

S.T.E.A.M. 5TH GRADE PENDULUM PROJECT: CREATE A NEWTON'S CRADLE AND WRITE ABOUT IT

Directions, rubric, anchor standards, resources, and anticipatory set included.

Overview

Designed for a highly gifted classroom, but great for any fifth grade class looking for a challenging and creative independent project to complete their unit on pendulums, this document contains Tips for the Teacher, Materials needed, Anchor standards addressed, an anticipatory set based on Carol Ann Tomlinson's approach for gifted students beginning long-term projects, a detailed 100 point rubric, a list of helpful resources, and a suggested timeline for completion.

Daryl Reeves
[Email address]

Tips for the Teacher

Thanks for your interest in this project! I hope you find it helpful in addressing your students' needs. This document was created with my specific program in mind, and every teacher should feel free to adapt it according to their own population. Here are a few things I've picked up over the years, regarding this project:

- Creating the Newton's Cradle is not entirely intuitive. Even with the guidance of the websites, your students will likely struggle with getting it to work. My advice is to not only allow this struggle, but to celebrate it. Particularly regarding the gifted population, many students need to learn how to cope with a task that doesn't come easily, and many valuable lessons can be learned from trying and failing before trying and succeeding. It's a great opportunity to address some social-emotional needs and to showcase many other great minds who never gave up.
- Have students journal, or take notes, on their journey to complete the Newton's Cradle. Emphasize that they pay particular attention to strategies they tried that they later had to revise, because they will be asked to include these attempts and solutions in their short essay. If they are not journaling, they are likely to forget what they tried before they succeeded.
- I would advise against demonstrating a step-by-step assembly of the cradle. In my experience, handing the students the materials they will need and providing the online resources has been enough to get them started, and I have learned that over-scaffolding removes the rigor from this project.
- I use this project at the beginning of the year, so I ask parents over the summer to collect shoe boxes (many people buy back-to-school shoes, so you don't want to miss this opportunity). It has never been difficult to collect one per student by the time we need them if I think ahead. The only real cost for this project is the beads. I have exclusively used hematite because I like the weight of them and they were affordable, but I'm sure other beads would also work well. Some stores are happy to give a discount to a teacher if the project is explained to them, but if you have the time, see if you can get the beads funded on [DonorsChoose.org](https://www.donorschoose.org) or receive a donation from a parent. Another possibility is recycling the beads at the end of the project so that you can use them year to year, but even if you offer to let your students take their Newton's Cradles home, as I do, you will likely have some who will not, and you can easily reuse the beads to save cost.

Materials Needed

- One shoe box, any size, per student
- 5 beads per student
- Light-weight string, five strands per student
- Scissors
- Tape
- Staplers
- Hole punchers

Pendulum Project: **Newton's Cradle**

Due Date: _____

Anchor Standards:

- Conduct short research projects that build knowledge about a topic.
- Use technology, including the internet, to produce and publish writing and to interact and collaborate with others.
- Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.

Thinking Questions: (worth 2 points each)

1. List the variables that affect the rate of a pendulum's swing.
2. Compare/Contrast a pendulum swinging in air and in water.
3. What would happen if you swung a pendulum on the moon? What effect do you think the difference in gravitational force would have on the pendulum?
4. Would you rather be an outside marble on Newton's Cradle or an inside marble? Explain why.
5. How would it feel if your arms were pendulums? What tasks would be easier and what tasks would be harder?
6. Why is learning about pendulums worthwhile?
7. How will you conduct your research of Newton's Cradle?

Activity: (worth 6 points)

Make a list of questions you would want to ask Galileo about his use of pendulums in experiments.

Directions:

On a separate piece of paper, **thoroughly** answer the thinking questions and address the activity before beginning your project. This portion of your project is worth 20% of your final grade, so be thoughtful and thorough in your responses.

Pendulum Project Rubric

Using the materials provided to you in class, create Newton's Cradle. Write a short expository paper to accompany your project detailing any problems you encounter and how you overcome them, and summarizing your understanding of how Newton's Cradle works.

Criteria for **Newton's Cradle**: (worth 50 points)

You earned:

- Assembly is solid. (5 points) _____
- Newton's Cradle works properly. (10 points) _____
- Written explanation of student's process and any troubleshooting is included. (10 points) _____
- Writing includes a brief explanation of why Newton's Cradle works. (10 points) _____
- Newton's Cradle is attractive; care was taken in its assembly. (5 points) _____
- All writing is in student's own words. (10 points) _____

Total: _____

Pre-Activity: (worth 20 points)

- Thinking Questions (14 points) _____
- Activity (6 points) _____

Total: _____

Essentials: (worth 30 points)

- Project and paper clearly include first name, last name, the date, and the title: (5 points) _____
- Is turned in on time: (5 Points) _____
- Grammar, Spelling, Punctuation, and Capitalization are correct: (5 points) _____
- Demonstrates attention to neatness (project assembly is neat and paper is typed or neatly written in ink: (5 points) _____
- Demonstrates considerable effort: (5 points) _____
- Student was on task in class: (5 points) _____

Total: _____

Recommended Resources

- http://www.ehow.com/inro_8417546_use-pendulums-real-world.html
- http://www.ehow.com/how_5534301_build-newtons-cradle.html
- http://en.wikipedia.org/wiki/Newton's_cradle
- http://galileo.rice.edu/lib/student_work/experiment95/galileo_pendulum.html
- *The Pulse of Time: Galileo Galilei, the determination of longitude, and the pendulum Clock* by Silvio A. Bedini
- *Pendulum: Leon Foucault and the Triumph of Science* by Amir D. Aczel
- *Galileo's Pendulum: From the Rhythm of Time to the Making of Matter* by Roger G. Newton
- *Galileo for Kids: His Life and Ideas, 25 Activities (for kids series)* by Richard Panchyk
- *Eyewitness Science*
- *Why Toast Lands Jelly-Side Down* by Robert Ehrlich
- *The Pendulum: A Case Study in Physics* by Gregory L. Baker

Suggested Timeline

This was designed to be a two week project, however it can easily be extended or minimized based on your population and on what you want to emphasize. If you want to use it to work on expository writing, you may want to extend your time frame and focus on that aspect of the project. If you feel your students may need more time in assembly, adjust accordingly. Treat this as an outline to be revised.

Day 1: Introduction of project. Directions, resources, and materials are presented.

Day 2: Begin research and notes for first paragraph of essay.

Day 3: Create a draft of first paragraph.

Day 4: Revise and edit first paragraph.

Day 5: Begin construction of Newton's Cradle. Take notes on any difficulties encountered.

Day 6: Continue construction of Newton's Cradle. Take notes on any difficulties encountered.

Day 7: Complete Assembly of Newton's Cradle. Take notes on any difficulties encountered.

Day 8: Write draft of reflection paragraph.

Day 9: Revise and edit reflection paragraph.

Day 10: Re-check the rubric to ensure you have missed nothing. Complete any finishing details in the presentation of Newton's Cradle and/or essay.