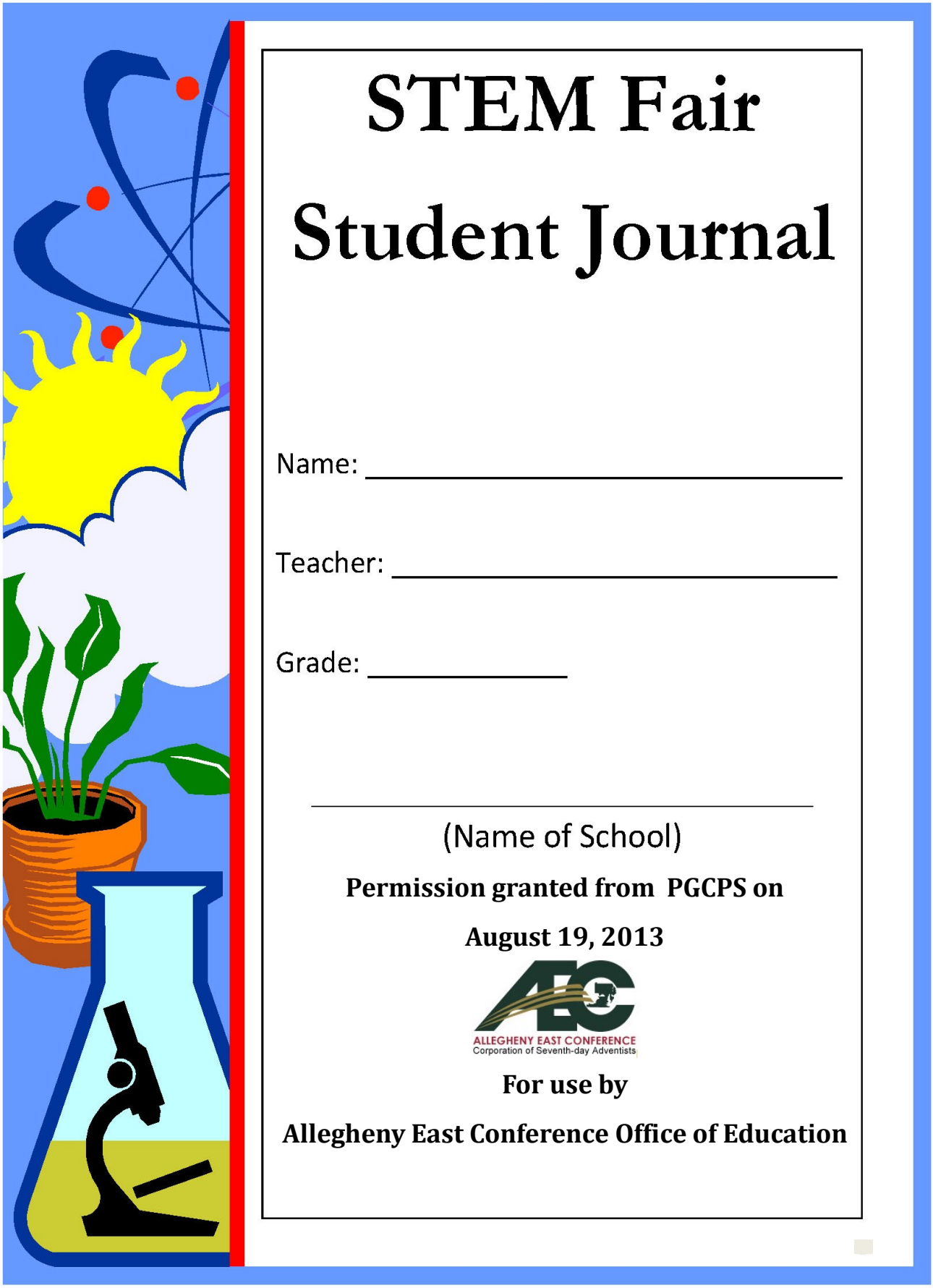


STEM Fair

Student Journal

Name: _____

Teacher: _____

Grade: _____

_____

(Name of School)

Permission granted from PGCPS on

August 19, 2013

ALLEGHENY EAST CONFERENCE
Corporation of Seventh-day Adventists

For use by

Allegheny East Conference Office of Education

Acknowledgements

Prince George's County Public Schools wishes to thank Virginia Casbourne whose work while at William Beanes Elementary School led to the development of this STEM Fair Student Journal. Several pages from the Prince George's County Public School Parent Involvement Guide, "Kids for Science" STEM Fair Rules and Regulations packet, and additional support documents have been incorporated into this revised STEM Fair Student Journal. Additional thanks are given to the Science Office, Kids for Science Steering Committee and Elementary Science Curriculum Writing Team for their valuable input, modifications and resource documents.

