

# Roller Coaster Lab Report

**Student Name:**

**Roller Coaster Name:**

**Date:**

**Class/Section:**



## Sixth Grade Science Roller Coaster Project



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### General Information Overview

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#### The Purpose and Goals for this Project:

1. You will research, document notes using Cornell Notes, write and document resources in a bibliography expressing your understanding of **force, motion, energy, history of roller coasters** and **scientists** involved. AND write a creative, narrative story explaining these important concepts. Teach the reader about these concepts.
2. The design of your team's coaster will further demonstrate that you understand forces, motion, and energy scientific concepts.
3. Your team will use and apply the engineering design process to solve this problem and record this information to a LAB REPORT.
4. Our goal is to continue to improve on cooperative lab group skills, and learn the value of teamwork. Your success and grade will depend on how well your construction team can manage the time and materials given.

#### Individual Requirements:

- A. **T-charts/Cornell Notes:** Research all topics on force, motion, energy, roller coaster history and scientists. (**Homework grades**)

B. **Research Paper (Test grade):** Write a narrative research paper including a bibliography. Paragraphs will include the following:

- Introduction**
- Force**
- Motion**
- Energy**
- Roller Coaster History**
- Scientist(s)/Engineers**
- Conclusion**
- Bibliography**

C. **Roller Coaster Construction Team Member:** Do your job as a team member. Commit to doing your job, bringing in your portion of the supplies and being present on the days of construction. **(Homework grade)**

D. **DAILY JOURNAL:** Each member of the team is responsible for keeping a journal of their rollercoaster's progress and continuing plans. **(TEST grade)**

### **Team Requirements:**

1. **CONSTRUCTION:** Build a roller coaster that meets all criteria using only the required materials **(Double Lab grade)**
2. **TESTING YOUR HYPOTHESIS:** Test your roller coaster, **collect data** on a **chart** and then **graph it on computer using Excel**. **(Lab grade)**
3. **FINAL LAB REPORT:** Document the Engineering Design Process from your plans and observations in your notes. **(Lab grade)**

## **ROLLER COASTER DESIGN & CONSTRUCTION TEAM:**

- ✦ Each member is assigned a role and is responsible for the development and construction of the roller coaster.
- ✦ Bring in needed supplies on time as agreed.
- ✦ Participate in the construction of your team roller coaster per your job responsibility.
- ✦ Create a unique company name & logo and submit both for approval
- ✦ Label your roller coaster where different forces, motions or energy are present (important curves, loops, hills, corkscrews, etc.)

## **JOB DESCRIPTIONS & RESPONSIBILITIES:**

### **Construction Superintendent {C.S.}**

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**(Organizes and communicates)** (highly organized / a leader/ writer/ planner/ reads and follows direction well)

- Oversees and directs the entire project
- Responsible for daily organization and plan for each member
- Helps build / type reports / problem solve / clean up
- The **only** person that reports to the C.E.O. (the teacher!)

### **Building Foreman {B.F.}**

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**(Set-up and clean-up)** (math & computer skills)

- responsible for management of materials and proper storage of construction project
- Responsible for getting materials and supplies out & put up each day
- Reports any problem to Construction Superintendent
- Helps build / type reports / problem solve / clean up

### **Financial-Operations Manager {F.O.M.}**

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**(Financial data entry)**(math /computer /hands-on skills/ measurement skills)

- Writes out daily materials list
- Measures out materials and **collects data** on use of materials
- Helps build / type reports / problem solve / **clean up**
- Reports any problems to Construction Superintendent

### **Jobsite Worker {J.W.}**

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(great typing skills, following written directions, computer use)

