EDUCATOR'S GUIDE

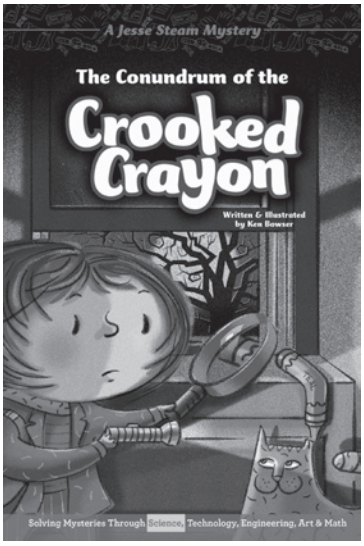
Jesse Steam: Solving Mysteries through Science, Technology, Engineering, Art & Math

Title: The Conundrum of the Crooked Crayon

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.



Lexile: 720 GRL: R 3,685 words

About This Book

In *The Conundrum of the Crooked Crayon*, Jesse and her friends observe phenomena powered by the Sun and made especially intense during the Summer solstice, the longest day of the year in the Northern Hemisphere. She also learns how a scientific tool can harness and amplify those awesome natural powers, making them even more awesome—and mysterious.

This title focuses on **science**.

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.

This title most closely relates to the standard covering Earth's place in the universe: **https://tinyurl.com/y4xp9s8r**

It also supports **https://www.nextgenscience.org/pe/4-ps3-2-energy**, which deals with the transfer of energy.

Background and Key Concepts

The Conundrum of the Crooked Crayon makes it very clear that the Sun is the "star" of the show on Earth! The giant furnace at the center of our solar system determines night and day, sunlight and shadow, warmth and chill, the seasons and so much more. You can use the book and this guide as a springboard to numerous learning opportunities, depending on your class's background and level of interest. No matter how you use it, we hope you'll encourage students to become active observers of the Sun-related phenomena happening all around us, every minute, wherever we are.

Major concepts include:

- The rotation of Earth in its own orbit roughly every 24 hours, causing night and day
- Earth's 23.5-degree tilt on its axis, which in combination with our planet's yearly orbit around the Sun causes different amounts of sunlight to be distributed to different parts of the world
- In the Northern Hemisphere, the summer solstice is the longest day of the year—the day with the most daylight hours. The winter solstice is the day with the least.
- In the Southern Hemisphere, this is reversed. Our summer is their winter; our shortest day is their longest, and so on.

Class Discussion

Have a globe (tilted at 23.5 degrees) and a flashlight handy before you begin.

Invite students to think about how much daylight they saw today. Did they notice more or less than yesterday? How about compared to last week? Write their observations on the board. Now ask if they expect more or less daylight tomorrow. Next week? Again, write their responses on the board and encourage them to talk about their answers.

Explain that the amount of daylight we experience increases or decreases every day, based on where in the calendar year we are relative to two special dates: the summer and winter solstices.

Ask a student volunteer to point out your school's approximate location on the globe. Discuss the fact that the United States is in the Northern hemisphere. Show various places in the Southern Hemisphere—South America, Australia, etc.

Now write these dates and facts on the board:

Northern Hemisphere

Summer solstice	Winter solstice
June 20, 21, or 22 (varies)	December 20, 21, 22, or 23 (varies)
"Longest day of the year"	"Shortest day of the year"

Write today's date on the board. Ask students where today falls in comparison to the summer or winter solstice. Are the days getting longer or shorter in your location?

Explain that when the Sun is directly overhead in one hemisphere, its rays are spread out the most in the other. You can demonstrate by darkening the room and shining a flashlight directly at the ceiling and then at different angles. (Or invite students to shine the light.) Ask the class to notice note the varying sizes and shapes of the illuminated sections. Explain that in a similar way, the Sun's energy spreads out over differing geographic areas when it reaches Earth's surface, causing more sunlight in some regions and less in others.

Note: PBS has an excellent animated video that makes Earth's spin on its axis and its path around the Sun clear and engaging. See the RESOURCES section on p. 3 of this guide for this link and others.

FEELIN' HOT, HOT, HOT: Student Activity/Demonstration

Note: For best results, try this on a sunny day.