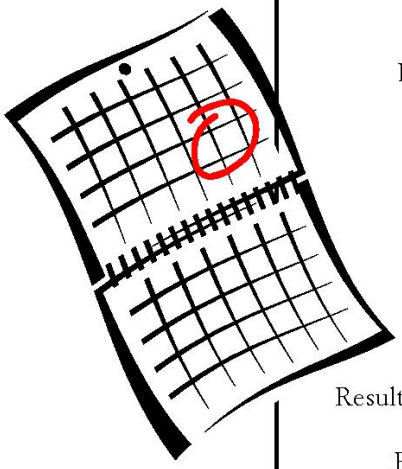
It's STEM Fair Time!!

STEM stands for Science, Technology, Engineering, and Mathematics. Over the next few months, you will choose your own research project that contains one or all of the STEM elements and conduct an investigation to seek the answer to your project's question. This long-term, at home project will enable you to combine reading, writing, math, data analysis and scientific inquiry all on a topic that you have chosen!

This handbook is meant to provide you with examples and models of each step of the STEM process. There is also a place where you will take notes and draft the elements of your project. Both you and your family, along with your teacher will all use this book to write, edit, comment and keep track of your work on each component of the STEM process.

Your teacher will give you specific deadlines for each phase of your project. Use the space below to write down your due dates. Then, turn the page and begin to brainstorm topics you might consider for your project.

Timeline for the STEM Fair Project



Component	Due Date
Question	
Prediction/Hypothesis	
Variables	
Materials	
Procedures	
Data Collection Tool	
Results, Actual Investigation	
Results, Graph of Data	
Results, Written Explanation	
Conclusion	
Research Paper	
Display Board to School	

Choosing a Topic

This STEM project is meant to be something that interests you, not something your teacher has chosen for you. To select a topic, think about the world around you and questions you might have about how things work, why they react the way they do or how elements interact with each other.

When considering a topic, here are some guidelines to follow.

- You may not conduct testing on vertebrates (people, other mammals, birds, reptiles or amphibians)
    - You may use vertebrates only if you are making observations of them and there is **no** interaction between the vertebrate and the observer.
- You may conduct testing on invertebrates (worms, mollusks, insects) provided there is no injury to the animal.
- You may not grow bacteria of any kind.
- You may not make a model that only displays information or shows how something works. (volcanoes, solar system, cells)
- You may conduct an investigation using mold or fire provided you have the written approval of an adult in your household and the approval of your STEM Fair teacher.

For all projects, you must ensure you have a written Safety Review pre-approval (pp. 6-7).

Getting Started

There are many ways to choose a STEM Fair topic. You can start by:

- observing the world around you
- searching the internet
- looking at books in your school library
- looking at books in your public library

You can also use the list below to determine a category of STEM inquiry that interests you. This might help you narrow down your ideas.

Earth / Environment	Chemistry	Physics	Life / Biology	Engineering	Mathematics
• weather • rain • climate • erosion • wind speeds • water filtration • recycling processes • composting	• freezing • melting • burning • rusting • heat	• speed • force • friction • gravity • magnets • electricity • elasticity • weight/mass • density	• plant growth (based on: water, temperature, sunlight, soil type) • invertebrates	• bridge design • building design • machine design	• probability • number relationships • frequency analyses

As you develop your project idea, consider the following questions with your family:

- Do we have time for this project or should we choose something that is shorter?
- Do we have the space (inside or outside) for this project?
- Can we purchase all of the items for this projects or are some too expensive or too hard to find?
- Will we need to build anything and, if so, can we do it?

As you narrow down your interests to one of the categories above, consider some of the project ideas listed on the next page.

Question

Your Question is the specific problem, topic or question you plan to investigate. The results or answer for your question can only be found by a hands-on investigation.

Good Example:

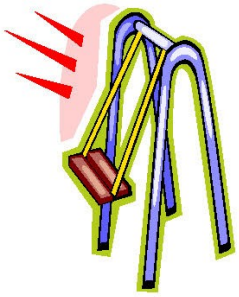
- Does weight affect how fast a pendulum swings?

This is a good example because you begin your question with a very basic wondering.

Bad Example:

- How does weight affect how fast a pendulum swings?

This is a poor example because when you use the word "how" you already assume you can change the pendulum's speed.



My question is: _____

_____

_____

_____

_____

☐ Your question is approved! Next, go to p. 10 to work on your Hypothesis/Prediction.

