

High school | Where the Motion Energy Goes

Name: _____ Date: _____

Free classroom and home printable. Paper-only; no account or internet required.

Goal: distinguish an energy account from evidence about a particular transfer. Prerequisites: describe motion and separate an observation from an explanation. No calculations are required.

Before reading the model

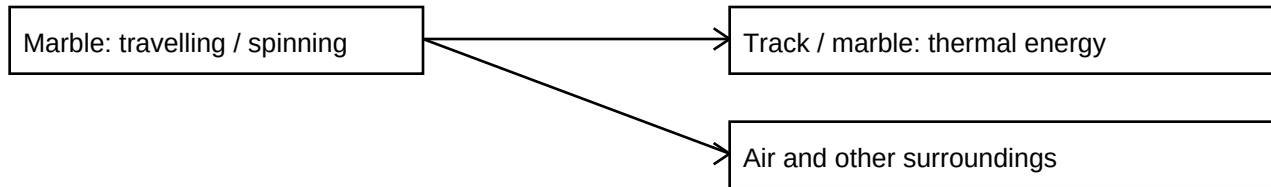
HS1. A hypothetical marble slows on a real track. Compare two claims: A: "The energy disappeared." B: "All of the lost movement energy heated the marble." For each, write what would need explaining or supporting. Give your own initial account.

HS2. Define the boundary of your account in words or a sketch. What would you miss by tracking only the marble's travelling and spinning motion?

The scenario supplies no measurements. Hypotheses are not observations.

A qualitative account with limits

A real track can deform, a marble can skid, joints can cause impacts, and air can receive energy from the moving marble. Energy no longer available for travelling and spinning has not disappeared. For example, thermal energy in the marble and track can increase. Include the surroundings when accounting for energy. This map names possible transfers; it does not measure their amounts.



Possible transfers only. Arrow sizes do not show energy amounts.

Movement energy: energy associated with travelling and spinning. Transfer: energy passing between objects or parts of a system. Surroundings: the track, air and other objects around the marble. Thermal energy: internal energy associated with heating. Qualitative: describing a relationship without measuring amounts.

An ideal no-loss comparison deliberately sets real transfers aside. It can isolate the role of the drop; it cannot establish how a real modification performs. In ideal rolling without slipping on a stationary surface, static friction at the contact need not transfer energy out of movement. Do not label every friction force an energy loss.

HS3. Critique the statement "The arrows prove that equal amounts became heat, impacts and air motion." Explain two limits of this diagram and repair the claim.

HS4. A classmate says all friction always drains movement energy. Use the ideal rolling condition above to qualify this claim. Why does that ideal condition not settle the energy account for a real track?

Design an inference, not a success story

Paper activity materials: pencil and these pages. Setup: sketch two otherwise matching tracks, one with a cloth patch. Steps: label the proposed change; list conditions to keep comparable; plan observations; write separate predictions and possible conclusions. No physical testing, small parts or tools are needed.

HS5. Plan repeated comparisons. Specify at least three conditions to keep comparable, what to record even on unsuccessful attempts, and a possible outcome that would challenge your prediction. What could catches support? What could they not establish about energy transfer amounts?

HS6. Apply the model to a hypothetical book sliding and slowing on a desk. Contrast an account of the book's motion alone with an account including the book and desk. Explain a possible increase in thermal energy and why slowing alone cannot tell you its distribution between them.

Use a separate sheet for extra detail. Planned comparisons are not performed tests. Repetition does not guarantee a repair or identify the amounts in each transfer.

Optional rabbit hole: original micro-lesson:

<https://thisworldexplained.com/okay-but/where-the-motion-energy-goes/> . Optional story: One More Take:

<https://thisworldexplained.com/okay-but/one-more-take/> . The story mentions real-track limits; it does not isolate or measure individual energy transfers. Both are optional: this worksheet works entirely on paper.

Further reading: MIT OpenCourseWare, Classical Mechanics chapter 14, sections 14.7-14.8 (energy accounting and sliding friction); OpenStax University Physics Volume 1, 11.1 Rolling Motion (ideal rolling assumptions); Exploratorium, Marble Machines activity guide, pages 1-5 (slowing features and testing). These resources inform the explanation, not a measured result from this activity.