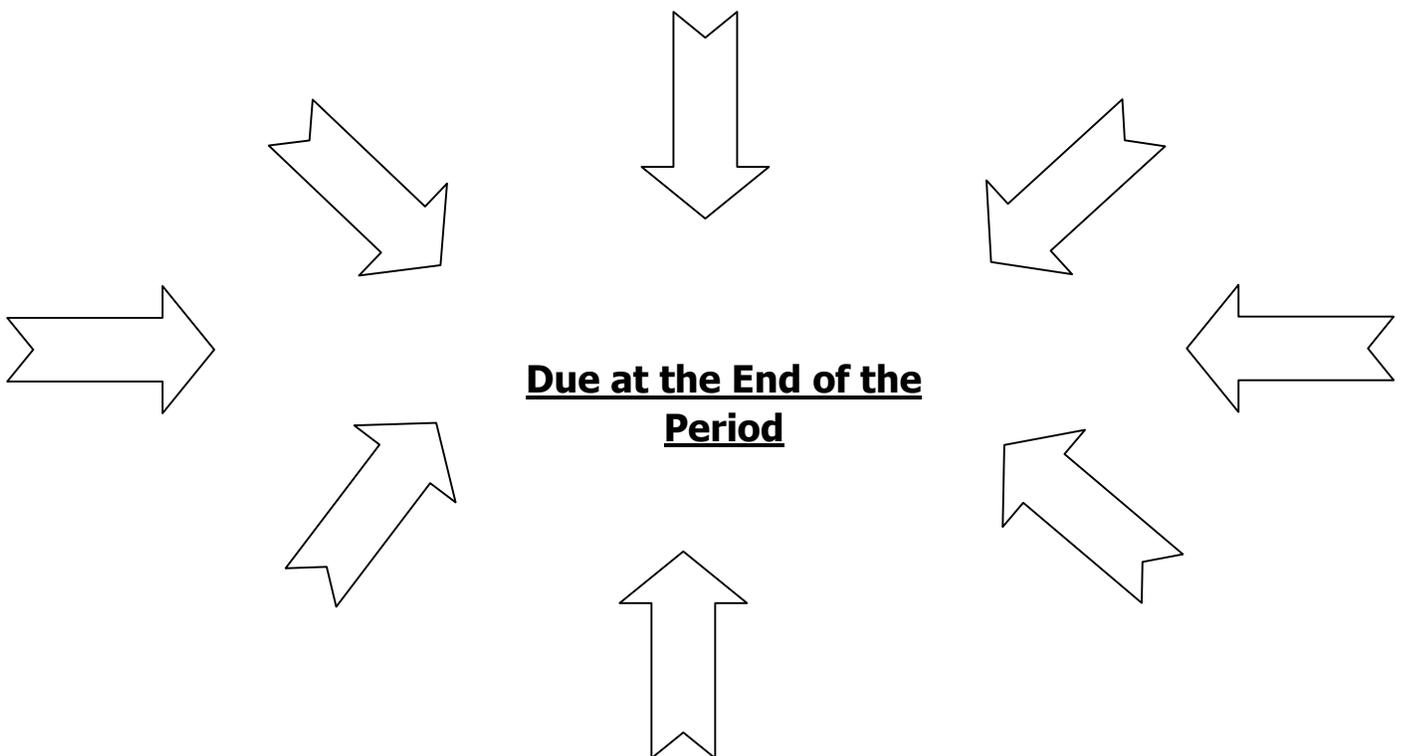
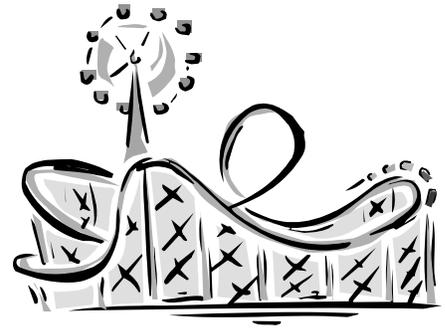
**Main** typist for reports.

- Helps build / problem solve / clean up
- Reports any problems to Construction Superintendent

## FINAL LAB REPORT:

Includes these items in this order:

- Title page**
- ASK:** Question or Problem
- IMAGINE:** Hypothesis
- PLAN:** Materials List and Step by step procedure
- CREATE:** Journals and Variables List ( Independent variable, dependent variable, controlled variable)
- IMPROVE:** Collected data, graphs, written analysis of what you observed based on data collected.
- SHARE:**
  - Was your hypothesis supported?
  - What data supports or rejects your hypothesis
  - What did your group learn from this experiment
  - What worked well? What would your team do differently?



