

ROLLING VERSUS SLIDING

High school worksheet

Name: _____ Date: _____

A clip is evidence - but for which claim?

Hypothetical evidence card: a ball center moves right and a surface mark turns clockwise. Contact with the stationary track is hidden. No times, distances or force measurements are supplied.

HS01 | Before reading below: does the evidence establish rolling without slipping, or could another contact condition fit it? State a provisional claim and why.

Concept and model boundary

A ball can travel along a track while turning around its center. Travelling is called translation; turning is rotation or spin. A block can slide without turning. A spinning ball can also skid: the touching surfaces slide relative to one another. For ideal rolling without slipping on a stationary rigid track, contact does not slide against the track. Friction at that contact can help the ball turn without draining movement energy through sliding. Real deformation and skidding have different limits.

Both travelling and spinning carry movement energy. The sharing depends on shape and how mass is distributed, so a cylinder result cannot automatically be used for a marble. This sheet gives qualitative reasoning, with no numerical speed or energy calculation.

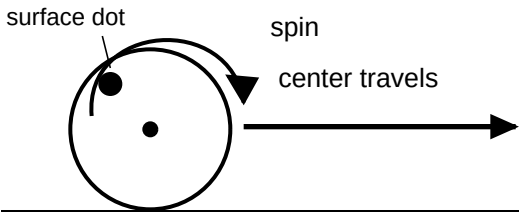
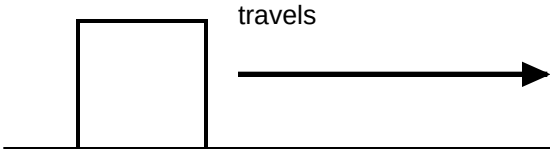
A. Ball travels and spins  Spin plus travel does not prove no slipping.	B. Block slides without turning  Block orientation stays the same here.
Illustrative model, not to scale. Arrows show motion, not force or speed values.	

Diagram text: A ball has a rightward arrow for its center travelling and a clockwise arrow for spinning; a marked dot turns around its center. These two motions alone do not establish whether contact slips. A separate block moves right without turning. Arrows describe motion, not forces or measured speeds; the drawing is illustrative and not to scale.

HS02 | Separate observation from inference. Which two motions are directly described by the evidence card? Which contact claim still needs evidence? Explain why the same visible motions could fit more than one contact condition.

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Test an explanation, not a slogan

Comparison cards (ideal models, not experimental results): A - a rigid ball rolls without slipping on a stationary rigid track; B - a ball travels and spins while its contact slides on a stationary track. Body size and material are held the same. The changed condition is slipping at contact. These cards do not supply numerical speeds, forces, energy fractions or times.

HS03 | Evaluate: "If friction acts, movement energy must be drained by sliding." Use cards A and B to explain why the contact condition matters. State the limits of your conclusion for real objects.

HS04 | Create a two-column evidence plan for a short ball clip. Column one: what to track about travel and spin. Column two: what to inspect about contact with the stationary surface. Explain why hiding contact weakens the no-slip claim. This is a plan on paper, with no trial or purchase required.

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Use a pencil and the supplied cards. Write the plan, compare it with the no-slip definition, then revise any claim that exceeds the available evidence. Oral description or typed notes are equivalent alternatives. No tools, moving apparatus, road/vehicle activity or real bowling trial is needed; a proposed plan is not a performed observation.

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Transfer to a different choice

HS05 | A hypothetical editor labels every travelling, spinning bowling ball "rolling without slipping." Decide what extra contact evidence the label needs, and propose a more cautious caption if that evidence is unavailable. Explain the connection to the marble model; do not test a bowling ball.

HS06 | Another editor borrows a cylinder energy result to describe a marble. What information about the body and its conditions would need checking before that transfer? Explain why seeing rotation alone does not justify that result. No formula or calculation is required.

HS07 | Return to HS01. Write a defensible final claim about the hypothetical clip, its evidence and its remaining uncertainty.

Next question, optional: when movement energy changes on a real track, what transfers are involved? The source lesson and related story below provide places to start; neither clip cards nor sketches measure those transfers.

Optional reading - follow a question

Rolling versus Sliding is the source micro-lesson: revisit the distinction between spin and non-slipping contact.

One More Take is the related ramp story: its explanation mentions travelling and spinning. It does not separately test rolling against sliding. These links are optional; this sheet contains the explanation needed to work offline.

Sources for the explanation

MIT: Rigid Body Dynamics, Examples 21.4-21.5 - rolling contact, spin and the distinction from sliding.

OpenStax: Rolling Motion, section 11.1 - translation and rotation, slipping and the ideal energy boundary.