☐ Your question is not approved. Use my comments to re-write your question. Your new due date for your question is: _____

Teacher Signature:_____ Date: _____

Parent Signature:_____ Date: _____

My revised question is: _____

_____

_____

_____

_____

☐ Your question is approved! Next, go to p. 10 to work on your Hypothesis/Prediction.

☐ Your question is not approved. Use my comments to re-write your question. Your new due date for your question is: _____

Teacher Signature:_____ Date: _____

Parent Signature:_____ Date: _____

My revised question is: _____

_____

_____

_____

_____

☐ Your question is approved! Next, go to p. 10 to work on your Hypothesis/Prediction.

☐ Your question is not approved. Use my comments to re-write your question on a separate piece of paper. Your new due date for your question is: _____

Teacher Signature:_____ Date: _____

Parent Signature:_____ Date: _____

Hypothesis / Prediction

Hypothesis is a synonym for a prediction. After you ask your question, you try to predict what the answer will be based on your own background knowledge from either research or everyday observations. You must always give a real-world reason for your hypothesis.

Model Question: Does weight affect the speed of a pendulum?

Model Hypothesis Example:

- I think weight does affect the speed of a pendulum because when my big brother and I are swinging, he always goes faster than I do and he weighs more than I do so weight can change the pendulum.

There is a reason for the hypothesis with a specific example from the student's own experience.

The student gives a definite answer to the question

Bad Hypotheses Examples:

- Weight might change the speed because I have seen swings moving at different rates.
- Weight can't change the speed of a pendulum because I have never seen it done before.

No definite prediction was made.

This reason doesn't prove the prediction "can't." Just because you haven't seen it doesn't mean it hasn't happened.

My hypothesis is: _____

_____

_____

_____

☐ Your hypothesis is approved! Next, go to p. 12 to work on your Variables.

☐ Your hypothesis is not approved. Use my comments to re-write your hypothesis. Your new due date for your hypothesis is: _____

Teacher Signature:_____ Date: _____

Parent Signature:_____ Date: _____

My revised hypothesis is: _____

_____

_____

_____

_____

☐ Your hypothesis is approved! Next, go to p. 12 to work on your Variables.

☐ Your hypothesis is not approved. Use my comments to re-write your hypothesis. Your new due date for your hypothesis is: _____

Teacher Signature:_____ Date: _____

Parent Signature:_____ Date: _____

My revised hypothesis is: _____

_____

_____

_____

_____

☐ Your hypothesis is approved! Next, go to p. 12 to work on your Variables.

☐ Your hypothesis is not approved. Use my comments to re-write your hypothesis on a separate piece of paper. Your new due date for your hypothesis is: _____

Teacher Signature:_____ Date: _____

Parent Signature:_____ Date: _____

Variables

A variable is something in your experiment that you change on purpose, wonder if it will change or if you force it to stay the same. All experiments have three (3) types of variables.

1. Independent Variable: You, as the scientist, change this in your experiment on purpose. Sometimes it is called the manipulating variable. You can only have one (1) per experiment.

2. Dependent Variable: This is what might change in your experiment based on your independent variable. Sometimes it is called the responding variable because it acts in response to what the independent variable did.

If you have a well-written question, your independent variable and dependent variable are already identified.

3. Controlled Variables: These are parts of the investigation you keep the same so they don't "interrupt" what the independent variable is doing and how the dependent variable is reacting.

You will change this on purpose.

You wonder if this will change.

Model Question: Does weight affect the speed of a pendulum?

Model Variables:

- Independent Variable – weight of the pendulum; you will add or take away weight to the pendulum with each set of trials
- Dependent Variable – speed of the pendulum; you don't know if this will change as you add or take away the weight.
- Controlled Variables – length of string used; type of string used; amount of time for each set of swings; starting "drop point" of the pendulum

String and a stopwatch were listed in your materials so you need to explain how you will control their use.

Use your materials list and your procedures to help you generate the controlled variables. There will be a different amount of controlled variables for different experiments.

My variables are:

- Independent Variable: _____
- Dependent Variables: _____
- Controlled Variables: _____

_____

_____

☐ Your variables are approved! Next, go to p. 16 to work on your Materials.

☐ Your variables are not approved. Use my comments to re-write your variables. Your new due date for your variables is: _____

Teacher Signature:_____ Date: _____

Parent Signature:_____ Date: _____

My revised variables are:

- Independent Variable: _____
- Dependent Variables: _____
- Controlled Variables: _____

_____

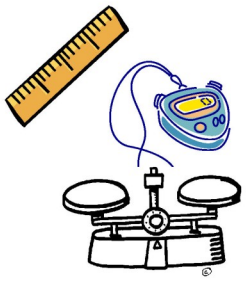
_____

☐ Your variables are approved! Next, go to p. 16 to work on your Materials.

