kind of stability in as they balance pencils on their points using counterweighting, and build mobiles that always return to their balanced positions.
- **Twirlers -** Students will make twirlers (flying spinners) that rotate by air resistance, first modifying soda straws with wings, and then making twirly birds from paper and paper clips, and investigate the variables that influenced their spinning.
- **Rolling Spheres** - Students will investigate a rolling-sphere system. Students will design a marble runway so the rolling marble can do tricks and, as a culminating class experience, help to design a marble works through which the marble can roll nonstop. Students will predict and describe the effect of the runway design on the rolling motion of the marble.
- **Gears -** Students will be using toy gears that will help the student visualize how gears turn. In this activity they will:
  - Discover rotational pattern of gears meshed together.
  - Explore relationship between the number of teeth to the number of turns.
  - Learn to think of gears as "round wedges" which will reveal why a large gear wheel spins slowly but produces a lot of power, while a small gear wheel spins quickly but produces little power.

- **Sand and Water Clock Design Challenge -** The hourglass is sometimes referred to as a sand clock or a sandglass. Like other timepieces, it needs to be carefully calibrated. Students will build a sand and water clock, and will test their instruments and fine-tune them to measure the correct length of time.
- **Clocks and Gears -** students will focus on how gears move the hands of a clock. They will assemble their own toy clock.

- **Catapults** - Catapults were one of the light artillery weapons used to throw objects into enemy territory in the Middle Ages. Students will build, test, and then modify the throwing distance of a catapult. The objective is to fling the ping-pong ball the furthest.
    - **Rollercoaster Design Challenge -** Why toys? Kids call it playing. Scientists call it experimenting. Playing = problem solving How do roller coasters work? The Answer - Physics. If you ever thought that physics was boring, think again because without it, we wouldn't have roller coasters. This workshop explores the physics of roller coasters. The science focuses on work, motion, forces, and energy, with an emphasis on gravity, potential energy, and kinetic energy. Activities will include experimenting with roller coasters by varying the height and angle of the rollercoaster track and by adding a jump and a bump.
    - **Tinker Toy and Lego Science** - Sometimes you can figure out whether something is in tension or compression by imagining yourself in that object's place. If you're a brick and someone piles more bricks on you, you'll feel squashed you're in compression. If you're a long steel cable attached to a couple of towers and someone hangs a bridge from you, you'll feel stretched -- you're in tension. Some materials -- like bricks and Legos® -- don't squash easily; they are strong in compression. Others -- like steel cables or rubber bands -- don't break when you stretch them; they are strong under tension. Still others -- like steel bars or wooden toothpicks or Tinkertoys® -- are strong under both compression and tension. Our students will use these concepts while constructing of Lego® and Tinkertoy® bridges and towers.
- **Toys In Space** – Students experiment with the toys, study about microgravity, and predict what the toys would do in space. The astronauts on those flights experimented with the toys and videotaped their results. Students will compare their results to what actually happened in space. This will allow elementary school children to learn some fundamentals about physics and microgravity research.
- **Complex Plans for Simple Projects -** Do you enjoy Rube Goldberg cartoons? Do you like watching gadgets that take a seemingly endless amount of time and steps to do simple tasks like opening a door? Learn about the physics of levers, gears, pulleys and simple machines, and build your own clever machine!
- **Zoom Machine –** Students create a "zoom machine" that will travel a specific distance in the shortest amount of time.
- **Gadget Anatomy -** This lesson will teach our students what simple machines are, how they work, and how they are useful in the household. We will be taking apart complex machines like clocks, toasters, and locks in order to discover the simple machines inside them.
- **Pedal Power Design Challenge -** Students have a wonderful time exploring the momentum, speed, velocity, gear ratios, air pressure (we let them over-pressurize tires until they exploded), bike frame construction (they cut open bike frames to see how they were built), friction, and making gyroscopes from bicycle tires. (3 hour workshop or 3 one hour sessions)
- **Galileo -** Students learn about gravity, momentum, inertia, Newton's laws and forces.\
- **How Things Work: Lawn Mowers and Car Engines -** Have you ever opened the hood of a car and wondered what was going on in there? In this 2 hour workshop students explore the physics of internal combustion by taking apart lawn mower and car engines.
- **What's In The Box?** - Have you ever wondered what it is in a computer that allows you to get all that work done – or in some cases makes you reboot six times in eight hours? Many of you have entertained this question but did not have the time to find out the answers. In this workshop students strip down a computer and look under its hood to learn how this machine works.