In The Conundrum of the Crooked Crayon, Jesse's crayon melted because of two factors: 1.) The summer solstice was occurring, so the day had the most and the strongest amount of light possible; and 2.) A magnifying glass was focused on it, intensifying its heat by focusing the light on one spot.

For safety reasons, we recommend you conduct this as a whole-class demonstration rather than in teams. That way you will be the sole controller of the magnifying glass.

Materials you'll need:

- Two thermometers
- Two clear drinking glasses of water, filled halfway with room temperature water. Don't use paper or plastic cups.
- One magnifying glass
- One stopwatch (optional)

Materials for each student:

- One data sheet (copy ours from p. 4 or students can create their own or use their notebooks)

If you try the **Design Challenge** (below), you'll also need:

- Different durable containers: Ceramic cups, glass containers in different shapes and colors, including dark blue, green or black. Again for safety's sake, do not use paper, plastic, or metal.
- Copies of the Design Challenge portion of the data sheet for each student

Instructions

Invite students to gather around. Place the glasses next to each other near a window. Put a thermometer in each glass. Read the temperatures and have students record them on their data sheets. The two should be the same.

Now focus the magnifying glass on one of the drinking glasses. Watch the thermometer carefully. How much does the magnifying glass increase the temperature? How long does it take? Repeat the experiment a couple of times to confirm the results.

Design Challenge

Students now have an idea of how long it takes for a magnifying glass to raise the temperature in a clear drinking glass. Assemble the containers you brought in. Ask students if they think the color, shape, or materials the container is made of can change the magnifying glass's powers to heat the liquid inside. Encourage them to share their thoughts. Try the experiment on the various containers, using one of the original clear drinking glasses as a control.

They should write a short description of each container you try and record the temperature. What materials or colors make the best conductors? Insulators? What other conclusions can they draw?

YOU'VE GOT FRIENDS IN LOW(ER) PLACES: Research Project

Invite students to choose a research partner. Ask each pair to come up and spin the globe and randomly select a country or major city in the Southern Hemisphere. Their job is to research the location and see how seasons reversed from ours affect daily life. For instance, if summer is winter, when do kids go to school? When are they on vacation? What is it like to celebrate winter holidays in summer?

Suggest they find visuals online or in magazines to create illustrated reports they can share with classmates. Encourage them to add poems, songs, a picture story for kindergarteners—creative expressions that will tell something special about their Southern Hemisphere location. Under your supervision, perhaps you can find a school to "adopt" and start a class pen pal project.

If you have access to the internet in the classroom, timeanddate.com is a wonderful research tool. It has a world clock, loads of maps, charts, calculators, weather data, articles, and fun facts. It customizes to your location, so all information is relative to where you are.

As part of this project or an extension, students research pairs might enjoy using timeanddate.com to track sunrise and sunset at other locations for a week or two. Then they can make a graph that tracks the changing amount of daylight over time, comparing it to the rate of change at home.

Additional Online Resources:

All about the Moon: Downloadable 158-page guide to the Moon for grades 4-12
https://www.nasa.gov/pdf/58199main_Exploring.The.Moon.pdf

Solstices: https://www.timeanddate.com/astronomy/facts-about-june-solstice.html

Videos

Why Do We Have Seasons?
https://kcts9.pbslearningmedia.org/resource/npls13.sci.ess.seasons/why-seasons/

NASA's dedicated STEM channel on YouTube
https://www.youtube.com/channel/UC9SM7V7J1pAhPabOUST01fw

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Data Sheet

FEELING' HOT, HOT, HOT

Students Name _____ Date _____

OBJECT	TEMPERATURE
Clear drinking glass #1	
Clear drinking glass #2	
Clear drinking glass #1 (no magnifying glass)	
Clear drinking glass #2 (magnifying glass)	
Clear drinking glass #1	
Clear drinking glass #2	
Clear drinking glass #1 (no magnifying glass)	
Clear drinking glass #2 (magnifying glass)	

What did you learn? Write your analysis below. Use extra paper if necessary.

Design Challenge

OBJECT	TEMPERATURE
Clear drinking glass (control)	
Container (describe below)	
Clear drinking glass (control)	
Container (describe below)	
Clear drinking glass (control)	
Container (describe below)	

What did you learn? Write your analysis below. Use extra paper if necessary.