☐ Your variables are not approved. Use my comments to re-write your variables on a separate piece of paper. Your new due date for your variables is: _____

Teacher Signature:_____ Date: _____

Parent Signature:_____ Date: _____



Materials

Your materials are a list of the items you will need to conduct your experiment. As you develop your procedures on the next pages, you may need to add to this list.

Remember to list specific amounts of items and to always use metric measurements. Some standard measurement units are listed below to help you.

Measureable Item	Metric Unit	Abbreviation
distance / length / height	millimeter centimeter meter kilometer	mm cm m km
time	seconds or minutes	sec / min
weight	milligrams grams kilograms	mg g kg
temperature	Celsius	C
capacity	milliliter liter kiloliter	ml l kl
volume	cubic centimeter cubic meter	cm^3 m^3

My Materials List (You may need more or less lines. If you need more, attach a piece of paper.)

Quantity	Description
• _____	_____
• _____	_____
• _____	_____
• _____	_____
• _____	_____
• _____	_____
• _____	_____
• _____	_____
• _____	_____
• _____	_____
• _____	_____
• _____	_____
• _____	_____

☐ Your materials list is approved! Next, go to p. 20 to work on your Procedures.

☐ Your materials list is not approved. Use my comments to re-write them. Your new due date for your list is: _____

Teacher Signature:_____ Date: _____

Parent Signature:_____ Date: _____

Procedures

Procedures are a detailed list of step-by-step directions of how to conduct your experiment. Using specific details are very important to procedures – using exact amount of materials, the time it will take for parts, etc. The goal for procedures is for someone to follow the experiment exactly as you meant for it to be conducted without having you there to explain the directions. Remember, you must repeat the activity a minimum of three (3) times!

Model Question: Does weight affect the speed of a pendulum?

Model Procedures Example:

1. Gather all materials.
2. Cut my sting into a piece that is 34cm long.
3. Tape one end of my string to a table so 30 cm are hanging off the side of the table.
4. Tie one plumbing washer to the free end of the string.
5. Lift the washer to the bottom of the table and release.
6. Start timing when the washer is released and continue timing until the pendulum has completed ten complete swings (back and forth).
7. Repeat 5 times and find the mean of the times. Record all data collect on the data chart.
8. Add one more washer to the string.
9. Repeat steps 4-7 with two, three, four and five washers on the string.
10. Compare the means of the data to draw conclusions.

Bad Procedures Example:

1. Gather your materials and ask mom for permission to work in the kitchen.
2. Tie one weight onto the end of the string.
3. Swing the pendulum 10 times and time how long it takes to swing.
4. Write down your answer.
5. Do it all over again until you have used all of the weights.

These procedures are not clear. The reader would not be able to recreate your experiment

My Procedures (You may need more or less lines. If you need more, attach another piece of paper.)

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

☐ Your Procedures list is approved! Next, go to p. 23 to work on your Data Display.

☐ Your Procedures list is not approved. Use my comments to re-write them. Your new due date for your list is: _____

Teacher Signature:_____ Date: _____

Parent Signature:_____ Date: _____

Data Collection Tool

You will need a place to write down your data as you conduct your trials and make your observations. Your collection tool can be a table and must include the following items:

- a title
- labels to describe the columns or rows
- space for repeated trials (a minimum of three; more is better!)
- space for the a calculation of the median of the data and the mean (average) of the data, if required by your teacher
- all data is collected in metric units (see Materials p. 14 for a reminder)

If you are not collecting numerical data but rather making observations, you still need to design a chart or keep a journal in which you can record your detailed notes. This is most typical with projects that involve the growth or decay of something.

Model Question: Does weight affect the speed of a pendulum?

Model Data Collection Table

Independent Variable

Dependent Variable Summary

Effect of Weight on Speed of Pendulum

Weight of Pendulum	**Trials Recorded in Minutes and Seconds**					**Median Time for 10 Swings**	**Mean Time for 10 Swings**
1 weight							
2 weights							
3 weights							
4 weights							
5 weights							

Dependent Variable Individual Results

My Data Collection Tool

(Use this space to design your own data collection tool or use a table from appendix, pp. xx-xx)

☐ Your data collection table is approved! Next, go to p. 24 to work on your Experiment.

☐ Your data collection tool is not approved. Use my comments to re-create it on a separate piece of paper. Your new due date for your table is: _____

Teacher Signature:_____ Date: _____

Parent Signature:_____ Date: _____

Results, Data from Experiment

Now you are all ready to conduct your experiment. All of the work you have done up to this point has prepared you for a thorough investigation on your topic. Before you begin your experiment, remember to:

- Gather all the materials you listed on p. 16
- Have an adult present if your investigation requires it
- Follow the procedures just as you wrote them on p. 18
- Keep accurate records by filling in your data chart as you go

REMEMBER!

