

One More Take

Teacher key: plan and facilitate

Separate teacher resource for the middle school and high school worksheets, OBH-001, version 2.0. Keep this file apart from student copies. All questions can be completed offline with the included briefs and diagrams; the full story is optional.

Learning goals and prerequisites

Middle school: explain how vertical separation differs from route length, show a changed-endpoint adjustment and distinguish a model prediction from an actual catch. High school: justify the energy comparison with assumptions, evaluate competing claims and design an observation with explicit limits. Prerequisites: recognise higher/lower, trace a route and compare two arrangements. No algebra is assumed. Vocabulary appears in each student brief; travelling and spinning are both movement.

Material-free activity and preparation

Print the appropriate student worksheet and keep this separate key. Materials: worksheet and pencil; no small objects, tools or physical track. Setup: use a flat writing surface. Steps: read the brief, mark start/finish heights in the supplied diagram, predict, sketch the changed-finish layout, then explain what needs checking. Observe reasoning and labelled geometry, not apparatus outcomes. This paper activity cannot measure speed, time or catch reliability. It has no marble/small-part activity risk because no marble is used; do not turn its sketches into instructions for high tracks, roads or access ramps.

Classroom, home and differing readiness

For one learner: ask for an initial prediction before consulting the key, then have them talk through a revision. For siblings or a class pair: one draws endpoints while the other asks what changed; swap roles before the transfer question. Compare reasons without ranking learners. A nonspecialist adult can ask, "Where is the finish reference?", "Which distance are you comparing?" and "Does that answer come from a model or a trial?" These prompts do not give the answer. Preparation is limited to printing and reading this key; no validated duration or curriculum alignment is claimed.

Simpler route: read the brief aloud, use MS01-MS03 first, and allow labelled drawings or dictated sentences. Deeper route: use HS02 and HS04 to challenge an inference, not merely demand more vocabulary. Learners may use scrap paper for extended responses. If a diagram is inaccessible, its complete text equivalent is supplied. Offline teaching keeps the same geometry/model reasoning but loses the optional full-story experience.

Misconceptions worth discussing

"Longer means slower" is tempting because longer journeys can take longer; finish speed and elapsed time are different quantities. "Every catch proves the theory" is tempting because the desired outcome is vivid; cup geometry, joints and the arriving motion also matter. "Friction always removes rolling energy" confuses ideal no-slip contact on a stationary rigid surface with real slipping or deformation. Do not require that last term in a student response: preserve the stated no-loss model and real-track limit.

One More Take

Middle school: matched answer guidance

MS01

He changed the route by adding a detour/extra track. Start height and finish height stayed the same. Also accept the same marble or cup if grounded in the brief. Reasoning: route length can change without changing the endpoint height difference. If a learner says "height changed", ask which endpoint they mean; moving a book in the narrative is not evidence that the release height changed.

MS02

B gives less ideal finish speed: its vertical drop to the shared finish is smaller, so the same marble-Earth system supplies less gravitational energy for travelling and spinning. Accept "less energy from the smaller drop" without specialised vocabulary. Require the ideal conditions stated in the brief, not a guarantee for a real cup. A is higher; the figure shows alternative releases of the same marble, not two different marbles or two simultaneous trials.

MS03

The new release should be lower by the same vertical amount as the new finish. Accept any two downhill sketches with matching straight-down release-center to finish-center separations; drawing proportions are illustrative, not measured data. A release left at the old height would create a larger drop. Marker lines represent vertical separation, not gravitational force or the distance along the track.

MS04

The model compares ideal movement energy/speed under stated assumptions. It does not isolate cup shape, track joints, impacts or real energy transfers, so it cannot guarantee retention. Accept any one relevant track/cup condition needing a real check. The narrative catches are story events, not a measured dataset. A response about cup geometry is substantive, even if it does not mention friction.

MS05

Raise the release by the same vertical amount as the higher finish to preserve the original drop, while keeping the route downhill. Accept a sketch plus this relative-height explanation. Real tray shape, incoming route/joints or whether the marble remains inside must be tested. Do not accept "a higher tray always catches it". This transfer introduces a new destination and raised-finish constraint; it is a paper design, not verified equipment.

MS06

Example: "I compare release height with finish height because their vertical separation sets the energy from the drop. The model cannot tell me whether this real cup catches the marble." Accept equivalents naming both endpoints, the drop/energy relationship and an actual limitation. Timing is also an acceptable limit if explained; do not insist on this sample wording.

Discussion sequence: ask for MS02 prediction and reason, use MS03 to show an endpoint change, and use MS04/MS05 to separate explanation from practical checking. An unexpected answer calls for a labelled comparison, not an invented successful run.

One More Take

High school: matched answer guidance

HS01

A gives greater ideal finish speed than B because its larger vertical drop supplies more gravitational energy to movement. Conditions: same marble/body, rest release with no shove, rolling without slipping and no energy losses; endpoints define the comparison. Travelling and spinning share the movement energy, without any assumed numerical fraction. A catch guarantee does not follow. Accept a structured paragraph or correctly labelled sketch plus explanation. A speed claim without conditions is incomplete.

