

Doing A Meaningful Scientific Discovery STEM Fair Project



The Scientific Discovery Process

These are the required steps when doing a project using the Scientific Discovery Process.

- Purpose
- Research
- Hypothesis
- Designed Plan and Data Gathering Methodology:
 - Write down the materials you will need
 - Write the step-by-step instructions you will follow
 - Write the variables of the experiment
 - Write the data gathering plan you are using
- Execution: Data Collection and Analysis
- Interpretation

What is Your Purpose?

- The purpose shows that you are going to solve a problem or find out something you don't know. **Write your purpose in your journal.** This is what you want to investigate.



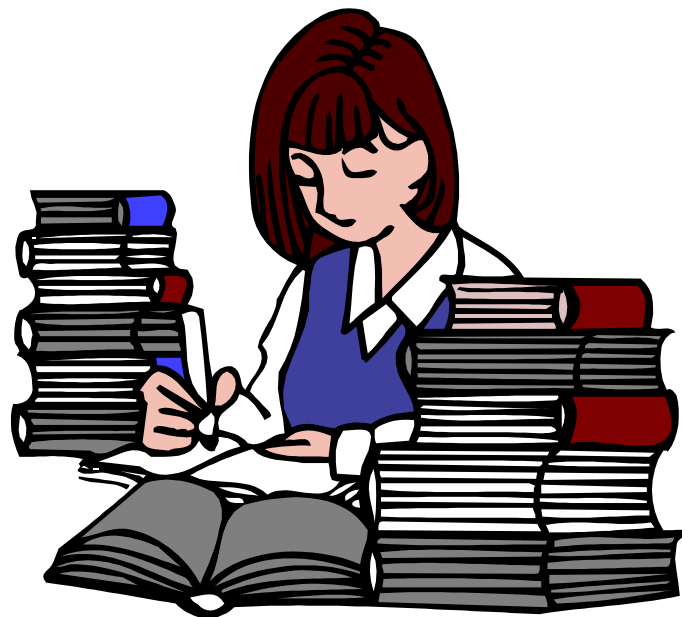
Purpose

Does changing the weight placed on a vehicle affect the speed of the vehicle moving on the floor?



Research Your Topic

- Before you begin experimenting, you some background information by using some of these resources:
 - Encyclopedias
 - Science Magazines
 - Science Textbooks
 - Library Books
 - Internet
 - Interviews
 - Letters
 - Phone Calls
- You need to research your topic by using at least three resources.
- Record the information you learned about in your journal.



Research Your Topic

(Textbook) ScienceSaurus (2004)

Gravity is a force of attraction that pulls objects toward the earth's surface. All objects regardless of their weight fall at the same speed toward Earth when there is no air resistance. (Air resistance will slow lighter objects down.) All objects will increase its speed 32 feet per second for each second it falls toward Earth. Things fall a little faster at the equator than it does at the poles.

(Website) physicsclassroom.com (1983)

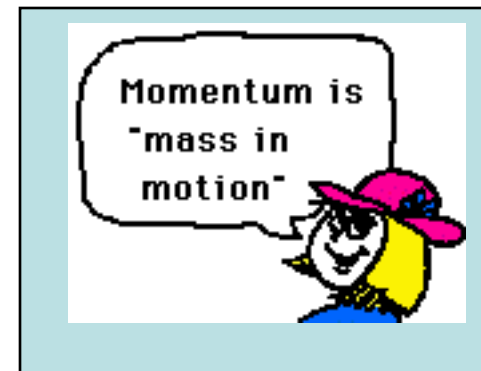
Momentum can be defined as "mass (weight) in motion." All objects have mass; so if an object is moving, then it has momentum which is mass in motion. The amount of momentum which an object has depends on the mass of the object and how fast it is moving. So in other words momentum depends upon the mass (weight) and velocity (speed). In terms of an equation, the momentum of an object is equal to the mass of the object times the velocity of the object $\text{Momentum} = \text{mass} \times \text{velocity}$

(Continue to write a paragraph.)

(Encyclopedia) Funk and Wagnell (1983)

Friction is the resistance of two objects coming in contact with each other which interferes with their movement. Friction can be found in sliding, rolling, or flowing motion of an object in relation to another object with which it is in contact. There are two things that determine friction. One is what the two surfaces are made of. The second one is how hard they are pressing against each other.

(Continue to write a paragraph.)



