

Force: separate teacher answer key

OBML-007 | Matches MS01-MS05 and HS01-HS05 | Free teacher and home copy

Teaching goal and preparation

Learners explain which object a hand's push or pull acts on, interpret its direction, and distinguish that description from a diagnosis or measured size. Prerequisites are supplied on the student sheets. Prepare one selected worksheet and a pencil per learner; retain this key separately. No accounts, equipment or physical trial required. Grade labels indicate intended differentiation, not validated suitability or curriculum certification.

Vocabulary: force = push or pull; slider body = guiding part; pull tab = attached part held by a hand; engagement = rows fitting together; condition = a relevant feature of the current situation. Use the concept card before asking learners to explain technical words.

Middle school answers

MS01 - Accept inspecting the visible passage, contents or spread edges, or proposing a packing change tied to those observations. A prediction before the concept card is not marked wrong for differing from later guidance. Ask "What did you notice?" before naming a solution. More pull is tempting because the hand moves the slider; it does not address every condition.

MS02 - The slider receives the pull through its tab. The arrow shows the stated rightward direction. It leaves force size, exact motion and success unknown. Accept "slider body" or a correctly labelled sketch. If the learner says the arrow measures force, ask where a scale or measured value is supplied: none is.

MS03 - Look for fewer contents and closer opening edges, plus distinct slider/tab and labelled pull direction. The sketch represents a proposed condition change; it is not proof of movement or damage-free operation. Accept a top or side view with consistent labels. Do not require a cutaway or exact tooth geometry.

MS04 - Caught cloth occupies the passage in A; spread/load from contents differs in B. The supplied guidance supports reducing contents and bringing chain sides close for B. Removing unseen cloth would not address B's stated condition. Inspecting before acting is acceptable. Stop at failed gentle normal movement or apparent damage; no universal repair claim.

MS05 - Hand supplies a push acting on the book toward the left. The declared arrow encodes direction only, not measured size or guaranteed movement. Accept verbal explanation instead of drawing. Do not require friction calculations or a prediction of speed.

Takeaway example: "Ask what conditions the pull is working against." Accept other observation-led wording; exact recall is unnecessary.

High school reasoning key

OBML-007 | Teacher answers continued

HS01 - Accept a provisional inspect-before-increasing-pull claim with relevant observations such as visible caught material, spread edges, packed contents or apparent damage. A cautious alternative is acceptable if tied to evidence. The imagined arrow doubling supplies no measurement. Preserve initial uncertainty and compare it with the later answer.

HS02 - Card A establishes the declared direction of the represented hand pull. It cannot establish size without measurement and a stated scale, or diagnose resistance without observation and relevant mechanism/condition evidence. The force acts on the slider through the tab. Card B explains guidance; C gives condition-specific handling. Neither supplies a numerical force for this pouch.

HS03 - Changed condition: caught material in P versus loaded, spread edges in Q. Shared features include the same kind of hand-operated zipper and resistance to closure; intact-compatible assumptions may be retained, not inferred as verified. Q: reduce contents and bring chain sides close before gentle normal closure. Manufacturer advice supports that choice under described conditions, not proof that every resistant zipper has this cause or will recover. Stop at failed gentle movement or apparent damage.

HS04 - A suitable paper model contrasts contents and edge separation while keeping the represented pouch, slider and intended closing direction constant. Do not claim hand-pull size is held constant unless a measurement exists: it does not here. A cautious prediction is that changing the overfilled condition addresses the problem described in guidance, with success unresolved for a particular pouch. Sketches cannot measure force, isolate causes, test damage or establish repair effectiveness. Accept a labelled verbal comparison as an accessible alternative.

HS05 - The stated hand action supplies an outward pull on the drawer through its handle. Its represented direction alone does not guarantee opening. Questions may ask about the pull's measured size, relevant conditions or whether the mechanism/path allows movement. The statement supplies no diagnosis. Accept other genuinely unresolved condition questions. Do not infer a safe force, a particular jam, or a repair procedure.

Revised takeaway example: "Direction describes my pull; observations and condition-specific evidence guide my decision." Accept evidence-aware alternatives.

Misconceptions worth discussing

"Longer arrow means stronger" - this drawing explicitly supplies no numerical scale. "Harder always works" - the same pull can face different conditions. "Resistance proves friction" - caught material and spread loaded edges require different questions. "Quinn closed it, so the choice always works" - an authored story outcome is not a universal empirical result.

Use the package without a lab

OBML-007 | Teacher guidance and source notes

Paper-only activity and discussion

Materials: chosen student worksheet and pencil; no device or physical object needed. Setup: keep the key away from student copies; read the initial puzzle before the concept card/evidence cards. Steps: (1) record a prediction; (2) read the concept and inspect the labelled diagram; (3) label a comparison; (4) use supplied condition guidance; (5) revise the prediction and explain a transfer. Observations are of the drawing and supplied descriptions, not actual device tests. Expected responses may differ in sketch style and vocabulary; require a supported relationship and an honest limit.

Safety and limits: do not turn these scenarios into overload, deliberately jammed-cloth or stronger-pull experiments. No blades, pliers, heat, lubricants or detached small components are needed. Physical operation is unnecessary. The paper model cannot establish force, friction contribution, rupture threshold or repair success. Unexpected reasoning should lead to "Which observation supports that?" rather than an invented result.

Classroom, home and accessibility routes

For one learner, an adult reads the initial prompt without revealing answers, listens to a sketch or verbal account, then asks "What changed?" and "What remains unknown?" before reading the key. In pairs or siblings, one identifies the hand action and another checks the condition evidence; rotate roles so the more experienced learner does not supply every answer. No timed contest or strongest-pull comparison.

Simpler entry: use MS02 with pointing or oral labels, then compare the two cases in MS04. Deeper route: use HS03-HS04 to distinguish a model constant from an unmeasured quantity and to test whether each conclusion follows. Large-print or oral response can replace writing/sketching while retaining the same reasoning. Printed explanation and text equivalent make online reading optional.

Optional reading paths

Force: what are you asking the pull to do? names the hand's action. The Bag That Wouldn't Take One More Thing, "One more thing," shows Quinn change the packed-bag condition. These readings extend the supplied explanation; they are not prerequisites. Public availability and exact links require separate technical release checks.

Force micro-lesson: <https://thisworldexplained.com/okay-but/force-what-are-you-asking-the-pull-to-do/>

Zipper story: <https://thisworldexplained.com/okay-but/the-bag-that-wouldnt-take-one-more-thing/>

Source scope

The definition comes from NASA's glossary; slider guidance and bag advice from YKK. The bag advice is a manufacturer contribution, not independently measured by this worksheet. No numerical formulas, observed results, verified duration, curriculum alignment or learning-effectiveness claims are supplied.

NASA, Toys in Space II, glossary p. 20: force means push or pull.

YKK, zipper structure: the slider guides joining and separation.

YKK, use precautions: different conditions need different choices; avoid forcing.