

# Energy in Motion

Plan a fair pendulum investigation to trace energy transformations.

**S8P2.b** "Plan and carry out an investigation to explain the transformation between kinetic and potential energy within a system (e.g., roller coasters, pendulums, rubber bands, etc.)."

NAME \_\_\_\_\_

DATE \_\_\_\_\_

## 1 READ AND MARK \_\_\_\_\_ Read it twice

**YOUR JOB** Underline each sentence that tells when energy changes form. Circle the variable changed, and number the four controls 1 through 4 to show how the plan makes a fair comparison.

### Testing a Pendulum System

- ① A swinging pendulum can help scientists track energy changes in one system. A student ties a metal washer to a string and pulls it to one marked release height. Before release, the washer has gravitational potential energy because it is above its lowest point. As it falls, that energy changes into kinetic energy. At the bottom, the washer moves fastest, so its kinetic energy is greatest. As it rises on the other side, kinetic energy changes back into gravitational potential energy.
- ② To test this transformation, the student plans three trials from each of three release heights. A strip of tape at the bottom marks the same point for every trial. A partner uses a phone's slow-motion video to compare how far the washer travels in equal time near that point. The release height is the variable changed. String length, washer mass, release method, and the bottom reference point are kept the same. The student records results in a data table and looks for a pattern.
- ③ If the video shows the washer traveling farther in equal time at the bottom after a higher release, the evidence supports a greater speed there. This supports the idea that a higher starting position gives the system more gravitational potential energy, which becomes kinetic energy during the fall. The washer will not return to its original height because air resistance and friction at the string support transfer some energy to the surroundings as thermal energy and sound. Repeating trials makes the comparison more reliable.

**2 ANSWER WITH EVIDENCE** \_\_\_\_\_ Use the passage

**1** What object and condition give the pendulum gravitational potential energy before it is released?

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**2** What variable does the student change, and name two conditions kept the same?

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**3** What evidence does the student collect to compare the washer's motion near the bottom?

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**4** What result would support the claim that more gravitational potential energy becomes kinetic energy, and why will the washer not return to its original height?

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**3 YOUR TURN** \_\_\_\_\_ Your own words

Plan a fair investigation of energy transformation in a rubber-band-powered toy car. In 5 to 7 sentences, name the variable you will change, at least two controls, what you will measure, the pattern you predict, and how potential and kinetic energy will transform.

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**PART 1 • READ AND MARK**

Underline each sentence that tells when energy changes form. Circle the variable changed, and number the four controls 1 through 4 to show how the plan makes a fair comparison. Accept any marking that follows this job and points at the right text.

**PART 2 • ANSWERS**

| # | QUESTION                                                                                                                                                        | ANSWER                                                                                                                                                                                                                                                              |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | What object and condition give the pendulum gravitational potential energy before it is released?                                                               | <b>The metal washer has gravitational potential energy when it is held above its lowest point.</b>                                                                                                                                                                  |
| 2 | What variable does the student change, and name two conditions kept the same?                                                                                   | <b>The student changes release height. Controls include string length, washer mass, release method, and the bottom reference point.</b>                                                                                                                             |
| 3 | What evidence does the student collect to compare the washer's motion near the bottom?                                                                          | <b>A partner uses slow-motion video to compare how far the washer travels in equal time near the bottom reference point.</b>                                                                                                                                        |
| 4 | What result would support the claim that more gravitational potential energy becomes kinetic energy, and why will the washer not return to its original height? | <b>After a higher release, the washer would travel farther in equal time near the bottom, showing greater speed. It does not return to its original height because air resistance and friction transfer energy to the surroundings as thermal energy and sound.</b> |

**PART 3 • YOUR TURN (SAMPLE ANSWER)**

I will investigate how the number of rubber-band turns affects a toy car's motion. I will change the number of turns before release. I will keep the same car, rubber band, surface, and starting line. I will measure the distance the car travels and complete three trials for each number of turns. I predict that more turns will make the car travel farther. Elastic potential energy in the twisted rubber band will change into kinetic energy of the moving car, while some energy transfers to the surroundings as thermal energy and sound.

Accept equivalent controls and measurements that create a fair test. For the open response, look for a changed variable, controls, a measurable outcome, a testable prediction, and an accurate explanation of potential energy changing into kinetic energy.