Where Energy Goes

Trace energy through motion and fields

PS.PS3.2 "Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as either motions of particles or energy stored in fields."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline places where energy is accounted for by particle motion, circle places where it is stored in a field, and number the changes in the order they occur. Use your marks to help build an energy model.

A Cart That Turns Around

1. A cart rolls down a smooth track from a high platform toward a flat section. At the start, the cart and Earth form an interacting system. Their gravitational field stores energy because the cart is elevated. As the cart descends, that stored energy decreases. The cart gains speed: its particles move together along the track, so more energy is accounted for by particle motion. A model can show this with labels for the cart and Earth, an arrow for the cart's motion, and an arrow from energy stored in the gravitational field to energy of particle motion.

2. On the flat section, the cart approaches a fixed magnet with the same pole facing a magnet on the cart. The magnets repel without touching. As the cart moves closer, it slows; some energy associated with its moving particles is stored in the magnetic field of the two-magnet system. At the closest point, the cart pauses and then rolls backward. As the magnets separate, stored field energy decreases while the cart's particles gain motion in the opposite direction. The magnets do not create energy; the model tracks energy as it shifts between motion and field storage.

3. A real track is not perfectly smooth. Even while the cart's overall motion slows, the wheels and track become slightly warmer where they rub. Their particles move more randomly, which accounts for some of the energy as thermal motion. Air near the cart can warm for the same reason. A useful energy model sets a boundary around the cart, Earth, magnets, track, and nearby air. It labels energy stored in gravitational and magnetic fields and energy in the ordered or random motion of particles. Arrows show transfers, not energy appearing from nowhere.

2 ANSWER WITH EVIDENCE

Use the passage

1. Describe a two-stage energy model for the cart at the high platform and at the bottom of the slope. Label the interacting system and the direction of energy transfer.

2. As the cart approaches the fixed magnet, what changes would you show in a model of its particle motion and the two-magnet field? State the direction of the energy-transfer arrow.

3. Model the cart just after it reverses. Which energy store decreases, which form increases, and which way do the cart's particles move together?

4. Add the wheels and track to an energy model. When they rub, where does some energy go, and how is that particle motion different from the cart's rolling motion?

3 YOUR TURN

Your own words

Choose a moving object other than a cart on a ramp. In three panels, model its energy at three moments: label the interacting objects, show particle motion and energy stored in a field, and use arrows to show energy shifts. Add one sentence explaining a change, and ignore air resistance.

Where Energy Goes

PART 1 · READ AND MARK

Underline places where energy is accounted for by particle motion, circle places where it is stored in a field, and number the changes in the order they occur. Use your marks to help build an energy model. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Describe a two-stage energy model for the cart at the high platform and at the bottom of the slope. Label the interacting system and the direction of energy transfer.	**The cart-Earth system has more energy stored in its gravitational field at the high platform. As the cart descends, an arrow points from field energy toward energy in the cart particles' motion.**
2	As the cart approaches the fixed magnet, what changes would you show in a model of its particle motion and the two-magnet field? State the direction of the energy-transfer arrow.	**The cart particles' shared motion slows while energy stored in the two-magnet magnetic field increases. The arrow points from particle motion energy to field energy.**
3	Model the cart just after it reverses. Which energy store decreases, which form increases, and which way do the cart's particles move together?	**Energy stored in the magnetic field decreases, and energy in particle motion increases. The cart's particles move together backward, away from the fixed magnet.**
4	Add the wheels and track to an energy model. When they rub, where does some energy go, and how is that particle motion different from the cart's rolling motion?	**Some energy is accounted for by warmer wheels and track, whose particles move more randomly. In the rolling cart, its particles move together along the track.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Panel 1: A tossed ball rises. Its particles move upward together; an arrow points from particle motion energy to energy stored in the gravitational field of the ball-Earth system. Panel 2: At the top, the ball pauses briefly, and more energy is stored in the gravitational field. Panel 3: The ball falls; an arrow points from field energy to particle motion energy, and its particles move downward together. Sentence: As the ball falls, stored field energy decreases while its speed increases.

Accept models with words, arrows, or both when they identify the interacting system and show the correct energy shifts. For Your Turn, accept a different moving object and field if all three moments form a physically consistent sequence.