Make a Hypothesis

- You are ready to make a prediction of what you think the results of your experiment will be in your journal.
- Based on your research, what do you think will happen when you do your experiment?
- **You also need to put an explanation in your journal as to “why” you chose this hypothesis.**
- **Example:**

Hypothesis:

When light shines on an object, the object will become hotter at a direct angle than on an indirect angle.

Explanation:

Light shining straight down covers a smaller area than shining on an angle. When on an angle, more heat is spread out causing less heat on the object.



Hypothesis

If I increase the weight in the back of the truck by one pound each time the truck goes down the ramp, then the truck will go faster on the floor each time.

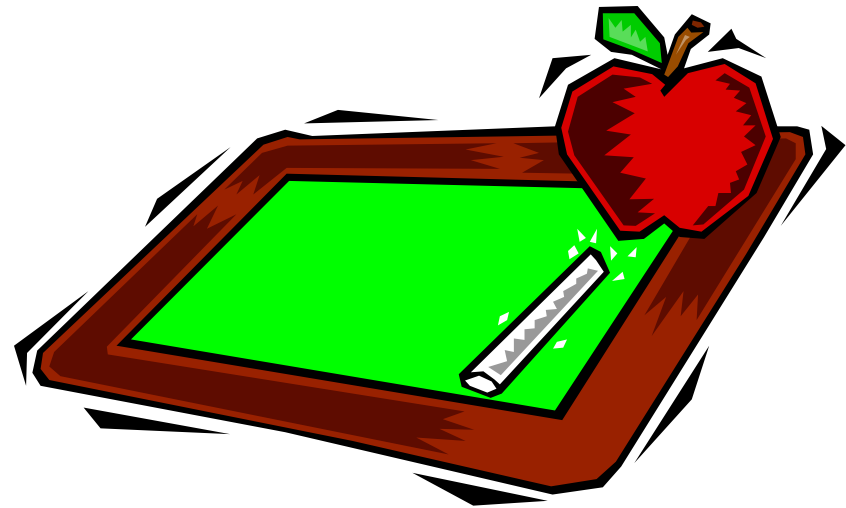
Even though gravity pulls on all objects at the same speed, the increasing weight will give the truck more momentum to travel faster.



Designed Plan and Data Gathering Methodology

“List of Materials”

- At this time you need to make a list in your journal of materials you are going to need for your experiment.
- Be sure to make your list very complete with describing words.
- Tell of all measurements and quantities you are going to use.



Designed Plan and Data Gathering Methodology

“List of Materials”

- Particle board, 8 feet long, 18 inches wide, and 1 inch thick.
- Stopwatch, measuring in hundredths of seconds.
- A 15-inch chair seat.
- The board set at a 25 degree angle.
- 50-foot floor length.
- 10 bags of sand, 1 pound each.



Designed Plan and Data Gathering Methodology

“Step-by-Step Directions”

- You need to write the directions of the procedure you are going to follow to do the experiment in your journal.
- These directions tell exactly the process you are going to follow as you do your experiment.
- As you write your directions in your journal, you have to be sure your test is fair. Keep all the conditions the same each time you do the experiment.



Designed Plan and Data Gathering Methodology

“Step-by-Step Directions”

1. Place the ramp on a 15-inch chair at a 25 degree angle and have the end of the ramp 50 feet from a wall.
2. Put a one-pound sandbag in the back of the truck.
3. Put the truck on the ramp and let it go down the ramp.
4. Begin the stopwatch when the front wheels hit the floor.
5. When the truck has gone 50 feet and hits the wall, stop the stopwatch.
6. Record the data.
7. Repeat by adding a bag to the back of the truck until they are all used.



Designed Plan and Data Gathering Methodology

“Controlled and Experimental Variables”

- “**Variable**” means something can change.
Everything around us has the possibility of changing so we live among variables. Variables are all the factors that have an effect on your experiment.
- You want to control most of the variables so they are called **the controlled variables**.
- You only want to change one variable to have a different outcome each time you do your experiment. This is called the **experimental variable**.
- Write your **controlled** and **experimental** variables in your journal.



Designed Plan and Data Gathering Methodology

“Controlled and Experimental Variables”

- My Control
 - How fast the truck rolls empty
- My Controlled Variables
 - The chair
 - The truck
 - The stopwatch
 - The 8-foot board
 - 50-foot floor run
 - 25-degree angle board
- My Experimental Variable
 - The ten bags of sand.



