Jane Student
Physics

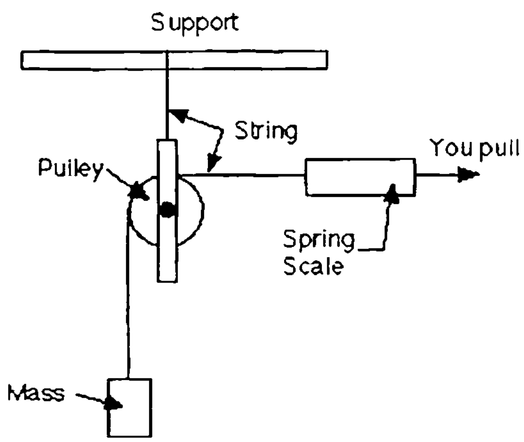
4/21/04
period 4

1. Problem
Using a block and tackle pulley, a single fixed pulley, and a single movable pulley, would the pulley with the greatest efficiency have the greatest mechanical advantage as well?

2. Hypothesis
The pulley with the greatest efficiency will have the greatest mechanical advantage. This will be proven when the work in and the work out are found. The efficiency, the loss of energy in a system, will be found by dividing Wh/Fd x 100%. The mechanical advantage is the ratio of output force divided by the input force.

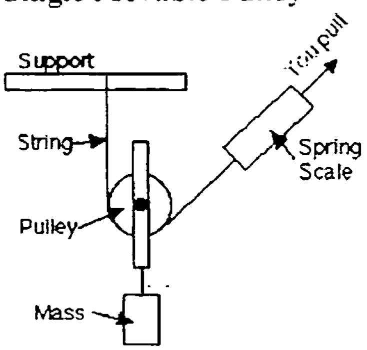
3. Data

Single Fixed Pulley



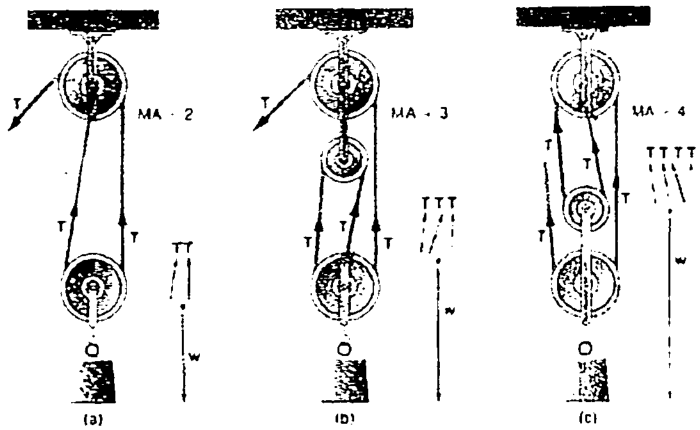
A single fixed pulley is the only pulley that when used individually, uses more effort than the load to lift the load from the ground. When it is attached to an unmovable object, it acts as a first class lever with the fulcrum being located at the axis, the only change being the bar become a rope. The advantage of a single fixed pulley is that one does not have to pull or push the pulley up and down. The disadvantage is that one must apply more effort than the load.

Single Movable Pulley



A single movable pulley is a pulley that moves with the load. The movable pulley allows the effort to be less than the weight of the load. The movable pulley also acts as a second class lever. The load is between the fulcrum and the effort. The advantage is that you use less effort to pull the load.

Block and Tackle Pulley
(The middle pulley in this picture is the one used with the lab)



The block and tackle pulley allows you to lift twice the weight with the same force as with the simple pulley, but you only lift it half as far. Because there are more pulleys and strings, it has a great mechanical advantage.

	Trial	Force Out (N)	Distance out (m)	Force In (N)	Distance In (m)
Single Fixed					
	1	.47	.2	1.323	.212
	2	1.96	2	2	.207
Single Movable					
	1	2.45	.2	1.25	.265
	2	3.43	.2	1.75	.271
Block and Tackle					
	1	2.45	.1	.75	.535
	2	3.43	.1	1.0	.532

Calculations

- a. Averages
  1. Single Fixed Pulley
     - a. force out = 1.715 N
     - b. distance out = .2 m
     - c. force in = .2646 N
     - d. distance in = .0424 m
  2. Single Movable Pulley
     - a. force out = 2.94 N
     - b. distance out = .2 m
     - c. force in = 1.5 N
     - d. distance in = .268 m
  3. Block and Tackle
     - a. force out = 2.94 N
     - b. distance out = .1 m
     - c. force in = .875 N
     - d. distance in= .535 m

