

An abstract graphic featuring three blue circles of varying sizes, each composed of concentric circles in different shades of blue. These circles are connected by thin, light blue lines that form a network-like structure. The circles are positioned in the upper right and lower right areas of the page, with the largest one in the bottom right corner. The lines extend from the top and left edges of the page towards the circles.

A Schmahl Science Workshop
Engineering Workshops Catalogue

- **Air Flight and Kites** Students discover how much force a breeze can produce on the kite they make and how the length of the connector string affects its flight.
- **Air Planes** Since the beginning of time, man has looked to the sky and dreamt of flying. In this workshop, students will build their own model airplane. They will build wings, fins and stabilizers. Creating their own rubber band powered plane, they will consider the effects of ailerons, elevators, and rudders on the movement of the plane through the air.
- **Alternate Energy - Ethanol As A Biofuel** Ethanol offers a valuable energy alternative to fossil fuels, which are both nonrenewable and contribute significantly to atmospheric pollution. Ethanol is often referred to as a 'biofuel' since it can be manufactured by fermenting grains, plant biomass and other organic materials using microorganisms, such as yeast cells. Fermentation is part of the energy producing process called cellular respiration that is shared by essentially all cells. Students learn about yeast fermentation and the factors that affect its rate, and learn some of the basic principles of proper experimental design.
- **Balance: Whirligigs and Thingamajigs** Students learn about balance and motion as they build whirligigs and thingamajigs for recycled materials.
- **Barn Owl Nesting Box Construction** If we set aside wilderness areas, we will help owls. Then laws need to be enforced so owls are not hunted or poisoned. And if we live in cities, nest boxes can be put up that make it possible for some owl species to live in populated areas. We need to remember that owls play an important role in nature, and we need to ensure a promising future for them wherever they live. One way to help owls and at the same time help us to learn more about them is to build owl-nesting boxes.
- **Bicycle Engineering** Students will have a wonderful time exploring gear ratios, air pressure (we let them over-pressurize tires until they explode), bike frame construction (they cut open bike frames to see how they are built), friction, and making bicycle gyroscopes from the tires.
- **Bottle Boat Design Challenge** Let's see if you can turn your water bottle a boat! Students design and investigate which motor to use, which propeller to use, how many batteries to use, how to hook up the power and, most importantly, what kind of design will work well.
- **Building Paper Bridges** Paper folded or rolled into columns and beams can be surprisingly strong. Through exploring the simplest type of paper bridges, children discover that they can make very strong structures with very limited materials. As they continue to take on more and more difficult bridging challenges and learn more about the capabilities of their materials, they gradually uncover a number of simple principles of bridge building.

- **Civil Engineering Superstructures - Arch Bridges** Students apply the principles of force while creating an actual bridge without the use of glue or mortar. Once the keystone is assembled, the arch is actually strong enough for students to stand on.
- **Civil Engineering: Superstructures - Dams and Locks** The monumental contribution of Civil Engineers to society often goes unnoticed. You will learn about structural and building design through hands-on design and explore the many geotechnical, environmental, and infrastructure problems that Civil Engineers must solve. The course provides a historical perspective to solving problems and looks at new innovative solutions being used to design the cities of tomorrow. In design teams, participants will design and build their own super structures.
- **Civil Engineering: Superstructures - Popsicle Bridge Design Challenge** Students build a bridge spanning twelve inches that will hold 50 lbs. The bridge is to be made of only Popsicle sticks and glue.
- **Civil Engineering: Superstructures - Struts and Ties** Students explore what exactly members of a structure do.
- **Civil Engineering: Superstructures - Suspension Bridges** One of the things engineers—specifically structural engineers—are most noted for is designing and building bridges. Bridges influence the development of cities, environments, and culture. They come in all shapes and sizes. One of the sturdiest, longest, and most elegant of these is the suspension bridge. Students learn about suspension bridges: what they look like and how they work. Although suspension bridges look as if they were invented with today's technology, they have been used for hundreds and hundreds of years.
- **Civil Engineering: Superstructures - Truss & Bridges Laboratory** A glimpse into what makes amazing superstructures; this workshop demonstrates the strength of different shapes and their ability to withstand loads. Students take a closer look at different types of bridges and how design constraints can hinder or increase the loading ability of the structure.
- **Earthquake Engineering** How do engineers construct buildings that withstand earthquakes? The students apply the lessons learned in their Strength of Materials workshop in building their structures.
- **Egg-car crash dummies** Students design and build cars that can be used to experience and to explore the science of motion. The low friction wheel and axle combination, one of the six simple machines, can be used with an inclined plane to collect data on the distances traveled by the car. Use different materials to cover the inclined plane or vary the weight in the cars to serve as variables for the experiments.

