Energy, Machine and Motion Storyline

Part One Energy

Lesson One Circuit of Inquires-A Pre-assessment	Lesson Two Making a Battery	Lesson Three Rechargeable Batteries	Lesson Four Storing and Using Energy in a Battery	Lesson Five Introduction to Forces
Focus Question: What do you know about energy and forces? Students perform eight exploratory activities.	*Focus Question: How do you make a battery? How do you know if a battery works?* Students build a zinc-copper battery.	*Focus Question: What evidence do we have that energy is stored in a battery? How can we change the amount of energy stored in a battery?* Students recharge a battery and learn about stored energy. They observe that the energy of a battery can be converted into different forms.	*Focus Question: How does the charging time affect the stored energy in a rechargeable battery?* Students recharge batteries for different amounts of time and use them to light a flashlight.	*Focus Question: What is a force? How are mass and weight (force of gravity) related?* Students determine that elastic force depends on the amount a stretch in a rubber band and that weight of an object depends on its mass. Students learn to calibrate a measuring tool, spring scale.
Lesson Six The Force of Friction	**Lesson Seven The Force Exerted by a Motor**	**Lesson Eight Work and the Motor**	**Lesson Nine Power of a Motor**	**Lesson Ten Assessing What You Know**
Focus Question: What are the factors that affect the force of friction? Students investigate how sliding friction on a wooden block depends of the weight of an object as well as the kinds of surface the block slides across. They also investigate the relationship of the sliding force to the surface area of the block.	*Focus Question: What are the operating conditions that produce the maximum force from a motor?* Students design an experiment to determine which combination of variables will produce the maximum force from a small electric motor.	*Focus Question: What is the relationship between forces applied and the work that is done?* Students are introduced to the scientific meaning of work. Students build a sled and try to lift it with the optimum conditions of the motor.	*Focus Question: How do scientists describe the term power?* Students learn how to calculate the power of a small electric motor. They then determine the relationship between the number of batteries connected in series and the power of the motor.	*Focus Question: What energy changes allow a falling body to light a bulb?* Students use equipment from previous lessons to investigate energy changes. They analyze a set of data and draw conclusions based on their data.

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Part Two: Machines

Lesson Eleven The Inclined Plane	Lesson Twelve The Pulley	Lesson Thirteen The Lever
Focus Question: What is a machine? Why is an inclined plane a machine? Students turn a K'NEX™ sled into a cart by adding wheels to it to observe how the friction is reduced. They pull the cart up an incline and measure the force needed to pull it at a steady rate. Students design a procedure to determine how the angle of the include affects the force need to pull the cart up the incline. Students construct a definition of the term "machine".	*Focus Question: How do pulleys work? Why are pulley's machines?* Students construct a pulley assembly system to lift a K'NEX™ sled a given distance. Students then configure different pulley combinations to measure effort force and efferent distance needed to lift a load a determined distance. Students refine their working definition of the term "machine".	*Focus Question: How do levers work? Why are levers machines?* Students explore how to position weights to balance a given load on a lever. Students use data tables to look for patterns to determine a "rule" to balance a load. Students then use their K'NEX™ sled to decide if the lever functions as a machine.
Lesson Fourteen **The Mechanical Advantage of Machines**	**Lesson Fifteen** **The Efficiency of Machines**	**Lesson Sixteen** **Machines Assessment** **A Technological Design Challenge**
Focus Question: What is the difference between ideal and actual mechanical advantage? How are the ideal and the actual mechanical advantage calculated? Students use data from the three previous lessons to calculate and compare the mechanical advantages of the machines they have used.	*Focus Question: what is machine efficiency? How is machine efficiency calculated?* Students use data fro three previous lessons to calculate and compare the efficiencies of the machines they have used.	*Focus Question: How can simple machines concepts forces, work and mechanical advantage) be used to enable a small motor to lift a load?* Students use what they have learned about machines to design a system that will enable a small motor to lift a K'NEX™. They work in teams to design a motor-machine combination to lift the sled a determined distance.

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Part Three: Motion

Lesson Seventeen **Introduction to the Anchor Activity** *Focus Question: How are machines and energy transformations utilized in everyday devices?* Students select or build a device they use in their everyday life and investigate how it works: identifying the forces that make the device work and the energy changes that take place when it is used. They research its design and find out when it was invented and how it meets human needs.	**Lesson Eighteen** **Motion of a Fan Car** *Focus Question: What is motion? What causes motion? What is speed and how is it calculated?* Students build a K'NEX™ fan car. They investigate how unbalanced forces affect the motion and speed of the car. Students learn to calculate speed using distance and time calculations. Students observe differences in the car with the motor turned on and when it is turned off.	**Lesson Nineteen** **Motion of a Mousetrap Car** *Focus Question: How does the size of the force affect the motion of an object? How does the duration of the force affect the motion of an object?* Students measure and observe the motion of a K'NEX™ mousetrap car. They look for the energy transformations forces acting on the vehicle. Students determine the speed of the vehicle at different points as it moves along a track.
Lesson Twenty **The Roller Coaster** *Focus Question: What is the difference between ideal and actual mechanical advantage? How are the ideal and the actual mechanical advantage calculated?* Students work together to construct a 3 meter long roller coaster using K'NEX™ pieces. Students will use the roller coaster to study the effect gravity has on the motion of a roller coaster car.	**Lesson Twenty One** **Motion on a Roller Coaster** *Focus Question: what is machine efficiency? How is machine efficiency calculated?* Students investigate the changing speed of a roller coaster car as it travels along the track. They learn about gravitational and potential energy and how it changes to kinetic energy.	**Lesson Twenty Two** **The Anchor Activity** *Focus Question: How can simple machines concepts forces, work and mechanical advantage) be used to enable a small motor to lift a load?* Students present their Anchor Activity investigations.