Civil Engineering Teaching Materials for Grades 6-8

Activity Title	Activity Description	Area	Торіс	Grade	Source	Required Time	Special Materials
	Learn about water pressure and						
Under Pressure	how the pressure at the top of a dam compares to the pressure at the bottom of it.	Hydraulic, Hydrology & Water Resources	Water Pressure	5-8	<u>Building Big</u>	30 min.	Acrylic caulk
Engineer a Dam	Build a dam in a trough that completely holds back the water and also find a way of executing a controlled release.	Hydraulic, Hydrology & Water Resources	Dams	5-8	<u>Try</u> Engineering	45 min.	
Flood!	Construct a model of a river system with levees.	Hydraulic, Hydrology & Water Resources	Dams - Levees	6-8	<u>NOVA</u>	45 min.	Large container, Modeling clay
River & Environment	Learn how water flow changes environemnt and vice versa.	Hydraulic, Hydrology & Water Resources	Water flow	6-8	See below (The River Model)	n/a	The river model should be built in advance.
Hydropower!	Build a water turbine and explore dams and hydroelectric power.	Hydraulic, Hydrology & Water Resources	Hydroelectric power	7-8	<u>ASCEville</u>	45 min.	
Underwater Dream Machine	Build your own submarine and make it neutrally buoyant in a diving tank	Hydraulic, Hydrology & Water Resources	Buoyancy	6-8	<u>NOVA</u>	n/a	Dishwashing liquid
How Green is My Roof?	Design and build a section of a green roof for a house.	Environmental	Green building	5-8	<u>Salvadori</u> <u>Center</u>	Two 45-min. sessions, a couple months apart	Plants, Soil
Landfill in a Box	Create a landfill system and investigate how it works over the course of a year.	Environmental	Landfills	5-8	<u>ASCEville</u>	several sessions, over a year	Soil, Sand, Gravel, Wooden block, Non- fusible interfacing fabric, Fish tank tubing
Don't Runoff!	Redesign a city and control stormwater runoff.	Environmental	Stormwater runoff	6-8	<u>EiE</u>	n/a	
Iron Glove Experiment	Understand the concepts of effective stress by observing how a rubber glove full of sand becomes rock-hard when subjected to vacuum pressure	Geotechnical	Effective Stress in Soils	6-8	See below (Soil Magic I)	n/a	Soil, Sand, Gravel
Which Sand Pile Falls Sooner?	Learn about rock bolting and soil reinforcement mechanisms.	Geotechnical	Reinforced soil effectiveness	6-8	See below (Soil Magic II)	n/a	Soil, Sand, Gravel
Magic Powder	Learn about viscousity of soils by playing with a water-corn starch mixture.	Geotechnical	Dilatancy Principle	6-8	See below (Soil Magic III)	n/a	
Shallow & Deep Foundations	Learn differences between shallow and deep foundations by testing a cardboard box test bed composed of layers of pebbles, soil and sand.	Geotechnical	Foundations	6-8	<u>Teach</u> Engineering	50 min.	Soil, Sand, Gravel
Car of the Future	How to decrease the carbon footprint of your city's public transportation system through the use of various new technologies and/or alternative fuels?	Transportation	Traffic Emissions	6-8	<u>NOVA</u>	Four class periods	
Daredevils of the Sky	Experiment with the size, shape, angle of the wings, rudder position and weight of a paper airplane	Transportation	Airplanes	6-8	<u>NOVA</u>	n/a	
Asphalt	Learn about time-sensetive loading properties of asphalt cement.	Transportation	Pavement	6-8	See below	n/a	Asphalt cement
Beam Bridge	Build a beam bridge using a flat eraser or a small sponge, and see what happens when a load pushes down on a beam bridge.	Structural & Construction	Bridges	5-8	NOVA	30 min.	
Popsicle Bridge	Design and build your own bridge out of up to 200 popsicle sticks and glue.	Structural & Construction	Bridges	5-8	<u>Try</u> Engineering	3 45-min. sessions	
Paper Bridge	Build a bridge that holds 100 pennies, using 1 sheet of paper and up to 5 paper clips.	Structural & Construction	Bridges	5-8	Building Big	30 min	
Spaghetti Bridge	Make a truss bridge out of spaghetti.	Structural & Construction	Bridges, Truss	6-8	<u>Teach</u> Engineering	2 hours	
Straw Bridge	Create truss beam bridges using straws.	Structural & Construction	Bridges, Truss	6-8	<u>Teach</u> Engineering	50 min.	
Suspension Bridge	Make a model suspension bridge using straws.	Structural & Construction	Bridges	5-8	Building Big	30 min	
Tension and Suspense!	Build a suspension bridge with chairs, cardboard, and string.	Structural & Construction	Bridges	7-8	<u>ASCEville</u>	45 min.	

