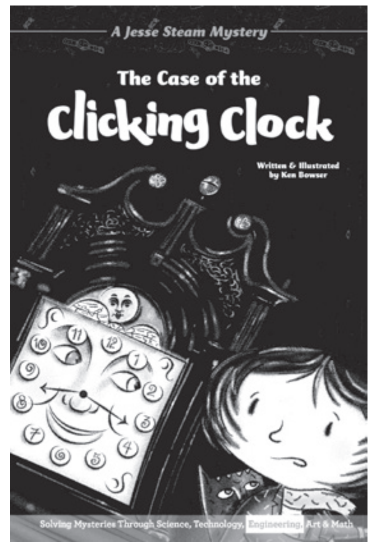
EDUCATOR'S GUIDE

Jesse Steam: Solving Mysteries through Science, Technology, Engineering, Art & Math

Title: *The Case of the Clicking Clock*



Lexile: 710 GRL: R 3,853 words

Series Overview

Ten-year-old Jesse Steam's curiosity about how the world works leads her to one mystery after another as she pedals around town, often with Mr. Stubbs, her tabby cat, keeping her company in the bike basket. Using simple scientific tools and their powers of observation, Jesse and her friends analyze, test hypotheses, and conduct experiments. If the kids get stuck, they know they can count on Professor Peach, a retired college science educator, to step in with a clear explanation

Each title in the Jesse Steam series focuses on one **STEAM** subject: Science, Technology, Engineering, Art, or Math.

About This Book

In *The Case of the Clicking Clock*, the old clock Jesse finds in her grandparents' attic mysteriously keeps running after a storm has knocked out the power. Jesse knows the clock is too old for batteries or a charger, so what keeps it going? She and her friends take the puzzle to Professor Peach, who explains that the clock's mechanism harnesses forces of nature (gravity and motion) to release potential energy.

The Case of the Clicking Clock focuses on **engineering**.

Next Generation Science Standards Alignments and Activities

The activities and learning ideas in this guide have been correlated with the
Next Generation Science Standards (NGSS): https://tinyurl.com/y649p73f

These standards were developed by the National Research Council (NCR) of the National Academy of Sciences. The NCR's Framework for K-12 Science Education combines practices, crosscutting concepts, and disciplinary core ideas to address relevant science, technology, engineering and math (STEM) concepts that students should learn.

For this book, the standards on engineering design and transfer of energy are particularly applicable:
https://www.nextgenscience.org/pe/3-5-ets1-1-engineering-design
https://www.nextgenscience.org/pe/3-5-ets1-2-engineering-design
https://www.nextgenscience.org/pe/3-5-ets1-3-engineering-design
https://www.nextgenscience.org/pe/4-ps3-2-energy

Background and Key Concepts

The big idea in *The Case of the Clicking Clock* is energy—specifically, the transformation of potential energy into kinetic energy—energy in motion. The story also presents an opportunity to explore the methods and inventions scientists and engineers have used through history to track the passage of time, from ancient water clocks and hourglasses through cuckoo clocks to today's sophisticated digital devices.

These definitions may be helpful:

- **Energy: the ability to do work**
- **Potential and kinetic energy: Two kinds of mechanical energy**
  - **Potential energy: Stored energy**
  - **Kinetic energy: Energy in motion**

Class Discussion

Ask students to name a few of their favorite activities. How many require energy? The answer is, of course, all of them. Share that the type of energy we see in motion is called kinetic energy, but there is another type of energy that is hidden away, stored. It's called potential energy.

Invite ideas on what "potential" means. (Having the power or ability to do or be something, but the end goal hasn't been achieved yet.) Like human potential, potential energy is a possibility but not yet actuality. It's stored inside until natural forces, human actions, or other factors transform it into kinetic energy.

Explain to students that you're going to lead them in an activity that explores this transformation, using rubber bands.