HS02

Ideal: same marble, same drop and the listed conditions give the same ideal finish speed even along different routes. Gravity energy depends on endpoint height change, so added length alone is not an ideal brake. Real: added joints, slipping, deformation or other transfers can alter movement energy, but greater route length by itself does not prove a slower finish. These statements address different assumptions and therefore do not conflict. Accept a real-track uncertainty response; reject a universal "curve wins" or "rougher always slower" rule.

HS03

Raise the release by the same vertical amount as the raised tray finish. Mark equal vertical endpoint separations in both layouts and retain a downhill route. With the same marble/rest/no-slip/no-loss assumptions, the ideal finish-speed comparison is preserved. Tray retention still needs checking because real arrival and container geometry are not established by that comparison. Accept any equivalent paper arrangement; no numerical height or apparatus result is required.

HS04

One suitable plan: change only the release mark; keep the same marble, track/cup and release-without-shove method as steady as feasible; observe whether the marble remains in the cup. Repeat both conditions, recording every catch/miss and visible exception, rather than selecting successes. Repetition exposes variation and helps compare these conditions; it cannot remove all systematic influences or prove all possible setups. A catch result is not a direct speed measurement. Also accept a planned speed/time response if the learner explains how it would be observed and avoids pretending it has been measured. This is a planning task, not an instruction to build or perform.

HS05

The same ideal finish speed is supported only with the same marble and stated rest/no-slip/no-loss conditions. The same travel time is not established: endpoint-energy reasoning does not specify motion throughout either route. A timer or suitably observed recording could compare elapsed time from letting go at the release point to crossing the same defined finish point, with repeated trials and consistent methods. Do not rank unknown routes or apply a sliding-particle formula to a spinning marble. Accept "measure each route time" with clearly matching start/stop events and caveats.

One More Take

Reasoning checks, takeaways and sources

Use the answers as evidence of reasoning

Look for four things: correct endpoint geometry; energy reasoning with model conditions; practical limits; and a transfer decision. A learner may use plain language, a labelled drawing or dictation. These materials propose learning opportunities; they do not demonstrate learning effectiveness or validate age suitability. No numeric grading scheme is required. Keep student predictions before discussing this key; an initial wrong prediction can be useful if the revision is reasoned.

Core takeaways

Compare both endpoints, not the release height alone. Distinguish distance along a route from vertical drop. For the same marble in the specified ideal rolling model, endpoint drop determines the available movement energy and finish-speed comparison. Carry a useful model into a changed condition, then check the actual arrangement. Catch outcome, finish speed and travel time are different questions.

Keep the rabbit hole optional

Return to One More Take for Quinn's lower-shelf application and final timing question. Its optional depth explores energy in travelling and spinning. The story remains complete without extra reading; these worksheets likewise supply their own essential prerequisites. Direct named refresher and extension links appear on the optional concept-lessons page; they are not a compulsory sequence.

Optional source reading

One More Take - source story | <https://thisworldexplained.com/okay-but/one-more-take/>

OpenStax: gravitational energy and endpoint heights | <https://openstax.org/books/college-physics/pages/7-3-gravitational-potential-energy>

OpenStax: energy in ideal rolling | <https://openstax.org/books/university-physics-volume-1/pages/11-1-rolling-motion>

NIST/SEMATECH: planning factors and responses | <https://www.itl.nist.gov/div898/handbook/pri/section1/pri11.htm>

NIST/SEMATECH: measurement variability | <https://www.itl.nist.gov/div898/handbook/mpc/section1/mpc114.htm>

Exploratorium: Marble Machines design/testing | https://www.exploratorium.edu/sites/default/files/tinkering/files/Instructions/marblemachines_activity-guide.pdf

Source boundaries: the OpenStax mechanics treatments support ideal endpoint/rolling reasoning; Exploratorium supports practical iteration, not a cup guarantee; NIST supports planning and variability, not a one-factor-only definition of all experiments. Story outcomes are authored events. Original questions and diagrams were created for this worksheet set; institutional artwork, assessment questions and text were not copied.

One More Take

Optional reusable concept lessons

Choose a refresher or extension only if it helps your question. These published lessons are extra reading, not required steps. The vocabulary, diagram and prompts in this worksheet already work offline; use those pages when links are unavailable.

Height into Motion

Optional refresher: revisit the relationship between a release height and the energy available from its drop.

<https://thisworldexplained.com/okay-but/height-into-motion/>

Vertical Drop versus Distance

Optional refresher for the changed-finish sketch: keep straight-down endpoint separation distinct from the distance along the route when a finish moves.

<https://thisworldexplained.com/okay-but/vertical-drop-versus-distance/>

Fair, Repeated Trials

Optional extension for comparison planning: explore recording all trials and discussing variation without treating one catch as proof.

<https://thisworldexplained.com/okay-but/fair-repeated-trials/>

Finish Speed versus Arrival Time

Optional extension for the final timing question: separate speed at the finish from elapsed time across the journey.

<https://thisworldexplained.com/okay-but/finish-speed-versus-arrival-time/>

Return to the source story: One More Take. Its lower-shelf application and final timing question give these concepts a practical setting.

One More Take

Optional return to Quinn's complete story; your worksheet remains usable without opening it.

<https://thisworldexplained.com/okay-but/one-more-take/>