Motion Project

Physical Science 10

Mr. P. MacDonald

Overview

For this project you will work in a group of two or three and you will submit one formal report. As a group you will record a slow-motion video of an object in motion. The precise motion of that object will be analyzed using a powerful, open source, computer program called *Tracker* developed by Douglas Brown (click here for the website). At minimum, you will measure the object's position, velocity, and acceleration as a function of time.

Evaluation

This project will carry about the same weight as a test and a half in terms of your overall grade. Your mark will be based on three components: participation, peer and self evaluation, and the final report document. Each group member will receive the same mark on the report document. You will be given a rubric outlining each of these.

- Participation: 20 marks
- Peer Evaluation: 5 marks
- Self Evaluation: 5 marks
- Formal Report: 35 marks

The Details

This project is meant to work in series with the motion unit previously discussed (and upcoming) in class. That means as you work together you may need your notes or textbook to review concepts and definitions of motion; like acceleration, velocity, displacement, etc.

First you need to come up with an object and how you want it to move. Predict what you think will happen; your hypothesis. Your analysis must consist of two (or more) different motions for the object. For example, if you analyze the motion of a ball falling to the floor then that is only *one* motion. If you allow that ball to bounce a few times and analyze the bounces then you have met the requirements for the project. All videos must be recorded at the school and you will be able to use the gym equipment to select your objects from. Project ideas and hypotheses must be approved before they are videoed. Below are some example projects to choose from:

- Throwing a ball twice.
- Shooting a floor hockey ball.
- Hitting a baseball, tennis ball, etc.
- Shooting a basketball from two places.
- Kicking a ball twice.
- Throwing a ball against the wall.
- Dropping a ball and letting it bounce.
- Dropping two different balls and letting each bounce.
- Jumping the eRevo car.

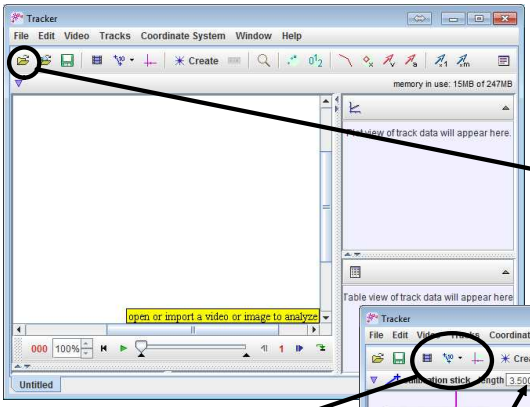
Taking Video

The video will be recorded with the slow-motion camera and the video will only be a few seconds long should you need to redo any experiments. You will receive your video and use the provided *Tracker* software to analyze the motion. The *Tracker* software will only produce accurate results if your object moves in two dimensions only; take that into consideration in your planning. I will operate the camera which will be mounted and immobilized on a tripod. We will do a tutorial in class about using *Tracker*.

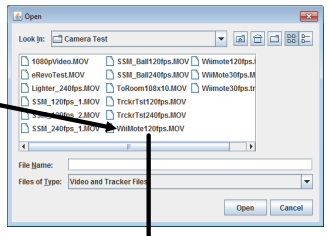
Your formal report will consist of an introduction, explanation of collecting your data, your graphical analysis from the *Tracker* program, and a discussion/conclusion. You will be given a rubric with the marking layout.