4. Results

- a. Work by Pulley = Force out x distance out
  1. Single Fixed Pulley
     - a. 1.715 N x .2m = .343 Nm
  2. Single Movable Pulley
     - a. 2.94 N x .2 m = .588 Nm
  3. Block and Tackle Pulley
     - a. 2.94 N x .1 m = .294 Nm
- b. Work IN = Force in x distance in
  1. Single Fixed Pulley
     - a. 1.66 N x .2095 m = .3478 Nm
  2. Single Movable Pulley
     - a. 1.5 N x .268 m = .402 Nm
  3. Block and Tackle Pulley
     - a. .875 N x .535 m = .468 Nm
- c. Mechanical Advantage = Force Out / Force In
  1. Single Fixed Pulley
     - a. 1.715 N / 1.66 N = **1.03 N**
  2. Single Movable Pulley
     - a. 2.94 N / 1.5 N = **1.96 N**
  3. Block and Tackle Pulley
     - a. 2.94 N / .875 N = **3.36 N**
- d. Efficiency = Wo / WI x 100% = (Fo x D0 / FI x Do) x 100 %
  1. Single Fixed Pulley
     - a .343 Nm / .3478 Nm x 100% = **98.62 %**

2. Single Movable Pulley
    a. .588 Nm / .402 Nm x 100% = **146 %**
3. Block and Tackle Pulley
    a. .294 Nm / .468 Nm x 100 = **62.8 %**

5. Conclusion

a) The pulley with the greatest mechanical advantage was found to be the block and tackle pulley, while the pulley with the greatest efficiency is the single fixed pulley.

b) Efficiency is the loss of energy in a system from friction. Because of this, a single fixed pulley is the most efficient. There is less string and supports, therefore less friction and loss of energy. The block and tackle pulley will have the worst efficiency because there is more supports and string. Efficiency can be calculated by Work out / Work in x 100 %. This is the ratio of useful work done by the pulley to the work that is put in. For a pulley to have a greater mechanical advantage, the output force is greater than the input force. The block and tackle has the greatest mechanical advantage because less work is done in than out by the pulley.