- If you are growing something (plants, mold) plan to allow a minimum of two weeks (approximately 14 days) for everything to grow enough for you to have a meaningful amount of data
- If you are freezing something, plan to allow a minimum of four hours for liquids to freeze completely so a meaningful amount of data can be collected
- If you are melting something, plan to allow an appropriate amount of time depending if you are melting the item in an oven or just by natural temperature
    - If you are using an oven, remember to have an adult present.

Do not begin to graph your data until your teacher has approved the data you collected in your table.

☐ Your Experiment Data is approved! Next, go to p. 25 to work on your Results, Graphic Display.

☐ Your Experiment Data is not approved. Use my comments to re-create it on a separate table. Your new due date is: _____

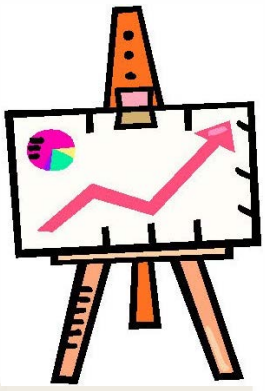
Teacher Signature:_____ Date: _____

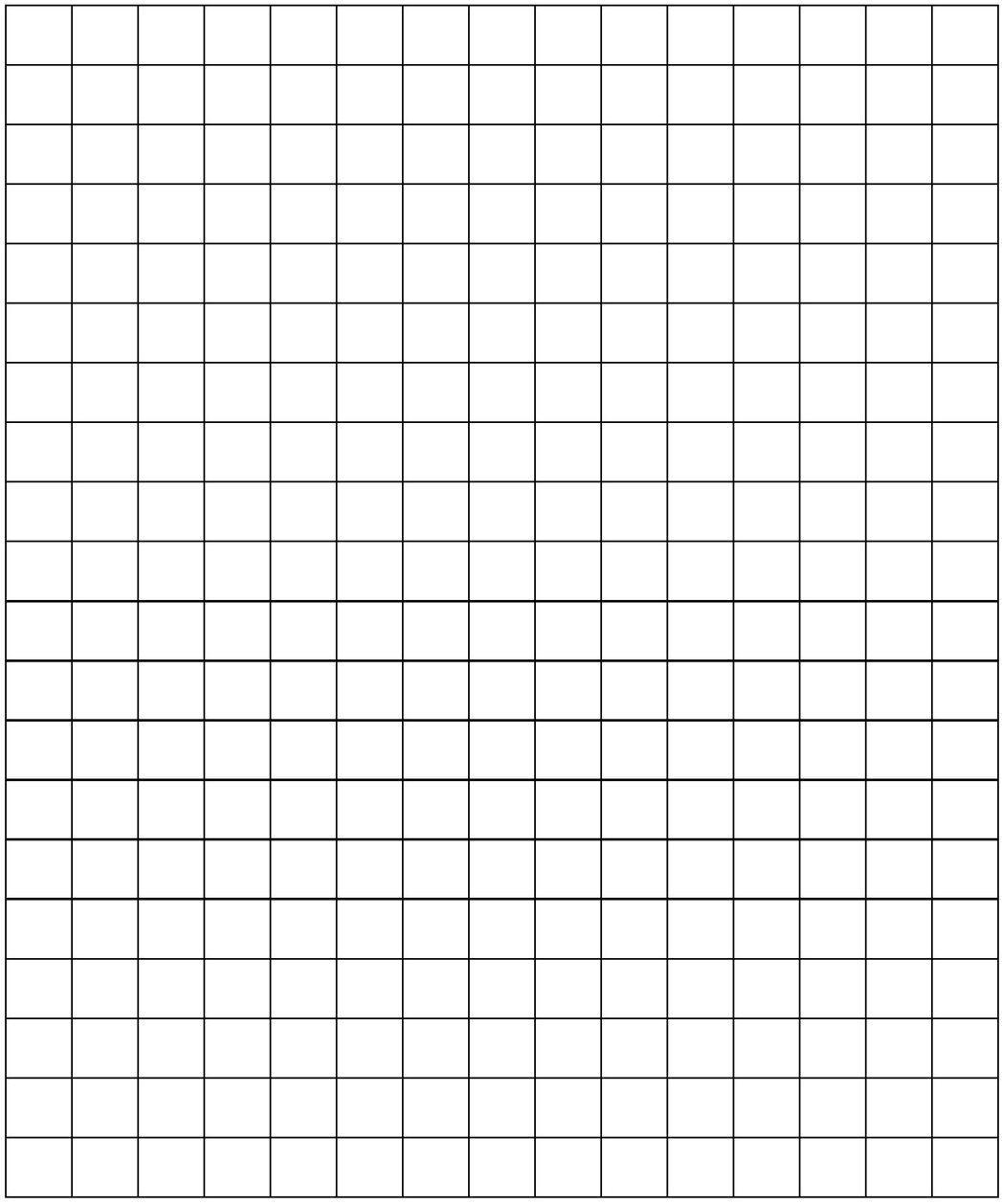
Parent Signature:_____ Date: _____

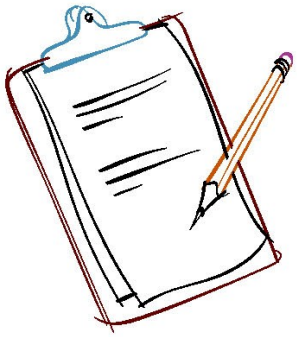
Results, Graphic Display

Once your teacher has approved the data you have collected in your table and you have summarized the data by finding the median, mean or some other method of highlighting the important results, you are ready to graph your data. Here are the steps to organize your material:

- You must choose the correct type of graph to display your results.
  - Line graphs should be used to display continuous data – information that changes over time.
    - temperature changes (not just a final, ending temperature)
    - growth changes
    - time changes
  - Bar graphs should be used to display data that is separate or distinct from other pieces of data in your activity.
    - height of bouncing or falling objects
    - distance objects travel
    - survey results
  - Pie charts, line plots and stem/leaf plots are not usual graphical displays in STEM projects. Please check with your teacher first if you are considering one of these types of displays
- All graphs need to include the following information
  - title – this can be the same as your data collection table
  - independent variable – this goes on the horizontal (x-axis); you can use what you have on the data collection table
  - dependent variable – this goes on the vertical (y-axis); use the same description as the data collection table
- If you only present one graphic display, it must be the summary data (median, mean)
  - You can present a graphic display of all of your data but it must be in addition to the summary graph
- You may use the graphing paper on the next page or select a graphing tool of your own.
  - On the provided graph, space has been left around the perimeter for all of the labels and to use it portrait or landscape style.