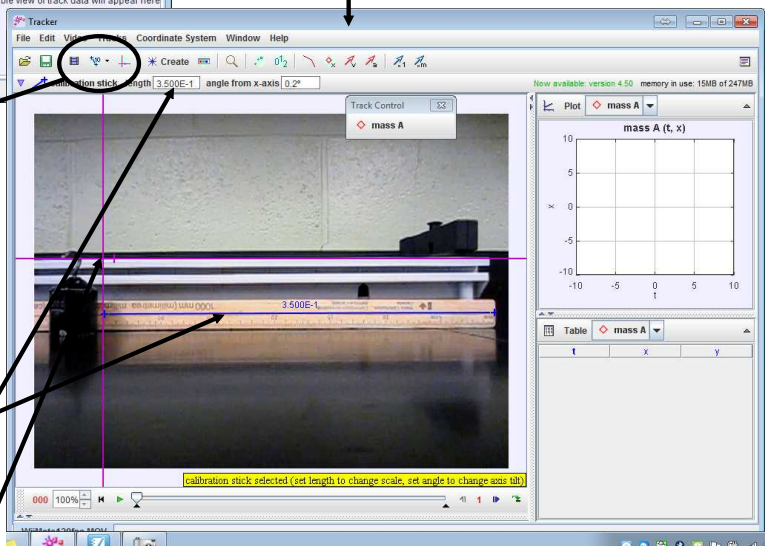
Group Members, Project Idea, and Hypothesis: **Nov. 16**; Video Taken: **Nov. 18**; Final Report: **Nov. 25**

Tracker: Quick Start Guide



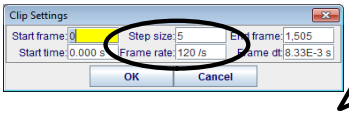
Click to load a file or video.





Before collecting data you need to adjust the frame rate information, scale, and set up a coordinate system.

Change frame rate to read the amount of fps setting of the camera and make the step size 5.



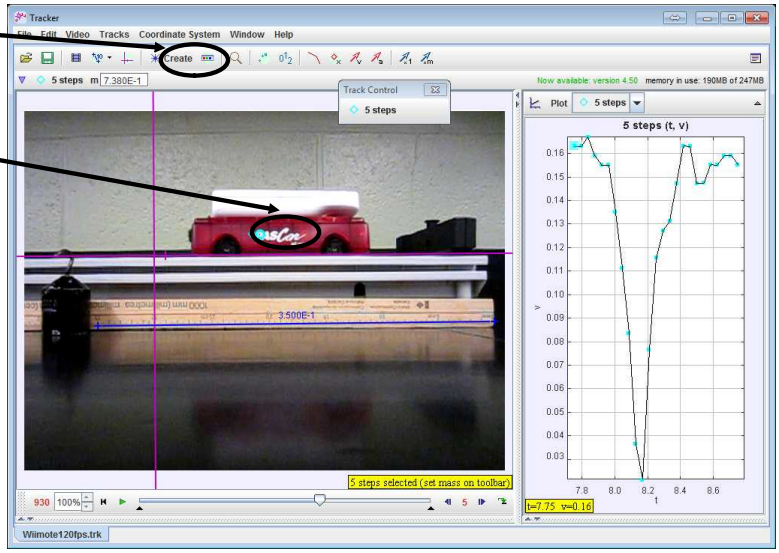
Click to set up the **calibration stick**. This is the relative scale of the video. In the yellow box type the scale.

Click this to set up your coordinate system. The origin (0,0) is where the lines cross.

You are almost ready to collect data!

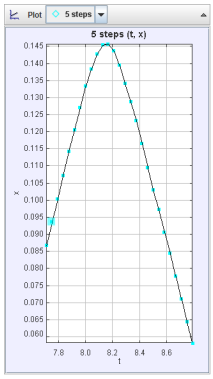
Next hit "create" and select point mass. When you click on the track control you should change its name to represent the object you are tracking.

Now, hold the shift key. The mouse cursor will turn into a square with a cross-hairs in it. Move it to the point you want to track and click the left mouse button. The program will automatically skip to the next frame. Repeat the process to track the same point on the object as it moves in the video.



Your data will automatically be stored and displayed in a graph. Note that when first started you may see your raw data displayed in a table below your graph.

In the image above it is graphing the objects velocity as a function of time. By default you will see distance vs. time. Using the data from this video we get the graph to the right:



Clicking on the "x" or "t" allows you to change the data displayed in the graph. Each graph can be printed, copied, or saved as a separate image to include in reports. The raw data can also be exported to a spreadsheet program like Microsoft Excel.