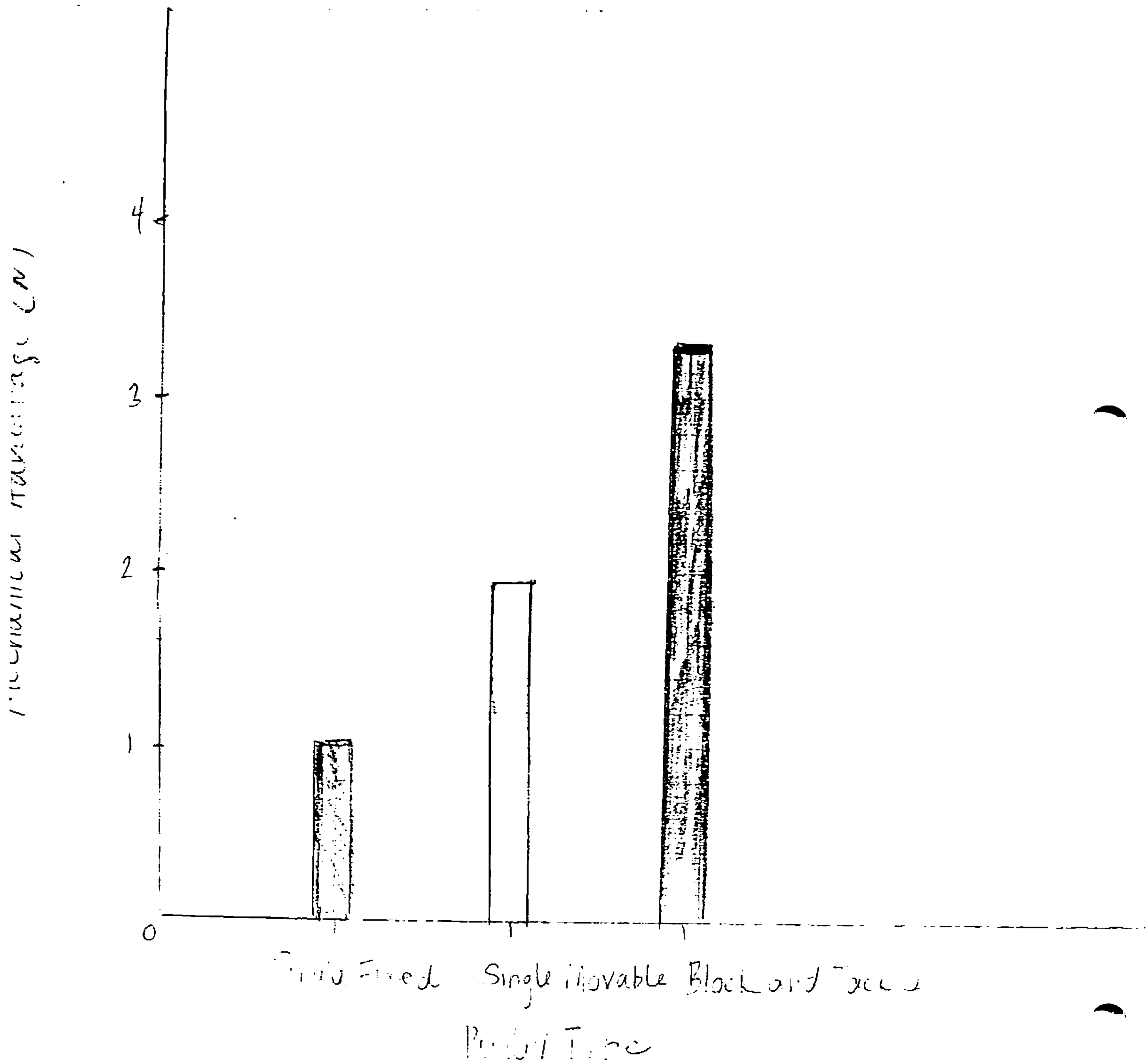
c) For the first pulley, the single fixed pulley, the work done by the pulley was .343 J. The work in was .3478 J. The mechanical advantage was 1.03 and the efficiency was 98.62%. For the single movable pulley, the work done by the pulley was .588 J and the work in was .402 J. The mechanical advantage was 1.96 N and the efficiency was 146%. For the block and tackle pulley, the work done out was .294 J and the force in was .468 J. The mechanical advantage was 3.36 N and the efficiency was 62.8%.

d) A simple machine is a device that does work with only one movement. The advantage of simple machines is that it is easier to do work because the force in is less than the mass of the load. Although, distance is sacrificed from a simple machine when work is done. For an ideal simple machine, the work in would equal the work out. This would only occur if there was no friction. The mechanical advantage is the number of times a machine multiplies the effort force. If the output force is larger than the input force, the machine has a mechanical advantage greater than 1. Efficiency is the loss of energy in a system. If the work out does not equal the work in, there was a loss of energy. The loss of energy is the result of friction.