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## Part 2: Doing Background Research & Developing a Hypothesis

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### Taking Notes:

Use Cornell Notes format (T-chart) to take notes. See calendar for due dates.

#### EXAMPLE:

TOPIC: FORCE

Star Idea: Inertia	<ul style="list-style-type: none"><li>• Several</li><li>• Points</li><li>• About</li><li>• The star</li><li>• Idea</li></ul>
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**Introduction:** *What can we expect to learn when we read your paper?*

**Forces (choose 3 to focus on)**

Force

Inertia

Mass

Balanced/Unbalanced force

Friction

Gravity

Mass and weight difference

Internal vs External Forces

**Motion (choose 3 to focus on)**

History of Newton's Laws of Motion

First law of motion (definition and example)

Second law of motion (definition and example)

Third law of motion (definition and example)

Reference points

Distance

Acceleration

Displacement

Speed

Calculating speed

Velocity

Changing velocity

Calculation of acceleration (definition and example)

**Energy (research all)**

- Potential
- Kinetic
- Mechanical
- How does resistance impact energy? (friction or air)

**History of Roller Coasters (research all)**

- When were they first built?
- Who or where were rollercoasters first built and why?
- How roller coasters work (gravity, energy)
- Roller coaster safety
- Famous roller coasters

**Scientist(s)/Engineers (research all)**

- Who were the scientists who founded the ideas/theories about force, motion and energy?
- What are the theories/ideas of force, motion and energy?
- When in history did they find/create/invent these ideas/theories?
- Why is this important to know or understand?

**Conclusion:** Summarize what we learned from reading your paper.

**Bibliography:** Using APA format, record the resources used in the creation of your research paper. Your LA teacher will assist you with formatting.

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## Part Three: Designing an Experiment to Test Your Hypothesis Using the Engineering Design Process

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### ENGINEERING DESIGN PROCESS:

**ASK:** Asking the question and/or defining the problem.

**IMAGINE:** Doing background research (paper) and developing a hypothesis.

**PLAN:** Designing an experiment to test the hypothesis

**CREATE:** Conducting the experiment & collecting data

**IMPROVE:** Analyzing the data and deciding what could be improved

**SHARE:** Communication the results of the experiment

### Where to start....

1. Assign job responsibilities.
2. Discuss and plan what your roller coaster will look like. Draw it out.
3. Collect materials for building your roller coaster.
4. Fill in your LAB REPORT.

### ROLLER COASTER REQUIREMENTS:

1. **MUST** be completed in 3 days.
2. **MUST** be constructed using only **approved recyclable materials**.
  - a. Duct tape
  - b. Paper towel or toilet paper tubes
  - c. 2 liter bottles
  - d. Glue (not hot glue)
  - e. Modeling Clay
  - f. Cardboard
  - g. Oatmeal boxes
  - h. Tube insulation
  - i. Masking tape
  - j. Popsicle sticks for additional support
3. **SIZE:** 1 foot square base and height of no more than 3 feet. The roller coaster may not exceed construction base size.
4. **FEATURES:** Curves, hills and/or loops
5. **BEGIN/END:** Have an attached starting gate and ending gate to catch the "car".

6. **Passenger safety** (simulated by marbles) is most important. It cannot come off of the track!
7. **NAME:** Make up a unique name for your roller coaster
  
8. **LABEL ALL CONCEPTS LISTED:** Identify and label **on the roller coaster** the following **physics concepts:** (SEE GRADE SHEET AT END)
  - A pushing **force**
  - A pulling **force**
  - A combined **force** (pushing or pulling) in the same direction
  - A combined force in opposite directions
  - A change in **speed**
  - A change in **velocity**
  - A section of track showing mass decreasing speed (**Newton's 2<sup>nd</sup> Law**)
  - A section of track showing mass increasing speed (**Newton's 2<sup>nd</sup> Law**)
  - Two places in which inertia is overcome (**Newton's 1<sup>st</sup> Law**)
  - A point showing **potential energy**
  - A point showing **kinetic energy**
  - An example of action-reaction (**Newton's 3<sup>rd</sup> Law**)
  - A point showing **momentum** either increasing or decreasing

**Time Management and Teamwork** are the keys here!

1. What can you get done in advance? Make tags for the features you will highlight on your roller coaster.
2. Fill in parts of the LAB REPORT.
3. Plan how much you will get built each day (1 foot).