Designed Plan and Data Gathering Methodology

“Data Gathering Plan”

- Before you begin your experiment, you need to write in detail your Data Gathering Plan.
 - Be sure it is:
 - Well designed
 - Well organized
 - And Systematic



Designed Plan and Data Gathering Methodology

“Data Gathering Plan”

- Each time the truck goes down the ramp, I will be adding another bag to the back of the truck.
- I will time it to see how fast it goes.
- For this purpose I will see if the truck goes faster or slower on the floor.



The Execution:

Data Collection and Analysis

“Data Collection”

- Be sure to write down the data you are observing in your journal.
- Be sure to collect sufficient data to make a reasonable conclusion.
- Organize your raw data into a chart or table in your journal.
- Test your experiment at least twice so it is valid.



The Execution: Data Collection and Analysis “Data Collection”



Raw Data

No bags took 9.09 seconds

1 bags took 8.57 seconds

2 bags took 8.06 seconds

3 bags took 7.97 seconds

4 bags took 7.93 seconds

5 bags took 7.88 seconds

6 bags took 7.69 seconds

7 bags took 7.63 seconds

8 bags took 7.59 seconds

9 bags took 7.50 seconds

10 bags took 7.44 seconds

The Table

Bag Number	Speed in seconds
No Bag (Control)	9.09 seconds
Bag #1	8.57 seconds
Bag #2	8.06 seconds
Bag #3	7.97 seconds
Bag #4	7.93 seconds
Bag #5	7.88 seconds
Bag #6	7.69 seconds
Bag #7	7.63 seconds
Bag #8	7.59 seconds
Bag #9	7.50 seconds
Bag #10	7.44 seconds

The Execution: Data Collection and Analysis “Data Collection”



The Execution:

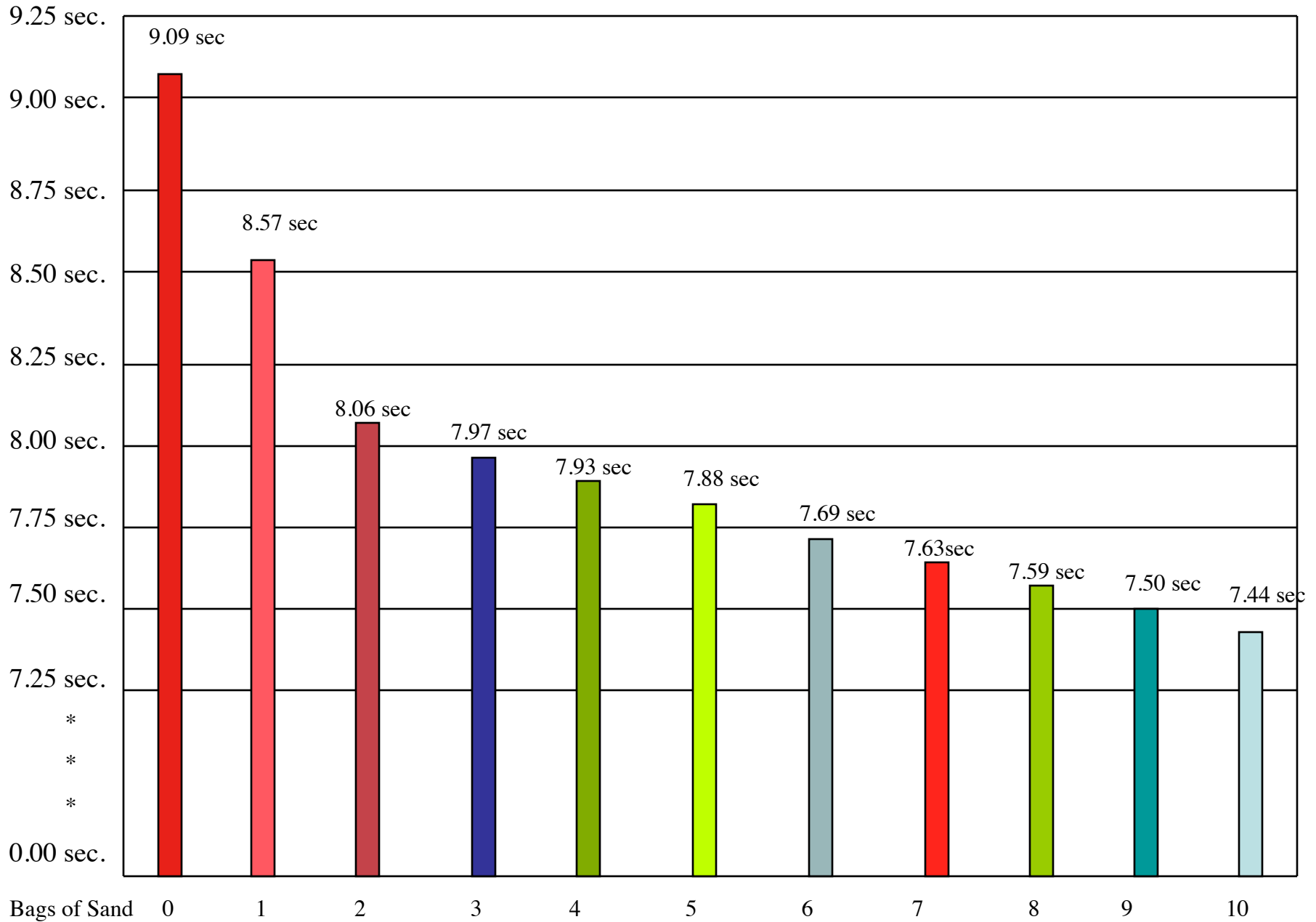
Data Collection and Analysis

“The Graph”

- Make a graph of your data.
- Be sure it is accurately made with all the parts labeled.
- Be sure the graph shows appropriate mathematical and statistical methods.
- Be sure the graph shows strong data comparisons
- Be sure the graph shows the reproducibility of the results.



The Execution: Data Collection and Analysis “The Analysis”



The Execution:

Data Collection and Analysis

“The Analysis”

To analyze mean to break something up into parts to be able to examine it. That is what you have to do with the data on the graph.

- **Write an explanation describing what the graph is telling you and the comparisons you see.**
- **Be sure the explanation is accurate and makes sense.**



The Execution:

Data Collection and Analysis

“The Analysis”

- I noticed that there is a big jump from the truck that didn't have anything in it to the truck that had one sand sack in it.
- There was even a big jump from the truck that had one sand sack in it to the truck that had two sand sacks in it.
- Then I noticed that the times from the 2nd sand sack to the 10th sand sack didn't speed up that much, only a few hundredths of a second.
- This tells me that even though there was more energy in the truck each time because it went faster each time, that the weight in the back of the truck was being affected by gravity each time.

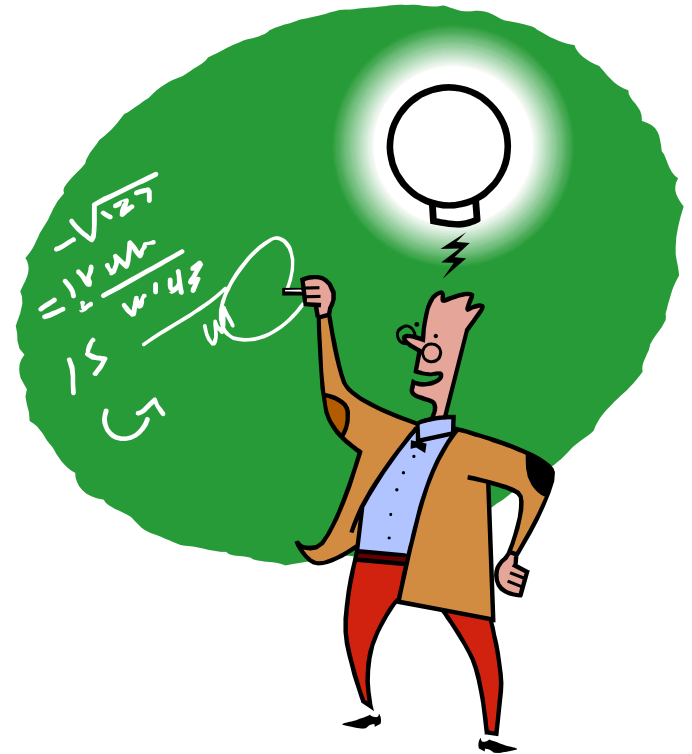


The Interpretation

“What Did You Find Out?”

Write about these ideas in your journal and anything else you can think of.

