Lesson Sequence for *Energy, Machines, and Motion*

Preassessment
Students have ideas, preconceptions, and misconceptions about energy and forces.

Part 1: Energy

- A wet-cell battery is made using two different metals and a liquid electrolyte.
- Batteries produce electrical energy.
- Batteries contain a limited amount of energy.
- Charging a storage battery puts energy back into it.
- The energy stored in a battery can be converted into different forms, such as light, heat, and mechanical energy. Energy is conserved.
- The amount of energy stored in a rechargeable battery depends on the time the battery is charged.
- Forces are pushes or pulls on objects.
- There are different kinds of forces, and each has unique properties.
- Elastic forces are proportional to the stretch of the elastic material producing the force.
- The weight of an object is proportional to the mass of the object.
- The magnitude of sliding frictional force depends on the nature of the surface that it slides across.
- The magnitude of sliding frictional force is proportional to the weight of the object moving across a horizontal surface.
- When an applied force counterbalances frictional forces on it, an object moves at a constant speed.
- A motor exerts its maximum force under specific operating conditions.
- Work is the product of force and distance.
- A motor does work when lifting a load.
- Power is the rate of doing work.
- The power of a motor is proportional to the number of batteries connected to it in series.
- Falling bodies release potential energy and can provide the energy to light a bulb.

Part 2: Machines

- Machines make doing work easier by reducing the effort force needed to do a given amount of work.
- The force to move an object up an incline is proportional to the angle of the incline.
- Inclined planes are machines.
- The effort force to lift a load using a pulley system depends on the number of pulleys and how they are connected to the load.
- Pulley systems are machines.
- Levers balance when the product of a weight and its distance from the fulcrum on one arm are equal to the product of another weight and its distance from the fulcrum on the other arm.
- A lever is a machine.
- Mechanical advantage describes how much machines multiply effort force.
- Actual mechanical advantage is less than ideal mechanical advantage because of friction.
- Efficiency is the ratio of work output to work input.
- Technological design is a process to create solutions to meet human needs.

Part 3: Motion

- Scientific researchers use a variety of resources to gather and document information.
- Unbalanced forces change the motion of objects.
- Average speed is distance traveled divided by time of travel.
- A constant unbalanced force can make an object steadily increase its speed.
- Friction can act against the motion of an object and decrease its speed.
- Changes in motion are a result of the combined action of applied forces and friction.
- Energy can be stored in a compressed spring.
- Kinetic energy is energy of motion.
- Energy stored in a spring can become kinetic energy.
- Friction works to reduce the kinetic energy of moving objects.
- Gravitational potential energy is energy associated with the position of an object.
- Gravitational potential energy and kinetic energy can interchange forms as an object changes its height. Energy is conserved.
- Technological designs apply physical science principles.

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