Materials lost because of **poor management** become the responsibility of the team.

**ASK:** Asking the question and/or defining the problem.

Which will be faster? 1 car, 2 cars or 3 cars on my roller coaster.

**IMAGINE:** Develop a hypothesis; what is the answer to your question.

**PLAN:** Designing an experiment to test the hypothesis

Roller coaster drawing with labels, name with beginning and end. Include a list of materials needed to complete the construction of your roller coaster.

**CREATE:** Conducting/Building the experiment & collecting data

After the Roller Coaster is built you will be given 3 marbles of different masses. These marbles will represent the masses of the roller coaster cars.

***Read all of the following direction carefully. Ask yourself these questions:***

1. What am I trying to find out? (ASK)
2. How will I measure what I find out?
3. How will I record what I measure?

***Procedure for testing the roller coaster:***

1. Begin with the single marble.
2. Place the marble at the starting point on your roller coaster.
3. At the signal, release the marble and time how long it takes to move from the starting point to the end point of the roller coaster.
4. Record this data in your chart.
5. Repeat steps 2 – 4 for a total of five times.
6. Repeat steps 2 – 5 with each marble.

Do not count trials that are incomplete – the bearing falls off or does not move down the entire track.

## Comparison of Speed and Car Mass

Variable #1	Rollercoaster	Car Mass	grams
trial #	length of track in cm	time in seconds	coaster speed in cm/s
1			
2			
3			
4			
5			
Average			

Variable #2	Rollercoaster	Car Mass	grams
trial #	length of track in cm	time in seconds	coaster speed in cm/s
1			
2			
3			
4			
5			
Average			

Variable #3	Rollercoaster	Car Mass	grams
trial #	length of track in cm	time in seconds	coaster speed in cm/s
1			
2			
3			
4			
5			
Average			

What is the formula for speed? Write it below. Then calculate the speed for each trial and variable.

**IMPROVE:** Analyzing the data and deciding what could be improved

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## Part Five

### Analyzing the Data and Drawing Conclusions

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Before you begin, answer the following questions:

1. What is the **independent variable** in this investigation?

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2. What is the **dependent variable** in this investigation?

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3. List variables that must be **controlled** in this investigation.

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4. When you graph data, where is the independent variable on the graph?

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5. Where is the dependent variable on the graph?

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6. Look at the type of data you collected in this investigation. What kind of graph is best for this data?