CATEGORY	Exemplary	Proficient	Partially Proficient	Unsatisfactory	POINTS
Focus on the Task and Participation	3 points	2 points	1 point	0 points	___/3
	Consistently stays focused on the task and what needs to be done. Very self-directed.	Focuses on the task and what needs to be done most of the time. Other group members can count on this person.	Focuses on the task and what needs to be done some of the time. Other group members must sometimes remind this person to keep on task.	Rarely focuses on the task and what needs to be done. Lets others do the work. .	
	A true team member who contributes a lot of effort, and encourages and supports the efforts of others in the group.	A strong group member who tries hard!	Sometimes a satisfactory group member who does what is required	Sometimes chooses not to participate and does not complete assigned tasks.	
Dependability and Shared Responsibility	3 points	2 points	1 point	0 points	___/3
	Consistently punctual for group meetings, turns in all work on time.	Usually punctual for group meetings, turns in most work on time.	Sometimes late for group meetings, frequently turns in work after the deadline.	Late for all or most group meetings, misses all deadlines for turning in work.	
	Follows through on assigned tasks and does not depend on others to do the work, responsibility for tasks are shared evenly.	Follows through on most assigned tasks.	Does not follow through on most assigned tasks and sometimes depends on others to do the work.	Seldom or never follows through on assigned tasks. Depends on others to do all of the work.	
Listening, Questioning and Discussing	3 points	2 points	1 point	0 points	___/3
	Respectfully listens, interacts, discusses and poses questions to all members of the team during discussions and helps direct the group in reaching consensus.	Respectfully listens, interacts, discusses and poses questions to others during discussions.	Has some difficulty respectfully listening and discussing, and tends to dominate discussions.	Has great difficulty listening, argues with teammates, and is unwilling to consider other opinions. Impedes group from reaching consensus.	

Research and Information-Sharing	3 points	2 points	1 point	0 points	___/3
	Routinely gathers research and shares useful ideas when participating in the group discussion. Defends/ rethinks ideas relating to the group's project goals.	Usually provides useful research and ideas when participating in the group discussion.	Sometimes provides useful research and ideas when participating in the group discussion.	Rarely provides useful research or ideas when participating in the group discussion.	
Problem-Solving	3 points	2 points	1 point	0 points	___/3
	Actively looks for and suggests solutions to problems.	Refines solutions suggested by others.	Does not suggest or refine solutions, but is willing to try out solutions suggested by others	Does not try to solve problems or help others solve problems.	
Group/Partner Teamwork	3 points	2 points	1 point	0 points	___/3
	Consistently makes necessary compromises to accomplish a common goal.	Usually makes necessary compromises to accomplish a common goal.	Occasionally makes compromises to accomplish a common goal, and sometimes helps keep the group working well together.	Rarely makes compromises to accomplish a common goal and has difficulty getting along with other group members.	
	Always has a positive attitude about the task(s) and the work of others.	Usually has a positive attitude about the task(s) and the work of others.	Occasionally is publicly critical of the task(s) or the work of other members of the group.	Is often negative and publicly critical of the task(s) or the work of other members of the group.	
	All team members contributed equally to the finished project.	Assisted group/partner in the finished project.	Finished individual task but did not assist group/partner during the project.	Contributed little to the group effort during the project.	
	Performed all duties of assigned team role and contributed knowledge, opinions, and skills to share with the team. Always did the assigned work.	Performed nearly all duties of assigned team role and contributed knowledge, opinions, and skills to share with the team. Completed most of the assigned work.	Performed a few duties of assigned team role and contributed a small amount of knowledge, opinions, and skills to share with the team. Completed some of the assigned work.	Did not perform any duties of assigned team role and did not contribute knowledge, opinions or skills to share with the team. Relied on others to do the work.	