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Newspaper Tower	What's the tallest tower you can build using only two sheets of newspaper? You can bend, fold, or tear the paper, but no tape, no staples, no glue!	Structural & Construction	Towers	5-8	<u>Building Big</u>	45 min.	
Tall Tower Challenge	Engineer the tallest tower you can build that can support the weight of a golf ball for 2 minutes, using just straws, pipe cleaners, and paperclips.	Structural & Construction	Towers	5-8	<u>Try</u> Engineering	1 hour	
Tower Investigation and the Egg	Design and build 3 types of towers that can hold an egg one foot high for 15 seconds.	Structural & Construction	Towers	6-8	<u>Teach</u> Engineering	1 hour	
K'NEX Tower and Skyscrapers	Build bridges and skyscrapers using K'NEX kits.	Structural & Construction	Towers	6-8	<u>K'NEX kits</u>	n/a	
Geodesic Domes	Build the strongest dome you can out of newspaper.	Structural & Construction	Domes	5-8	Building Big	45 min.	
Build a Big One!	Build a large scale geodesic dome.	Structural & Construction	Domes	5-8	Building Big	60-90 min.	
A Great Lodge!	Build two roofs, one with a truss and one without, and compare their strength.	Structural & Construction	Trusses, Roof	6-8	<u>PBS/Great</u> Lodges	1 hour	
Speedy Shelter	Invent an emergency shelter that can fit a person and is sturdy and quick to build.	Structural & Construction	General Construction	5-8	<u>Design</u> Squad	45 min.	
Paper Table	Build a table out of newspaper tubes that can hold a heavy book.	Structural & Construction	General Construction	5-8	<u>Design</u> Squad	45 min.	
Kinetic Sculpture	Make a sculpture at least 6 in. tall with parts that move in the wind, and is yet sturdy enough to stand up in the wind.	Structural & Construction	General Construction	5-8	<u>Design</u> Squad	45 min.	An electric fan
Mobile Forces	Learn about gravity, convection air currents, and balancing forces by creating your own mobiles	Structural & Construction	General Construction	6-8	<u>Teach</u> Engineering	1 hour	

Activity Descriptions:

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The River Model	Construct a river model as a 20 in. wide by 48 in. long by 4 in. deep Plexiglass box filled with sand. The boxes are filled with a mixture of fine, medium, and coarse sand to allow the creation of three dimensional river systems. The flow through the model is accomplished by using a small submersible pump in a lower reservoir. For convenience and economics, the reservoir is simply a 20-gallon plastic storage container. Water is inserted into the upper portion of the modeling box through a small hose behind a diffuser. The diffuser slows the velocity of the water to resist excessive erosion at the point of entry. The box is set at a slight angle to facilitate flow through the river system. The water returns to the reservoir after leaving the model through a square notch in the end of the box. The water then recirculates through the system. The water needs to be occasionally exchanged because the unfiltered water becomes quite "muddy." Students are asked to verbalize what they see and how water flowing through the system is changing the environment. The system allowed students to visualize various river processes including sediment transport, bank and bed erosion, river evolution, flooding, etc. The use of non-uniform sand allowed students to visualize the transport of different sediment bizes as would be encountered in nature. Depending on the velocity of the water, students could see smaller grains of sediment being transported, with larger grains settling onto the bottom. Additionally, students have the opportunity to change their environment by adding scale features to the model such as boulders (using sponge anchored with toothpicks). The river model can easily be changed to incorporate these features and see how the river adapted to the changes. Finally, after students are given opportunities to alter the system, they are asked to construct a new river system and predict how it would react when water was added. <i>Challenges:</i> Patience - The students frequently wait long enough for the system to adapt to chan	Original Source
	Students are initially asked to build simple structural shapes such as squares and triangles with K'NEX kits and to investigate what happens when they are "loaded." They then individually construct a simple pier bridge. By performing these experiments, they will be introduced to common terminology such loading, tension, compression, span, support, joint, connection, abutment, footing, etc. Once the students have background knowledge in the subject matter, they are split into teams and presented an engineering challenge with several restraints. The students then work as a team to	

complete their project using the materials contained in a single K'NEX kit. The challenge may involve a bridge or a skyscraper. The K'NEX kits include blueprints for constructing various types of bridges and the students are allowed to use these blueprints to simplify the construction process.

K'NEX kits	K'NEX kits In the case of a bridge, the students are told to span a distance (14 in.) using a bridge design of their choice. Two p may be awarded: one for the most aesthetically pleasing/interesting bridge and another one for the strongest brid strongest bridge will be judged by determining the number of science textbooks it can hold during a load test befor collapsing (given lateral foundation support). A more interesting contest would have been a bridge weight to load ratio, but the students are usually more interested to see the ultimate load and failure. The strongest bridge will be variation of an elevated train truss structure and supported more than 20 textbooks before collapsing. The student usually enjoy the catastrophic failure of their creations.			
	In the case of the skyscraper, students are given a rectangle of construction paper that represent a "city block" and that would be the maximum foundation footprint size for their building (i.e. in the final design, the K'NEX pieces at "ground level" must be contained by the border of the construction paper). Similar to the bridge assignment, students are presented with two challenges with prizes awarded: an award for the tallest constructed building that can withstand a hurricane load (box fan) without toppling, and an award for the most volumetric office space given the foundation size and specified amount of materials.			
Soil Magic I: Iron Glove Experiment	Students are challenged to understand the concepts of effective stress by observing how a rubber glove full of sand becomes rock-hard when subjected to vacuum pressure (iron glove experiment). The concept of effective stress in soils may be revisited using a demonstration of a bag of potato chips under loaded conditions (with pin holes introduced to the bag over time).	Original Source		
Soil Magic II: Which Sand Pile Falls Sooner?	Rock bolting is demonstrated using a bucket of gravel that remained in place after tipping the bucket upside down. This behavior is achieved through the action of applied compressive forces through the rock mass with bolts. The effectiveness of reinforced soil is demonstrated by hiding paper discs within one pile of sand next to a "control" pile of sand, and the students will see that the reinforced sand pile (which appeared identical to the control pile) is able to hold substantially more weight before failing. The soil reinforcement demonstration is quite rapid because it has to be entirely set up ahead of time to maintain the element of surprise.	<u>Original Source</u>		
	Students make a water-corn starch mixture (termed "ooblech" by Elton) that maintains form as a ball as long as they keep moving it from hand to hand. However, if the action stops, the substance becomes viscous and runs down their hands and arms.	Original Source		