- **Egg Drop Design Challenge** The contest challenges students to design devices that will protect a raw egg from a two-story drop.
- **FOSS: Solar Water Heaters** In this environmental workshop, students build model houses to focus on solar power. They determine how windows can affect heat, and conduct controlled experiments.
- **Gliders** Children construct simple airplanes from paper that are remarkably elegant fliers. After testing their own designs for tails, bodies and wings they construct a rubber band launcher which allows them to gain a more consistent way of evaluating all of these variables.
- **Hovercrafts** "Race Across the Hallway" Hovercraft Challenge. The Hovercraft Design Challenge is a construction project that demonstrates lift. Students construct a hovercraft from a foam tray, propeller, motor, 9V battery snap, wire, straw, mini slide switch, craft sticks and clips.
- **How Things Work: Lawn Mower Engines 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.
- **Inventions and Patents** Use everyday objects to create a solution to a problem faced by engineers. Learn what is required for filing patents for inventions.
- **Lego Robotics** This is a 2-1/2 hour hands-on workshop where teams of two kids will build a robot from LEGO parts and program the robot to perform "challenge" tasks. Each team will have a LEGO Mindstorms kit and a computer for programming the robot using a graphical programming language called RCX code.
- **Leonardo da Vinci's Bridge** Sometime around 1485-1487, Leonardo da Vinci devised a method for building a self-supporting arched bridge that doesn't require any ropes or other fasteners. The bridge's own weight keeps it together; the more you stack on it, the more stable it gets. It was originally meant to be a quick bridge for military usage - just bring along the pre-cut pieces and slot them together. Students build an arch bridge that stands by itself without any fasteners or complicated joinery!
- **Mechanical Design Series** Leonardo da Vinci's artwork is famous, but his engineering sketches place him in history as the first to think up many of today's inventions including the helicopter. This 6 week course will cover all the fundamentals of drafting basics, so students are able to communicate their ideas and inventions to make them a reality. The course begins with pencil and paper drafting basics. Then students will take their knowledge to the next level and begin to use computer software to draft in 3D. These ideas will take shape when the students transfer their inventions to a computer-

aided machine, where the students will watch as their images are transferred to code, code is transferred to machine, and their part takes shape. The last day of the course the students will take a tour of an industrial lab, so they are able to see how the technology of ideas takes shape in the real world.

- **Monster Car Rally Design Challenge** Students are challenged to build a super soaker using pesticide spray guns and syringes.
- **Motor Cars** Students build a battery-powered car by constructing a u-shape body. They then install the mechanism and race it down the hall!
- **Motor -Propeller Cars** Students build a unique vehicle that is part plane, part car - although it moves on wheels, it is battery-powered and mobilized by a plane propeller.
- **Panama Canal and Pumps** 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 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.
- **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 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** This 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 celebrate the technology and strength of paper as we folded paper into boats.

- 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. (6-hour workshop or 3- two day workshops)
- Rubberband Cars**

Designing and constructing a car out of cardboard, dowels, balsa wood, and rubber bands can be quite challenging for children. Using only these limited materials, not only do they build their own cars, but they also learn in a direct way the engineering concept of optimization by testing different sized rubber bands and different diameter plates as wheels
- Sand and Water Clocks**

The hourglass is sometimes referred to as a sand clock or a sandglass. Like other timepieces, it needs to be carefully calibrated. Students build a sand and water clock, and will test their instruments and fine-tune them to measure the correct length of time.
- Simple Machines: Build a Clock**

Students assemble their own toy clock.
- Simple Machines: Clock Gadget Anatomy**

Wind-up alarm clocks have been around a long time, but they are still fun to explore. Students will be taking apart clocks to learn what makes them tick.
- Simple Machines: Gadget Anatomy**

This lesson teaches 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.
- Simple Machines: Gears**

Students use toy gears that will help the student visualize how gears turn. In this activity students: 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.
- Simple Machines: Gears and Clocks**

How can you lift a 200 pound object with only 50 pound of force? How do elevators move? These are just some of the questions explored in this hand-on workshop. Through experimentation, discover the answers, and how work is made simpler by using levers, inclined planes, screws, pulleys, wheels and wedges.
- Simple Machines: Gears and Levers**

Give me a lever long enough and a place to stand, and I will move the world." -Archimedes, 230 BC. Students will learn how gears and levers make work easier,

- **Simple Machines: Levers, Pulleys, Wheels and Tinker Toys** Students investigate simple machines and their usefulness in everyday life. Three simple machines are covered: the lever, the pulley, and the inclined plane. The wheel, the wedge, and the screw are derived applications of the basic machines.
- **Simple Machines: Mouse Trap Game** It may not be the most efficient way to catch a mouse, but it sure is a fun way to learn about simple machines. Milton Bradley's classic board game, Mouse Trap, is a wacky contraption of levers, cranks, and inclined planes. Students enjoy building this Rube Goldberg inspired mousetrap that is ridiculously complex and fun to play.
- **Simple Machines: Tinker Toy Buildings** 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 use these concepts while constructing of Lego® and Tinkertoy® bridges and towers.
- **Simple Machines: 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 compare their results to what actually happened in space. This will allow elementary school children to learn some fundamentals about physics and microgravity research.
- **Simple Machines: Trebuchets** Trebuchets 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 Trebuchet. The objective is to fling a marshmallow the farthest.
- **Simple Machines: Wheels and Axles/Newton Cars** 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.
- **Solar Cars** Students are given the basic components and have to design a solar-powered car.
- **Solar Cooker** Students construct two models of solar cookers that will cook a hot dog or Smores: a parabolic solar collector and a pizza box solar cooker.

- **Solar Houses**

In this environmental workshop, students build hot-water heaters to focus on solar power. They determine how windows can affect heat, and conduct controlled experiments.
- **Spinner Cars**

Students investigate the amount of potential energy given the rubber band vs. the distance traveled by the spinner car. After collecting data and graphing the results, students are challenged to make their spinner car travel a certain given distance.
- **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.
- **Super Slinger Design Challenge**

Students create a device that will launch a ball at a target.
- **Super Soakers Design Challenge**

Students are challenged to build a super soaker using pesticide spray guns and syringes.
- **Testing A Windmill Generator**

Roll up your sleeves and get busy, because the *Garage Workshop* is a place where you can build things and take things apart, see how machinery and engines run, and learn how to fix them when they don't. It's only real machines, tools, materials and safety here. In this Workshop, tinkering is the rule. You are not only allowed, but also encouraged to take apart household appliances like stereos and computers to see how they work.
- **Under The Hood - Welcome To The World Of Car Maintenance**

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- **What's in the Box? Computer Hardware**

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.