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Motion Project Participation Rubric

Student:

	Criteria				Points
	4	**3**	**2**	**1**	
Attendance / Promptness	Student is always prompt and regularly attends classes.	Student is late to class once every two weeks and regularly attends classes.	Student is late to class more than once every two weeks and regularly attends classes.	Student is late to class more than once a week and/or has poor attendance of classes.	
Level Of Engagement In Class	Student proactively contributes to class by offering ideas and asking questions more than once per class.	Student proactively contributes to class by offering ideas and asking questions once per class.	Student rarely contributes to class by offering ideas and asking questions.	Student never contributes to class by offering ideas and asking questions.	
Listening Skills	Student listens when others talk, both in groups and in class. Student incorporates or builds off of the ideas of others.	Student listens when others talk, both in groups and in class.	Student does not listen when others talk, both in groups and in class.	Student does not listen when others talk, both in groups and in class. Student often interrupts when others speak.	
Behavior	Student almost never displays disruptive behavior during class.	Student rarely displays disruptive behavior during class.	Student occasionally displays disruptive behavior during class.	Student almost always displays disruptive behavior during class.	
Preparation	Student is almost always prepared for class with assignments and required class materials.	Student is usually prepared for class with assignments and required class materials.	Student is rarely prepared for class with assignments and required class materials.	Student is almost never prepared for class with assignments and required class materials.	

Physical Science 10 Motion Project Formal Report Rubric

Group Members:

Criteria	1	2	3	4	5
Purpose	• Purpose is not identified • Relevant variables are not described	• Purpose is somewhat vague • Relevant variables are not described	• Purpose is identified • Relevant variables are described in somewhat unclear manner	• Purpose is identified • Relevant variables are described	• Purpose is clearly identified • Relevant variables are described
Hypothesis	• Predicted results and hypothesized relationship between variables not stated	• Predicted results and hypothesized relationship between variables are unclear	• Predicted results and hypothesized relationship between variables stated and appear reasonable	• Predicted results and hypothesized relationship between variables stated	• Predicted results and hypothesized relationship between variables clearly stated and reasonable
Materials	• There is not a list of the necessary lab materials	• Most lab materials included	• All necessary lab materials included but not listed in any particular order	• All necessary lab materials included and listed	• All necessary lab materials included and listed in an organized manner
Procedure	• Procedures are not listed	• Procedures are listed but not in clear steps	• Procedures are listed in clear steps but not numbered and/or in complete sentences	• Procedures are listed in clear steps • Each step is numbered and in a complete sentence	• Procedures are listed in clear steps • Each step is numbered and in a complete sentence • Diagrams are included to describe the set-up
Data	• Data is not represented or is not accurate	• Data lacks precision	• Good representation of the data using tables and/or graphs • Precision is acceptable	• Accurate representation of the data using tables and/or graphs • Data is fairly precise	• Accurate representation of the data using tables and/or graphs • Graphs and tables are labeled and titled • Data is precise
Analysis	• Trends/patterns are not analyzed • Questions are not answered • Analysis is not relevant	• Trends/patterns are not analyzed • Answers to questions are incomplete • Analysis is inconsistent	• Trends/patterns are logically analyzed for the most part • Questions are answered in complete sentences • Analysis is general	• Trends/patterns are logically analyzed • Questions are answered in complete sentences • Analysis is thoughtful	• Trends/patterns are logically analyzed • Questions are answered thoroughly and in complete sentences • Analysis is insightful
Error Analysis	• There is no discussion of experimental errors	• Some experimental errors are identified	• Experimental errors and their effects are discussed	• Experimental errors are determined • Their effects are discussed	• Experimental errors are determined • Their effect and ways to reduce errors are discussed
Conclusion	• No conclusion was included or shows little effort and reflection on the lab	• A statement of the results is incomplete with little reflection on the lab	• A statement of the results of the lab indicates whether results support the hypothesis	• Accurate statement of the results of the lab indicates whether results support the hypothesis • Possible sources of error identified	• Accurate statement of the results of lab indicates whether results support hypothesis • Possible sources of error and what was learned from the lab discussed