  - Computer-generated graphs are allowed but be sure they contain all of the information listed above.







Results and Written Explanation

A written explanation gives a brief analysis of the data you collected in your table and displayed visually in your table. It should be about one paragraph and summarize the data shown in the table and graph. It can include trends you noticed in the data, if any, but it should not be a conclusion.

Model Question: Does weight affect the speed of a pendulum?

Model Written Results Explanation Example:

- The mean (average) time for 10 swings was approximately the same for all the weights. The longest time was with 2 weights at 28 seconds and the shortest time was with 5 weights at 24 seconds. However, since these times are close to each other and so are the other times, I would say the trend is that nothing really changes. When I look at the median data, the results are about the same – there is no real difference.

(This data was made-up just to demonstrate how to write an explanation.)

This explanation summarizes the data by only mentioning the shortest and longest piece of data.

There is an attempt to discuss a trend to the data even though a trend isn't completely clear.

Bad Written Results Explanation Example:

- My mean data was 1 weight at 26 seconds, 2 weights at 28 seconds, 3 weights at 27 seconds, 4 weights at 25 seconds and 5 weights at 24 seconds. I can't tell if there is a trend to this data.

This explanation just states in words exactly what the table says. It doesn't summarize the most important data nor is there any brief discussion of a possible trend. Stating that you "can't tell if there is a trend" is not an analysis.

Here is the written explanation of my results.

☐ Your Results and Written Explanation is approved! Next, go to p. 29 to work on your Conclusion.

☐ Your Results and Written Explanation is not approved. Use my comments to re-create it on a separate piece of paper. Your new due date is: _____

Teacher Signature:_____ Date: _____

Parent Signature:_____ Date: _____

Conclusion

The conclusion tells what you learned about the topic after completing the experiment. It contains many parts. Use the question prompts below to organize your ideas. Then, join them together into multiple paragraphs to create your final conclusion.

What is the answer to the question your asked?

Re-read your hypothesis. Was it correct?

What can you infer about your results?

How can this information help you, others or even companies in the real-world?

Did you have any problems as you conducted your investigation?

If you kept the same topic, what different idea would you test next year?

_____

_____

_____

_____

_____

_____

_____

_____

☐ Your Conclusion draft is approved! Next, go to p. 30 to work on your combining your Conclusion statements into one final product.