- Write what you found out.
- Write what you what you learned from your investigation.
- Write other questions you might have now.
- Write what you might do differently next time.
- Tell general statements how this relates to the world.
- Write what connection your results shows with a real world application which shows a transfer of knowledge.
- Does what you wrote show evidences of learning?



The Interpretation

“What Did You Find Out?”

- I found out that the first two bags carried by the truck showed a huge increase in speed (which was a decrease in time) showing the momentum that can be acquired by weight. After that the speed did increase but I noticed that it didn't increase as much each time. This tells me that the weight of the bags are being affected by gravity and causing more friction and slowing the truck down so it couldn't increase as fast.
- I think that if I increased the weight more and more that eventually gravity would pull on the truck more causing an increase in friction and slow it down even more. This would cause less momentum. It might get to the point where the truck would travel slower than when there was no sand in the truck at all. This would be another science experiment.
- I know that it takes energy for a truck to carry things. The more they carry more energy is needed to transport stuff. So as the load gets bigger and bigger more power is needed to keep the momentum up to keep the speed up.
- Gravity can be a big help to us, but is also a hindrance to us when the weight of something increases. More energy is needed to keep up the same amount work that when the weight is increased.



The Display Board

This is your Showcase!

You need a display board.

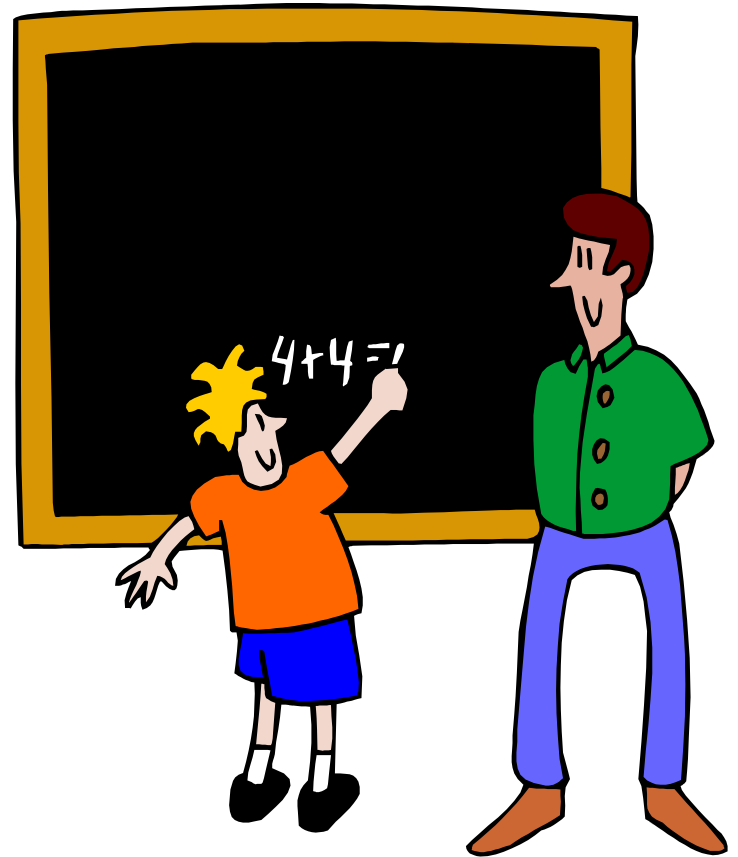
- All the steps with explanation of the Scientific Discovery Process should be on the display board: **Purpose, Research, Design Plan, Data Collection and Analysis, and Interpretation.**
- Research need not be on the board, but your reference cites needs to be on the board.
- Give yourself at least 1 week to make your display board.
- Make it:
Neat, Creative, Easy to Follow, Errorless (no scribbles), and Informative
- Your display board should reflect your journal.



The Interview

You will be interviewed.

- Know these things:
 - Information you have read about.
 - All the things you did while following the scientific discovery process.
 - What you learned from your project.
 - How the projects has helped you better understanding the world around you.
 - Other questions you now have.
 - What you would change next time if you did the project again.



Thoroughness

- Follow through with these ideas:
 - Goals of the project
 - Creativity in the design
 - Clarity
 - Appropriate methods
 - Appropriate equipment
 - Appropriate grade level
 - Knowledge
 - Enthusiasm
 - Individual effort
 - Completed journal
 - Creative display board

