

Use and preparation

Separate teacher key for the middle-school MS01-MS08 and high-school HS01-HS08 sheets, package OBH-002 v1. Free classroom and home resources accompanying The Bag That Wouldn't Take One More Thing. Audience labels indicate different scaffolding and reasoning demands; no curriculum alignment, verified duration or learning effect is claimed.

Observable goal: learners distinguish local slider guidance from metal-model retained fit, explain reversed relative motion, and justify different choices for obstruction versus loaded edges while stating limits.

Prerequisites: joined/separate, ahead/behind in an agreed direction, and visible versus inferred. Point to a large drawing and define these locally; a prior post is optional.

Prepare: read the questions and key; provide the appropriate three-page student sheet, pencil and space to sketch. Supply the route diagram or read its text alternative. Keep this key separate from student copies.

Page 1 offers a prediction before the page 2 model. Let learners retain and revise an initial idea without marking the first prediction as a failure.

Optional ordinary-item observation: an adult checks an intact attached closed-end zipper on an empty case for smooth normal motion and absence of sharp/damaged parts or detached pieces. Lay it flat, clear lining, identify parts, agree on opening/closing direction, predict changes just ahead/behind, move gently a short distance, reverse and record only what is visible. Keep item/orientation/empty condition constant. Stop immediately at resistance or abnormal movement; substitute the printed model.

Safety: keep fingers and hair away from the moving passage. Do not deliberately trap cloth, overload, pull chain sides apart, detach stops or small pieces, or use blades, pliers, heat or lubricants. Younger siblings should not handle loose small pieces; an adult can retain all handling. No physical operation is required. This proposed observation is not a tested repair activity or safety certification.

Expected range and limits: joined/separate states may be visible; tiny geometry may not be. An opaque slider does not show its hidden passage. A coil may differ from the metal detail. Record uncertainty and actual observations; never require reproduction of Quinn's authored outcome. No-material route: trace the printed branches and single route, then reverse verbally. It teaches model interpretation with less direct evidence than an ordinary-item observation.

One learner: ask "What makes you think that?" and "Which part has moved away?" before revealing the model. Mixed readiness: one learner describes states, another tracks relative motion, another names a limitation; rotate roles and let each predict before sharing. Accept a labeled sketch or oral explanation. Simpler route: MS01-MS04 with fewer words and large pointing gestures. Deeper route: HS03-HS08, separating evidence types and withholding unsupported quantities.

Middle school key: MS01-MS05

MS01 | Expected: joined length, separate rows and slider position are visible; hidden passage/retaining geometry are inferred through a model. Accept "I see teeth joined behind it; I cannot see inside." Look for the seen/inferred distinction, not a precise internal drawing. Ask "Could your eyes see through this slider?" if the learner calls the Y route an observation.

MS02 | Prediction is open before reveal. Accept a fork/branch route, a plausible clamp idea or another reasoned sketch as an initial idea. After the model, look for two routes meeting one and reversal separating. Do not award certainty merely for drawing a Y. A clamp prediction is productive when the learner later asks what retains the section left behind.

MS03 | With slider fixed, closing sends separate rows through branches toward the joined chain; opening reverses relative travel and divides the engaged chain. Accept clear sketches or ordinary language. Assess both directions plus a reason for revision/retention. "The slider moves downward in these arrows" mixes viewpoints; ask which part the caption says is fixed.

MS04 | Slider passage guides local engagement; fitted projections/recesses retain the join in the bounded metal model after the slider leaves. The whole length is not clamped by the little body. Accept "neighboring shapes stay fitted" without technical words. Require guide versus retained fit and model scope; reject glue/friction-alone explanation or an indestructibility claim.

MS05 | Same case, slider/chain, empty contents, clear lining, table and orientation; intended change is direction of relative movement. Any two relevant fixed conditions suffice. Up/down changes when an item is rotated; opening/closing labels name the function relative to the chain. This comparison is a proposal, not an observed result.

Middle school key: MS06-MS08

MS06 | A has unwanted lining in the passage; B has clear-looking passage and loaded spread edges. A calls for stopping and addressing caught material gently; B calls for reducing contents and bringing sides close before normal gentle closure. Accept "inspect first" because these observations do not diagnose every failure. Look for distinct causes and matched condition changes. Do not treat easing back as a universal repair.

MS07 | Reduce thick contents/repack to relieve burden and bring the sides close before a gentle attempt; stop at resistance or apparent damage. Accept choosing to carry some card separately. Success in one hypothetical or actual pouch cannot prove every resistant zipper is repairable: damaged/incompatible shapes and other conditions remain possible. Criteria: changed packing condition, gentle limit, no universal inference.

MS08 | Takeaways should recover guided joining/separation, fitted metal-model engagement left behind, and inspect/change conditions rather than force. Accept a limitation question about hidden geometry, force magnitude, construction differences, locks or whether a particular damaged item can be repaired. Encourage a question about what further evidence would be needed; do not fill it with an invented force number.

