PENNY PUSH

BENCHMARKS and TASKS

SC.B.1.2.1 The student knows how to trace the flow of energy in a system (e.g., as in an ecosystem).
SC.B.1.2.4 The student knows the many ways in which energy can be transformed from one type to another.
SC.C.2.2.2 The student knows that an object may move in a straight line at a constant speed, speed up, slow down, or change direction dependent on net force acting on the object.
SC.C.2.2.4 The student knows that the motion of an object is determined by the overall effect of all of the forces acting on the object

- The student identifies force as any push or pull (e.g., gravity, electricity and magnetism) that causes objects to change their state of motion. The greater the force is, the greater the change in motion.
- The student describes the motion of an object by its position, direction, and speed.
- The student traces the flow of energy as it is converted from one form to another (e.g., potential to kinetic) through a system.

KEY QUESTION

How is energy transformed from one type to another?

BACKGROUND INFORMATION

An object is in its equilibrium position when it is sitting still (no outside force is acting on it) and gravity holds it in place. The object has **potential energy** (stored energy). If two objects collide, momentum is transferred between them. When one moving object strikes a stationary object, the first moving object transfers some of its forward motion of **energy,** or momentum, to the stationary object, which is set in motion. The momentum can pass from one object to another and even to a third object. The moving object has **kinetic energy** (energy of motion).

MATERIALS

Teacher

Dominos

Per pair of students

10 pennies
1 quarter
1 dime
1 nickel
variety of coins

ENGAGE

1. Create a straight-line path of standing dominos. Make sure each domino is no more that 1½ inches from the next domino.
2. Ask students to predict what will happen when you push the domino at one end of the path.

EXPLORE

Student Directions:

1. Arrange nine pennies in a row on a desk. Make sure each penny is touching the one next to it.

2. Place another (tenth) penny about 12 cm from one end of the row. Give that penny a quick push so that it slides into the ninth penny in the row. What happened?
3. Rearrange the pennies. Try pushing the tenth penny harder. What happened?
4. Rearrange the pennies. Now push the tenth penny more gently. What happened?
5. Place eight pennies in a row so that each penny is touching the one next to it.
6. Place the remaining two pennies about 12 cm from the back end of the row.
7. Give the two pennies a quick push so that they both slide into the back end of the row. What happened?
8. Use a quarter as the knocking coin. What happened?
9. Use a dime as the knocking coin. What happened?

EXPLAIN

Force is any push or pull that causes objects to change their state of motion. What force caused the pennies to move? (The force was generated by the tenth penny pushing the ninth penny, the ninth pushing the eighth, and so on. Finally, when the pushing force was passed on to the penny at the far end of the row, that penny moved away from the others. The force of the knocker transferred all of its momentum to the row of pennies, setting them in motion. Momentum is the forward motion of energy.)

What happened when you pushed the tenth penny into the other pennies harder? (The penny on the far end moved away from the group.)

What happened when you pushed the tenth penny into the other pennies more gently? (The penny on the far end still moved, but not as far.)

What happened when two pennies were pushed into the other pennies? (Two pennies from the far end moved away from the group.)

What happened when a quarter was used as the knocking coin? (At least three pennies on the far end moved away from the group.)

What happened when a dime was used as the knocking coin? (One penny from the far end moved away from the group.)

What happened when a nickel was used as the knocking coin? (Two or three pennies on the far end moved away from the group.)

Was the force of the knocker a push or a pull? (a push)

Was the push of the knocker the only force acting on the pennies? (No, more than one force can, and usually does, act on an object at the same time.)

When did an energy transformation occur? (The pennies had potential energy while they were at rest. If two objects collide, momentum is transferred between them. When one moving object strikes a stationary object, the first moving object transfers some of its energy, or momentum, to the stationary object, which is then set in motion. That moving object has kinetic energy. Potential energy was converted to kinetic energy when the knocker hit the pennies and they began to move.)

EXTEND/APPLY

Encourage students to design another experiment, using different sizes of coins in a row and a different size coin as a knocker.

EXTENSION

Try the same investigation on different surfaces.