Where Energy Goes

Model a swing's changing energy.

PH.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 where energy is stored in a field, circle both kinds of particle motion, and write 1 beside the downward energy change and 2 beside the slowing energy change.

A Swing in Motion

1. At the top of a playground swing's arc, a rider briefly stops before moving down. The rider and Earth form a system. Because the rider is higher than at the bottom, the system has energy stored in its gravitational field. Starting higher increases that stored energy. A useful energy model labels the system and its forms of energy, then uses arrows to track changes. It does not need to show every particle in the rider.

2. On the way down, the rider loses height and gains speed. The energy stored in the gravitational field decreases. Meanwhile, the rider's particles move together as the rider swings, so energy can be accounted for as shared particle motion. Near the bottom, the rider moves fastest. This does not mean that particles suddenly appear or that gravity creates energy from nothing. A model connects a decrease in one form of energy with an increase in another.

3. Air pushes against the moving rider, and parts of the swing rub at the joints. These interactions slow the swing and transfer some energy into random motion of particles in the air and swing parts. That random motion can warm them slightly. After several trips, the rider reaches a lower height than at the start. A complete model tracks field energy, shared particle motion, and random particle motion in the surroundings instead of treating slowing as lost energy.

2 ANSWER WITH EVIDENCE

Use the passage

1. At the top of the arc, what system and energy form would you label in a model?

2. As the rider descends, draw or describe an arrow between two energy forms. Which form decreases, and which increases?

3. Add an arrow to show where some energy goes as the swing slows. What particles does your model label?

4. If the rider starts higher, what change would you make to the model at the top? Explain using the passage.

3 YOUR TURN

Your own words

Draw a three-panel energy model for a bicycle that starts high on a hill, rolls downhill, then slows when the rider brakes. Label the energy form in each panel and use arrows to show the changes.

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PART 1 · READ AND MARK

Underline where energy is stored in a field, circle both kinds of particle motion, and write 1 beside the downward energy change and 2 beside the slowing energy change. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	At the top of the arc, what system and energy form would you label in a model?	**Label the rider and Earth as the system and gravitational field energy as the stored energy.**
2	As the rider descends, draw or describe an arrow between two energy forms. Which form decreases, and which increases?	**An arrow points from gravitational field energy, which decreases, to shared motion of the rider's particles, which increases.**
3	Add an arrow to show where some energy goes as the swing slows. What particles does your model label?	**An arrow points from shared motion of the rider's particles to random motion of particles in the air and swing parts.**
4	If the rider starts higher, what change would you make to the model at the top? Explain using the passage.	**Show more energy stored in the rider-Earth gravitational field because a higher starting point increases that stored energy.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Panel 1: Bicycle and Earth high on a hill, with energy stored in their gravitational field. Panel 2: Bicycle rolling downhill, with an arrow from field energy to shared motion of the bicycle's particles. Panel 3: Bicycle slowing, with an arrow from shared motion to random particle motion in the brakes and wheel.

Accept models that distinguish the bicycle's shared particle motion from random particle motion in parts warmed by braking. Arrows should show energy changing form, not disappearing.