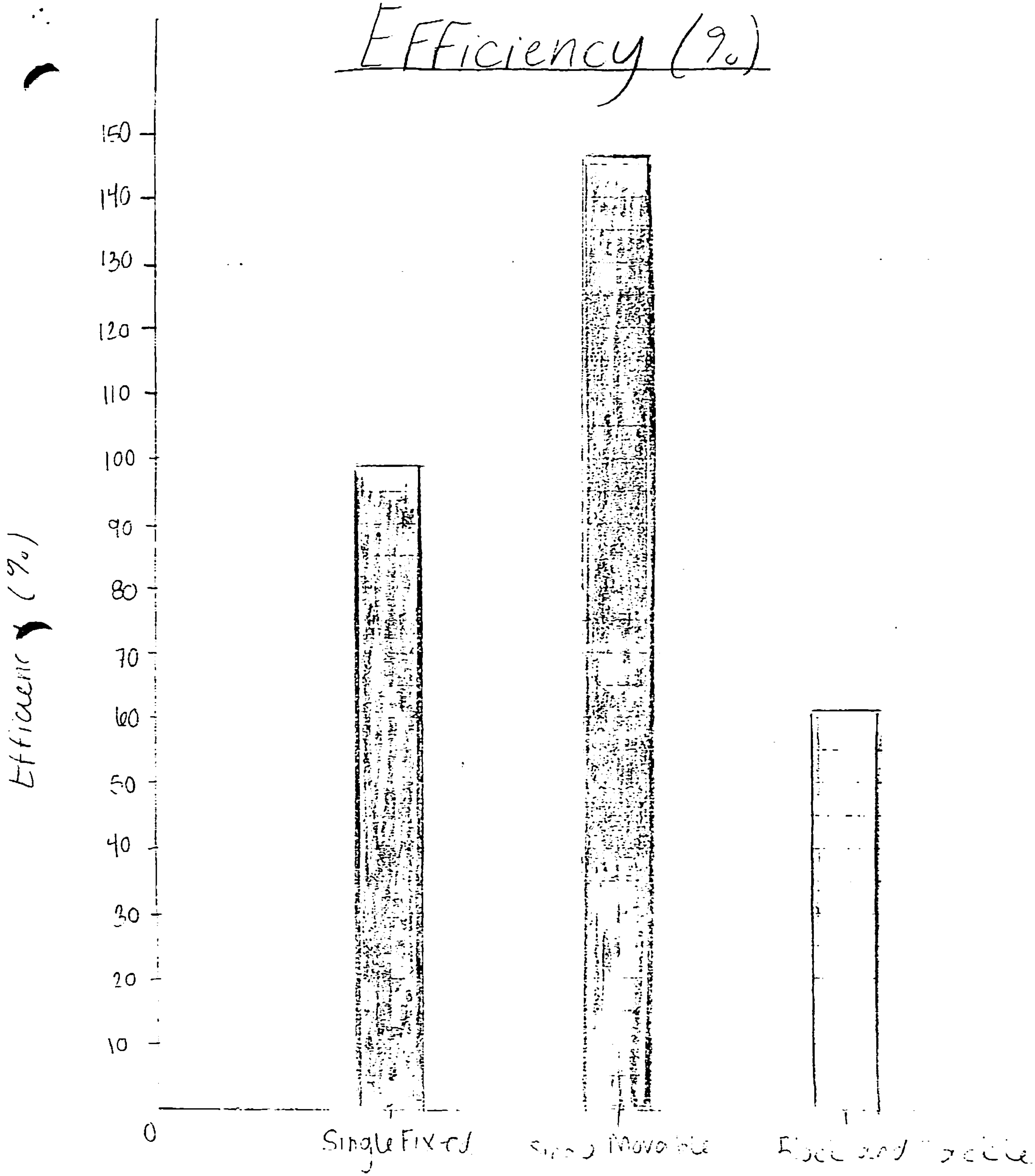
e) The data collected in this lab could be off because of certain limitation. Some of these include the correct set up of the lab. Because the lab was done without a direct set of direction, the groups designed their own labs. Some may have set up their pulleys incorrectly. Another limitation was measuring the distance. There should not be an angle when the spring scale is pulled. This affects the overall calculations.

Pulleys are used everywhere to make the work of the load easier on people. Some examples of pulleys through time are elevators, lifting cranes, and a flagpole. A new problem that could be posed is what happens to the efficiency of a squeaky wheel barrow compared with a well oiled one. The squeaky wheel means that there is great friction and this means that wheelbarrow will lose energy, affecting its efficiency.

Mechanical Advantage



Efficiency (%)