☐ Your Conclusion draft is not approved. Use my comments to re-create it on a separate piece of paper. Your new due date is: _____

Teacher Signature:_____ Date: _____

Parent Signature:_____ Date: _____

Final Draft of Conclusion

Appendix C: STEM Fair: Research Paper Rubric

Student Name: _____

Category	Possible Points	Points Earned	Comments
Organization – Information is very organized with well-constructed paragraphs and subheadings.	5		
All Parts Present – All **five** parts of the research paper are present and complete (Title Page, Acknowledgements, Question, Background Research and Bibliography).	5		
Amount of Information – All topics are addressed and all questions answered with at least 2 sentences about each.	5		
Quality of Information – Information clearly relates to the main topic. It includes several supporting details and/or examples.	5		
Mechanics – No grammatical, spelling or punctuation errors.	5		
Sources – All sources (information and graphics) are accurately documented in the desired format.	5		
Totals –	**30**		**Final Grade:** _____

Appendix A: STEM Fair: Oral Presentation Rubric

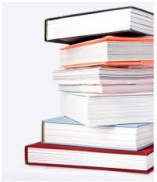
Student Name: _____

Category	Possible Points	Points Earned	Comments
Eye Contact – Student is not reading from display board and maintains eye contact with class the majority or the time.	2		
Loudness of Voice – Students is loud enough for all members of the classroom to hear.	2		
Preparation – Student should appear to have practiced their presentation.	2		
Organization – Student is presenting information in a logical order.	2		
Enthusiasm – Student seems interested and excited about their topic.	2		
Title – Student states their title.	1		
Question – Student states their question and explains why they chose this topic.	3		
Hypothesis – Student states their hypothesis.	1		
Materials – Student explains the materials they chose for their experiment.	1		
Procedures – Student summarizes how they did their experiment, being sure to mention how many times the experiment was repeated.	3		
Results – Student summarizes the results giving a few examples of numeric data collected.	1		
Conclusion – Student tells whether or not their prediction was correct and summarizes conclusions that could be made based on the data collected. Student should also explain anything they might do differently if they were to do this investigation again.	3		
Research Paper – Student should explain something they found interesting in their research.	2		
Totals –	**25**		**Final Grade:** _____

Appendix B: STEM Fair: Display Board Rubric

Student Name: _____

Category	Possible Points	Points Earned	Comments
Overall Appearance and Organization: • All parts of the project are included, clearly labeled and in sequential order (title, question, hypothesis, materials, procedures, results, conclusion. • Display board is neat and attractive.	5		
Question: • Question led to an investigation, not a report, demonstration or model. • A creative approach to problem solving was used to formulate the question.	5		
Hypothesis/Prediction: • Prediction must state a possible outcome of the experiment with an accompanying explanation. • Should show students background knowledge.	5		
Materials/Procedures: • Materials and equipment are listed with specific amounts using METRIC units. • All steps to conduct the experiment are described and in order.	5		
Variables/ Experimental Design: • Independent, dependent, and controlled variables are correctly identified and listed. • Adequate dada were collected through repeated trials to justify the conclusion. • Sufficient sample size was used to support the conclusion (as necessitated by project).	5		
Results/Graphic Representation: • Data is presented in the form of a table with appropriate labels and title. • An appropriate type of graph is accurately constructed (scale, labels and title) from the data on the table.	5		
Results/Written Explanation: • Explanation analyzes and summarizes the data to note patterns and trends. • Explanation interprets the graph.	5		
Conclusion: • Answers the original question being investigated. • Tells whether or not the hypothesis was correct, using specific data as a reference. • Additional questions to investigate are presented.	5		
Totals –	**40**		**Final Grade:** _____



Appendix C: STEM Fair: Research Paper Rubric

Student Name: _____

Category	Possible Points	Points Earned	Comments
Organization – Information is very organized with well-constructed paragraphs and subheadings.	5		
All Parts Present – All **five** parts of the research paper are present and complete (Title Page, Acknowledgements, Question, Background Research and Bibliography).	5		
Amount of Information – All topics are addressed and all questions answered with at least 2 sentences about each.	5		
Quality of Information – Information clearly relates to the main topic. It includes several supporting details and/or examples.	5		
Mechanics – No grammatical, spelling or punctuation errors.	5		
Sources – All sources (information and graphics) are accurately documented in the desired format.	5		
Totals –	**30**		**Final Grade:** _____

Appendix D: Tips for Creating Outstanding Display Boards

Be Neat – Avoid frayed or ripped edges of paper, glue globs, lots of cross outs or white outs etc.

Use Colors to Attract Attention – Use no more than three colors on your project board. Too many colors can be distracting.

