

Substitute Guide: Newton's Laws and Transportation Safety

Grade: 8 **Subject:** Science **Time:** ~45 min core + ~15 min extension Science

Learning goal (plain language)

Students learn **Newton's three laws of motion** — **inertia** (things keep doing what they're doing), **$F = ma$** (net force equals mass times acceleration), and **action–reaction** (equal and opposite forces) — and use them to explain why car and bus safety features protect riders in a sudden stop. Working alone with a pencil, students read a short passage, study a labeled force diagram and a data table, do a small force calculation, and write an evidence-based design recommendation. **You do not need a science background to run this.** Everything students need is printed in their packet. This is a **paper** activity — no lab, no materials, no hazards.

Standards alignment

Framework: 19 TAC §112.28 (Grade 8 Science). Knowledge & skills on **force, motion, and Newton's laws**.

- **Provisional — 8.7 (Newton's laws):** apply Newton's three laws to describe and predict the motion of objects, including in transportation-safety situations.
- **Provisional — forces & $F = ma$:** calculate and interpret net force, mass, and acceleration using $F = ma$; distinguish balanced and unbalanced forces.

Provisional — pending educator verification against the current official TAC source. Codes and letters are placeholders until confirmed.

(Standards are paraphrased here, not quoted. Please confirm codes and wording against your official source. This packet is does not claim formal alignment to the TEKS.)

Setup Before class (5 min)

- Count and hand out one **student packet** per student.
- Confirm each student has a **pencil**. No calculators, computers, or lab items are needed (the $F = ma$ numbers are small and can be done by hand).
- Write the date on the board and remind students to fill in the name line.
- Keep the **answer key** with you — it is a separate file and is **not** in the student packet.

Materials What's needed

- Printed student packet (4–6 pages) per student.
- Pencil per student.
- This guide and the separate answer key (teacher only).
- No technology, no calculator, no lab equipment, no safety hazards.

Timing Suggested pacing (~45–60 min)

Segment	Time	What students do
Start — Notice & Wonder	5 min	Q1–Q2 warm-up
Build — Read the science	5–10 min	Read passage, word bank, force diagram; Q3
Apply — Use the data	20–25 min	Table 1; Q4–Q7 (includes an $F = ma$ calculation)
Explain — CER	5–10 min	Q8 design recommendation (claim/evidence/reasoning)
Close — ACE	5 min	Articulate / Connect / Extend
Continue — early finishers optional ~15 min		Predict what changes if speed or mass changes

Script Read aloud to start

"Today's assignment is a paper science investigation called *Newton's Laws and Transportation Safety*. You will work by yourself with just a pencil — no computers or calculators, and nothing to build or move. First read the short passage and study the force diagram and the data table. Then answer the questions in order; if one is tricky, skip it and come back. There is one small math step where you multiply mass times acceleration — the numbers are easy to do by hand. Write in complete sentences where it asks you to explain. You may quietly read the passage aloud to yourself. Put your name, class period, and date at the top now. You have about 45 minutes; raise your hand if you need help understanding a word."

Support When students ask for help

- **You may read any part aloud** to a student or the class.
- If they are stuck on "which law," point them to the **Newton's three laws** box and **Figure 1** — each arrow matches a law.
- For the $F = ma$ item (Q6), remind them the formula is printed: force = mass $\times$ acceleration, so 50×8 . They do not need a calculator.
- Encourage the printed **sentence stems** for the CER (Q8) and ACE sections.
- Do **not** give answers; prompt with "What does the data show?" or "Which arrow matches this?"
- It is fine if a student cannot finish the optional early-finisher task.

Access Accommodations & language support

- **Read-aloud** of any passage or question is allowed for all students.
- Point students to the **sentence stems** and the **Word Bank** (definitions provided).
- Extended time is fine; the core can stop after Q8 if time runs short.
- Students may answer in phrases if writing full sentences is a barrier, as long as the idea is clear. Showing the $F = ma$ multiplication is enough for Q6.
- The packet is grayscale-safe — it prints and reads clearly in black and white.

Tools Allowed & not allowed

Allowed: pencil, the printed packet, quiet self-read-aloud. **Not needed / not allowed:** calculator (the one math step is small), phones, computers, lab materials.

Collect at the end: Collect every packet, whether finished or not, with names on them. Stack them for the teacher. Note on a sticky how far most students got and any questions that caused confusion.

Answer key: The **answer key is a separate file** (answerkey.html) and is for the teacher only. Please do not hand it to students.

Teacher follow-up (for the returning teacher)

Watch for two high-value misconceptions: students calling *inertia a force*, and thinking *action–reaction forces cancel out*. A quick next-day discussion tying each of Newton's laws to one arrow in Figure 1, plus reviewing the observation-vs-inference item (Q4) and the $F = ma$ calculation (Q6), would reinforce this well. The CER (Q8) responses show who can cite the belted-vs-unbelted force data as evidence.

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