IT'S A S-T-R-E-T-C-H! Classroom Activity (Adapted from ScienceBuddies.com. See Online Resources, p. 4)

DRAG RACE: Student Activity

(Note: This activity makes a good companion to Try It Out! on page 64 of the student book, which gives instructions for building a toy parachute.**)**

Materials

- 10 large rubber bands (exactly the same size)
- Metric ruler
- Metric tape measure
- Duct tape to mark the starting line
- Student data sheets, one per student

Instructions

1. Distribute the student data sheets. Ask for two volunteers to be helpers.
2. Clear one end of the classroom.
3. Stand as far back in the cleared place as you can. Mark a starting line with the tape.
4. Make sure all students are safely off to the side.
5. Hook a rubber band on the front edge of the ruler. Stretch it back to the 10-cm mark on the ruler. Keep the ruler as level as possible.
6. Let it fly! Leave the rubber band where it lands.
7. Repeat the process with four more rubber bands, keeping the ruler level and leaving all bands where they drop.
8. Invite one volunteer to measure the distances from the starting line to the closest edge of each rubber band. He or she should call out the measurements one by one for other students to record on their data sheets under the heading Trial A. (They can work in any order.)
9. For Trial B, launch five more rubber bands, this time stretched back to 15 cm. Continue to hold the ruler level. Repeat the measurement and recording processes with your second volunteer's help.

Once everyone has recorded their data, invite them to divide into groups of 4-6 to evaluate their data and write their observations on the data sheet. Each group can present its conclusions to the class at large.

SLINKING TO VICTORY: Design Challenge
Materials per group of 4-6

- Large and small Slinky toys
- A stopwatch, smart watch or other device that displays seconds

A Slinky is a simple, old-fashioned toy that has delighted generations. It's also a loosely coiled spring, which is another example of potential energy. Students will have fun witnessing the transformation to kinetic energy firsthand in this race.

Invite students to work in their teams to construct a vertical racetrack using stacks of books, tables, windowsills, furniture, shelves—whatever is handy. Then they should position the Slinkys one at a time at the top and start them moving down the track, writing down the times. One student should act as the timer. Challenge teams to brainstorm ways to modify the course so that the performance of one or the other is improved. They should use extra paper to write down all results and conclusions. (Guessing the winner of each race first will add to the fun.)

IT'S ABOUT TIME: Research Project

How have timekeeping devices evolved and changed over time? How did they improve on ones that came before? Ask students to choose a timekeeping invention and research its history in the library or online. They should prepare a report, with photos or illustrations, to share with the class.

Here are some ideas to choose from, or encourage them to come up with their own:

- Candle clock
- Sundial
- Hourglass
- Clocks with gears
- Astronomical clock
- Pendulum clock
- Pocket watch
- Electric clock
- Quartz clock
- Atomic clock

Online Resources:

KClass Science Channel: Rubber Bands and Potential Energy
https://www.youtube.com/watch?v=YOyrjm5zFDY

Science Buddies—Good site for all kinds of science resources, including videos.
https://www.sciencebuddies.org/

Additional Online Resources:

Additional detail on our rubber band activity
https://www.scientificamerican.com/article/bring-science-home-rubber-bands-energy/

Upper elementary resources and lessons
https://kcts9.pbslearningmedia.org/resource/hew06.sci.phys.maf.lpenergy/investigating-kinetic-and-potential-energy/

Cool rubber band science from KidsDiscover
https://www.kidsdiscover.com/teacherresources/a-lesson-in-potential-and-kinetic-energy/

Extension of Slinky Design Challenge
https://www.discovere.org/sites/default/files/A%20Sample%20of%20Slinky%20Science_0.pdf

Data Sheet

IT'S A S-T-R-E-T-C-H!: Classroom Activity

Student Name: Date

TRIAL A: Rubber band stretched to 10 cm	Distance traveled (in cm)
Rubber Band 1	
Rubber Band 2	
Rubber Band 3	
Rubber Band 4	
Rubber Band 5	

TRIAL B: Rubber band stretched to 15 cm	Distance traveled (in cm)
Rubber Band 1	
Rubber Band 2	
Rubber Band 3	
Rubber Band 4	
Rubber Band 5	

Which rubber bands traveled farther, Trial A or Trial B?

Did the bands in Trial A travel farther than 10 cm?

Did the bands in Trial B travel farther than 15 cm?

What conclusions about potential energy can you draw based on this activity? Use extra paper if you need it.