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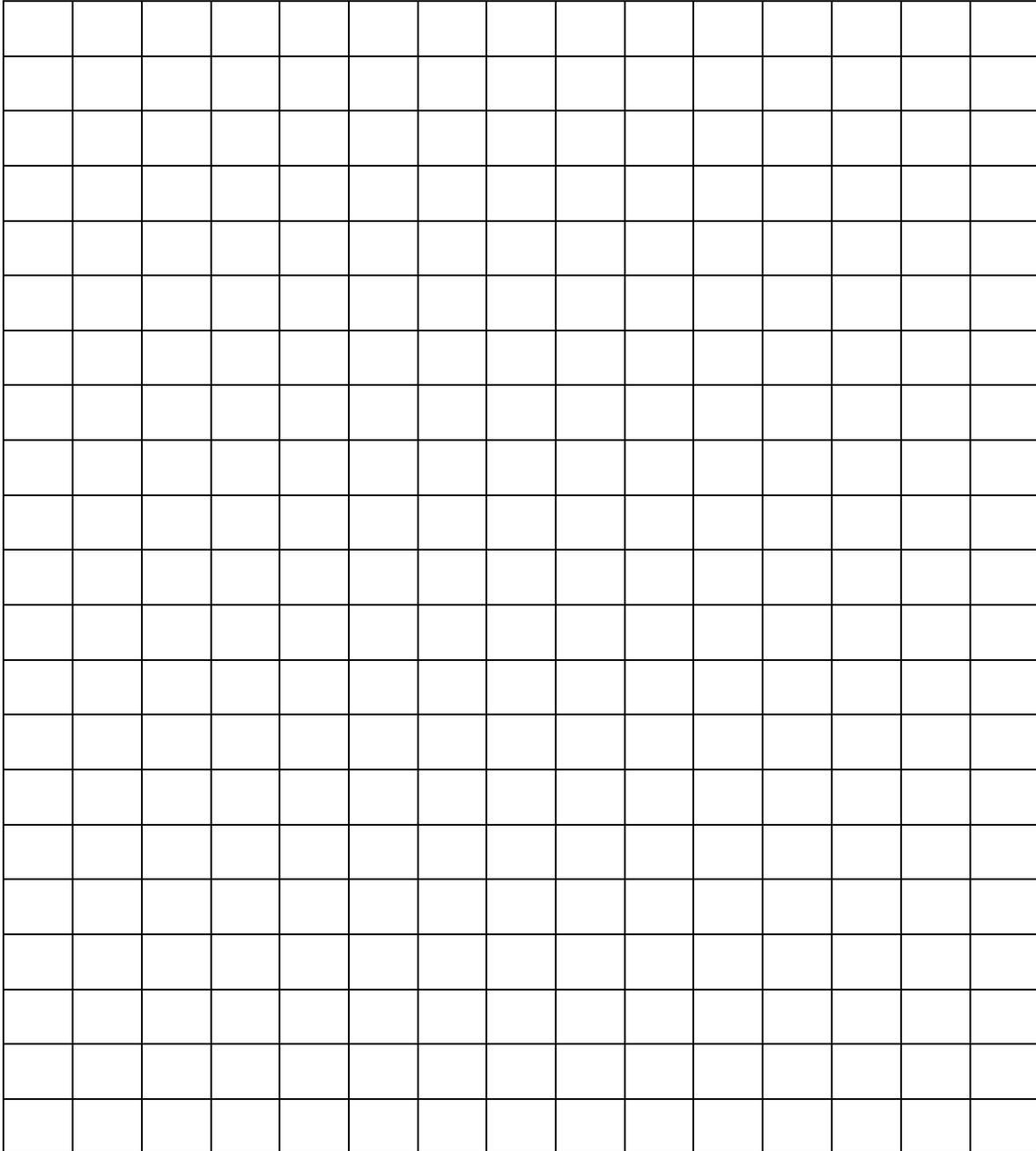
Why?

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## Data Analysis:

Make the appropriate graph of your data. Remember to include a title that describes the data, labels on each axis, and the unit(s) of measurement. Have your teacher initial the graph.

Graph:



Now, use Excel to create a professional quality graph of your data.

Look at the graph carefully. What pattern or relationship do you see? In other words, what did the independent variable have to do with the dependent variable?

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**SHARE:** Communicating the results of the experiment

**Conclusion:**

Restate the answer to your question and identify if your hypothesis was supported or rejected and why. What did you learn from this experiment (force, motion, energy)? What worked well and what could be improved next?

## Roller Coaster Design

Requirement	Possible Points	Points Earned
Attached starting gate	5	
Attached ending gate	5	
Pushing force	5	
Pulling force	5	
Combined force in same direction	5	
Combined force in opposite direction	5	
Change in speed	5	
Change in velocity	5	
A section of track showing mass decreasing speed (2 <sup>nd</sup> Law)	5	
A section of track showing mass increasing speed (2 <sup>nd</sup> Law)	5	
2 Places in which inertia is overcome (1 <sup>st</sup> Law)	10	
A point showing potential energy	5	
A point showing kinetic energy	5	
An example of action-reaction (3 <sup>rd</sup> Law)	5	
A point showing momentum either increasing or decreasing	5	
Safety (marbles don't fall off)	10	
Size	10	