Rockets

- **Agilent Afterschool Newton's Rocket Car -** The focus of the student's work in this session is on the careful assembly of a balloon-powered car that provides a practical application of Newton's third law of motion. After they have completed their cars and considered the importance of axles, bearings, and symmetry they will have a lot of fun racing them around the room.
- **Balloon Rocket Design Challenge -** Students learn that air takes up space. Students learn about pressure and about the relationship between temperature, pressure, and volume (Boyle's / Charles' laws). Students learn that air moves (the Bernoulli principal) and that air has weight. Students will create an air-powered rocket that will travel the greatest distance.
- **Bottle Blasters Design Challenge –** Student build a device that will launch a ball to knock over bottles.
- **Water Rockets!** Better wear your swimsuit to this workshop as students design and launch rockets made from 2-liter bottles.

Magnetism and Electricity

- **Magnetism -** Explore what magnets really attract (not every metal!) and investigate magnetic poles. Learn where magnets are used and try out some magnetic magic tricks.
- **Compass Design Challenge:** Students will explore the fundamentals magnetism as they build their own compasses.
- **Static Electricity – Sparks and Shocks -** Some materials create more static electricity than others. Since static electricity is the collection of electrically charged particles on the surface of a material, various materials have a tendency of either giving up electrons and becoming positive (+) in charge or attracting electrons and becoming negative (-) in charge. The Triboelectric Series is a list of materials, showing which have a greater tendency to become positive (+) and which have a greater tendency to become negative (-). The list is a handy tool to determine which combinations of materials create the most static electricity. This workshop will answer your questions and explain how static electricity works. Students will make their own static electricity generator to take home!
- **Enlightening Electrical Circuits -** You'll get a positive charge out of Enlightening Electricity... the electricity workshop! Demystify the shocking possibilities of electricity. Participants will learn electrical basics while building and redesigning circuits with "D" cells, wire, paper clips, and Christmas tree mini-lights. We guarantee this workshop will be enlightening!
- **Fun with Circuits -** The essential parts of a circuit are the conducting path, the electrical load, the power source, and a switch. The conducting path can be made from any material that conducts electricity. A switch can be made using a simple paper clip and small metal tabs. For this workshop, you will be using some unusual parts to create your circuits.
- **Agilent Afterschool Steady Hand Game -** In this workshop, students explore the fundamentals of electricity. They build an electrical circuit that includes an energy source, resistance, a light and a switch. The completed assembly is also a steady hand game that students will have fun playing and demonstrating to family and friends.
- **Agilent Afterschool Matching Game:** Students explore the fundamentals of electricity. They build an electronic circuit that includes an energy source, a resistor, and LED lights. The completed assembly is an electronic game that will enhance our student's knowledge of circuits and electrical flows. Each student has the opportunity to construct their own game, which serves as an electronic checker for matching correct questions and answers. The students create their own sets of Q & A for challenging family and friends.

- **Agilent Afterschool Invisible Forces -** *Invisible Forces* begins with a series of experiments that help students discover the invisible forces of magnetism and electromagnetism. During these experiments, students observe and analyze compasses, magnetic influences on various objects, and the magnetic fields created by electricity. In the second half of the session, students build their own electromagnetic motor, combining the magnetic forces caused by their magnets and the electricity flowing through a coil of wire.
- **Experiments In Electrochemistry:** In 1791 Luigi Galvani discovered electrical activity in the nerves of the frogs that he was dissecting. He thought that electricity was of animal origin and could be found only in living tissues. A few years later, in 1800 Alessandro Volta discovered that electricity could be produced through inorganic means. In fact, by using small sheets of copper and zinc and cloth spacers soaked in an acid solution, he built a battery - the first apparatus capable of producing electricity. Naysayers were quick to predict that electricity would never serve a useful purpose. Obviously they were very wrong. Electricity has a central role in our lives and to this day Electrochemistry is a standard course of study. Students will apply concepts relating to electrochemistry by constructing a fruit-powered battery. This workshop is designed to compliment/reinforce discussion of concepts regarding electricity and chemistry (e.g., ions. electrolytes, voltage, & batteries).