AME JANE STUDENT

ATE 4/21/04

SSIGNMENT PHYSICS LAB EXAMPLE

	5 Exceeds Standard	4 Meets Standard	3.5 Nearly Meets Standard	3 Below Standard	2 Little Progress Toward Standard	0
Problem Statement	Sophisticated resources appropriate to the investigation are identified. Pertinent concepts and/or theories from previous learning are evident. The problem is clearly stated. There are no errors in grammar, usage or spelling. Advanced scientific language is used.	Common resources appropriate to the investigation are identified. Pertinent concepts and/or theories from previous learning are evident. The problem is stated. There are few noticeable errors in grammar, usage, or spelling. Common scientific language is used.	Some common resources appropriate to the investigation are identified. Some pertinent concepts and/or theories from previous learning are identified. The problem is generally clear. There are some noticeable errors in grammar, usage, or spelling. Some common scientific language is used.	Few resources appropriate to the investigation are identified. Few concepts and/or theories from previous learning are identified. The problem is unclear. There are many noticeable errors in grammar, usage, or spelling. Little common scientific language is used.	No resources appropriate to the investigation are identified. No concepts and/or theories from previous learning are identified. The problem is not clear. There are excessive errors in grammar, usage, or spelling. No common scientific language is used.	NO WORK SUBMITTED
Hypothesis	The hypothesis addresses the problem statement. A proposed resolution to the problem anticipates possible questions and is supported by previous learning. There are no errors in grammar, usage, or spelling. Advanced scientific language is used.	The hypothesis addresses the problem statement. A proposed resolution to the problem is supported by previous learning. There are few noticeable errors in grammar, usage, or spelling. Common scientific language is used.	The hypothesis somewhat addresses the problem statement. A proposed resolution to the problem is supported by some previous learning. There are some noticeable errors in grammar, usage, or spelling. Some common scientific language is used.	The hypothesis weakly addresses the problem statement. A proposed resolution to the problem is supported by little previous learning. There are many noticeable errors in grammar, usage, or spelling. Little common scientific language is used.	The hypothesis does not address the problem statement. A proposed resolution to the problem is not supported by previous learning. There are excessive errors in grammar, usage, or spelling. No common scientific language is used.	
Data	Drawings, tables, and/or charts are flawless; arrangement on the page is attractive and adds to understanding. Accurate details of color, pattern, texture, and scale are shown; titles and proper units are included. Explanatory text and/or procedures have no errors in grammar, usage, or spelling. Advanced scientific language is used.	Drawings, tables, and/or charts are neat, presentable, and attractively arranged on the page. Accurate details of color, pattern, texture, and scale are shown; titles and proper units are included. Explanatory text and/or procedures have few noticeable errors in grammar, usage, or spelling. Common scientific language is used.	Drawings, tables, and/or charts are mostly neat, presentable, and attractively arranged on the page. Some accurate details of color, pattern, texture, and scale are shown; some titles and proper units are included. Explanatory text and/or procedures have some noticeable errors in grammar, usage, or spelling. Some common scientific language is used.	Drawings, tables, and/or charts are somewhat neat, presentable, and attractively arranged on the page. Few accurate details of color, pattern, texture, and scale are shown; few titles and proper units are included. Explanatory text and/or procedures have many errors in grammar, usage, or spelling. Little common scientific language is used.	Drawings, tables, and/or charts are not neat, presentable, and attractively arranged on the page. Details of color, pattern, texture, and scale are inaccurate; no titles and proper units are included. Explanatory text and/or procedures have excessive errors in grammar, usage, or spelling. No common scientific language is used.	
Results	All calculations have titles and all values have proper units. All work is shown. When appropriate, data is graphed with proper labels. Advanced scientific language is used.	All calculations have titles and all values have proper units. All work is shown. When appropriate, data is graphed with proper labels. Common scientific language is used.	Most calculations have titles and most values have proper units. Most work is shown. When appropriate, most data is graphed with proper labels. Some common scientific language is used.	Some calculations have titles and some values have proper units. Some work is shown. When appropriate, some data is graphed with proper labels. Little common scientific language is used.	Few/no calculations have titles and few/no values have proper units. Some work is shown. When appropriate, data is not graphed with proper labels. No common scientific language is used.	
Conclusion	The conclusion anticipates questions, answers problem, and discusses hypothesis. Facts found are clearly stated. Connections are made to prior learning. Limitations, new problems, applications, connections, and steps to extend lab to future studies are identified and explained. There are no errors in usage, grammar, or spelling. Advanced scientific language is used.	The conclusion answers problem and discusses hypothesis. Facts found are stated. Connections are made to prior learning. Limitations, new problems, applications, connections, and steps to extend lab to future studies are identified. There are few noticeable errors in usage, grammar, or spelling. Common scientific language is used.	The conclusion somewhat answers problem and discusses hypothesis. Facts found are somewhat clearly stated. Some connections are made to prior learning. Some limitations, new problems, applications, connections, and steps to extend lab to future studies are identified. There are some noticeable errors in usage, grammar, or spelling. Some common scientific language is used.	The conclusion poorly answers problem and discusses hypothesis. Facts found are weakly stated. Few connections are made to prior learning. Few limitations, new problems, applications, connections, and steps to extend lab to future studies are identified. There are many errors in usage, grammar, or spelling. Little common scientific language is used.	The conclusion does not answer the problem and discuss hypothesis. No facts are found and stated. No connections are made to prior learning. No limitations, new problems, applications, connections, and steps to extend lab to future studies are identified. There are excessive errors in usage, grammar, or spelling. No common scientific language is used.	

TOTAL POINTS 22 X 4 = FINAL SCORE 88 (Proficient Product =Score of 80)