Tempting misconceptions: "harder works" follows from noticing a pull is needed, but ignores the working conditions; "friction glues the chain" confuses contact sliding resistance with fitted retention; "all zippers use these hollows" extends one model to other constructions. Ask learners to name the evidence or boundary rather than simply replacing a wrong word.

Brief assessment across MS: a usable explanation names guide and fit, tracks both directions, matches each cause to a condition change, and states one limit. A partly developed response names parts but does not connect their jobs; prompt with "What remains after the guide leaves?" Record an unclear observation as uncertainty, not learner failure.

High school key: HS01-HS05

HS01 | The long joined section away from the small slider challenges H1 as a complete explanation. A branch route can support local engagement and reversed separation in H2. The initial sketch may differ; require observation-based reasoning and a remaining uncertainty (hidden geometry, exact retention or type differences). An authored story event is illustrative, not a quantitative test.

HS02 | A causal question such as "What fitted structure retains engagement after the slider leaves?" distinguishes arranging from retaining. Accept equivalent wording. "What is the part called?" alone does not address the remaining relationship. In the later metal reference, alternating nested shapes answer that bounded question.

HS03 | With tapes fixed in the displayed orientation, equivalent closing slider travel is toward the branch/separate-row side (opposite the elements' relative travel through the held slider). The fixed-slider drawing shows rows moving into branches and out as an engaged chain. Require consistent fixed/moving labels in both descriptions; rotation can change page directions. Copying element-motion arrows as slider travel reverses their meaning. No absolute speed or universal up/down rule follows.

HS04 | Observation: joined/separate state changes near the slider. Model explanation: a Y passage guides those changes and fitted geometry retains a metal join. Needed other evidence: hidden passage/part geometry for the actual type, force or strength measurements. Normal opaque-item observation cannot directly verify interiors, numerical coefficients or every construction. Accept other properly separated examples.

HS05 | General guided joining/separation can remain useful; exact metal projection/recess shape cannot automatically be assigned to coils. A change in construction is a scope difference. Assess retention of useful general reasoning plus withheld detail. Reject either "every coil has this same hollow" or "one difference makes all models useless".

High school key: HS06-HS08 and sources

HS06 | Sliding friction opposes relative sliding at contact, but occupying a passage and spreading/loading edges add different conditions. Stronger pulling can worsen caught-fabric trouble or loaded-chain damage; inspect and relieve the relevant condition rather than prescribe force. Cases provide no measured forces, coefficient or force threshold. Require definition, both cases and quantitative limit, without claiming friction is absent.

HS07 | Accept a conditional sequence: stop; inspect route and sides without forcing; determine whether flap intrudes and keep it clear; reduce/rearrange cards and bring sides close; only try normal gentle movement if intact and suitable. Stop if resistance persists or parts appear damaged. Other observation-first orders are valid if justified. Uncertain obstruction and untested damage mean no guaranteed diagnosis/repair; do not require a destructive test.

HS08 | Changed condition: direction. Fixed: same item/slider/chain, orientation/table, empty contents and clear lining (three suffice). Record joined/separate states just ahead/behind and any visibility limit; stop at resistance, keep fingers/hair clear and introduce no obstruction or load. Paper alternative reverses relative arrows but does not observe a real device. Cannot establish hidden actual geometry, force coefficient/threshold, strength, repair guarantee or learning efficacy. Takeaway should link guidance/fit/conditions to a stated new use, without numerical invention.

Brief HS assessment: require a causal account, consistent reference frame, claim-specific evidence boundary and conditional transfer. Accept different vocabulary and diagrams if relationships are clear. A response that names friction but does not explain why the condition matters needs follow-up, not a memorized definition. For an unexpected answer ask "Which observation supports that?" and "What would you need to inspect or measure?"

Evidence notes: YKK: zipper parts and Y-shaped passage: Parts, guidance and construction limits. Sundback: original metal fastener design, US1219881A: Specific alternating projection/recess model; not every construction. YKK: zipper-use precautions: Caught fabric and overfilled-bag handling; no repair guarantee. Coats: Invisible Opti Zips technical brochure: Page 3 clearance evidence for this particular invisible-zip type. NASA: Toys in Space II glossary: Printed page 20: force/friction foundations, not zipper tests. NASA: Flight Testing Newton's Laws: Section 4.9: qualitative sliding-friction context, no zipper coefficient. Source access: paired story source notes provide these links; the student sheets retain complete working explanations offline. Optional next reading: Force asks what a pull is being asked to do. It can extend the packing-choice question, but this worksheet needs no online lesson. Story: <https://thisworldexplained.com/okay-but/the-bag-that-wouldnt-take-one-more-thing/> Force: <https://thisworldexplained.com/okay-but/force-what-are-you-asking-the-pull-to-do/>