Frame or Matte Your Work – Use construction paper, or other materials, to provide a background for your written work and labels.

Choose a Good Title – Titles should be short, catchy and related to your topic.

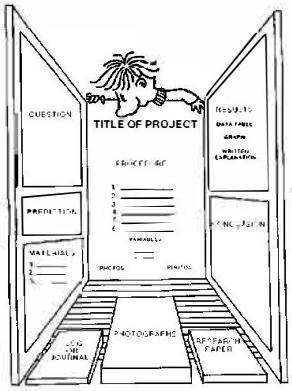
- For example, Cool Color Cubes is better than The Melting Rate of Different Colors of Ice Cubes

Writing Should Be Neat – If possible, everything on your board should be typed, making sure that you use the same fonts and font sizes throughout. Do not go overboard with fonts, font colors or font sizes. Try to keep everything looking uniform. If you are hand writing, use pen and write very neatly so that everything can be read. Cursive is not encouraged.

Spelling Counts – Have an adult check all of your spelling before printing.

Practice the Layout – Before you glue anything to your board, lay it all out to make sure it fits. If items are too small make them larger, if items are to large make them smaller. You do not want things to overlap and you do not want too much white space.

Do Not Glue Any Materials From Your Project* – Only paper and photographs are allowed on your board. If you want to put a material on your board, take a picture of it and glue that on your board.



Do Add Photos and Drawings – This is the best way to clearly show what you did during your investigation.

Research Papers Should be Placed on the Table in Front of Your Board – DO NOT attach the research paper to your backboard.

Select the Right Size* – Choose a board that is no larger than 100cm wide and 95 cm high.

*** denotes a requirement for the county fair, Kids for Science. If you are invited to the fair your board must follow this tip.**

Appendix E: Tips for Creating Outstanding Digital Projects

Be Neat – Avoid using different types of fonts in various sizes. Find what you like and use it throughout the whole presentation.

Use Colors to Attract Attention – Use no more than three colors in your presentation. Too many colors can be distracting.

Presentation Theme – Select one theme that is appropriate for your topic and use it throughout the entire presentation.

Choose a Good Title – Titles should be short, catchy and related to your topic.

- For example, Cool Color Cubes is better than The Melting Rate of Different Colors of Ice Cubes

Spelling Counts – Have an adult check all of your spelling before printing.

Plan Your Slides* – Before you begin make sure you have planned each of your slides. Plan to have 13 or less slides, including slides for the title, question, prediction, materials, procedures, variables, graphic representation of results, written explanation of results, conclusion and acknowledgements.

Do Add Photos and Drawings – This is the best way to clearly show what you did during your investigation.

Do Add A Brief Video* – Consider adding a video of you conducting your experiment. It should be less than two minutes long. Do not add any other video clips.

Research Papers Should be Placed on the Table in Front of Your Board – DO NOT attach the research paper to your presentation.

Be prepared Bring a hard copy of your presentation just in case the computers don't work.

*** denotes a requirement for the county fair, Kids for Science (KFS). If you are invited to the fair, your board must follow this tip.**

*** A video is not required for the KFS, but if you add a video it must be less than two minutes.**

Conclusion

This process of warm air rising and cold air falling keeps the air moving and helps carry pollution away from the source. A thermal inversion occurs when hot air is above cooler air. Hot air rises and cold air falls. If the cold air is nearer to the ground, there will be not mixing of air. This "still" air has no wind to carry away pollution particles. A thermal inversion traps air near the ground.

My hypothesis proved incorrect. I predicted that the hot air smoke would not rise out of the bottle. Instead, it would be trapped near the ground (stay in the bottom of the bottle) and the cold air would rise. I also predicted that a thermal inversion would have no effect on the air pollution at all.

In doing my experiment, I observed that the cold air smoke stayed in the bottom of the bottle for a long time instead of disappeared. At no time did it rise to the top. I was so sure that the hot air smoke would not rise; instead it would stay at the bottom of the bottle. However, it seemed once I dropped the match into the bottle with the hot air smoke, I saw the smoke rise out of the bottle and then it quickly disappeared. I did this experiment six times. Each time I got the same results. The only problem I remember was that sometimes the match would go out before I could get it to the bottle. I think this happened because I was scared of the fire. I was afraid I might get burned, but my mom said she wouldn't let it happen.

I'd like to try this experiment with a watch instead of a timer. I could check the amount of smoke in the bottles every minute to see if there was smoke in them or not.

Bibliography

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Stile, Darlene R. Air Pollution. Chicago: Children's Press, 1990.

Appendix G: Sample Data Collection Tools

				Median

				Mean

				Median

				Mean

						Median

						Mean

						Median	Mean