Foothills Elementary School

STEM
SCIENCE • TECHNOLOGY • ENGINEERING • MATH

FAIR

March 1, 2018

Informational Packet Contents

For more information contact Mrs. Kraus, Foothills School STEM Coordinator

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Foothills STEM Fair General Information

All information needed to prepare an outstanding STEM Fair Project can be found in the attached STEM Fair Instructional Packet. Special attention should be given to the **Important Dates** page of this packet. The following are important items to note:

- All students in 4th and 5th grades are **REQUIRED** to complete a STEM Fair project. All projects will be graded by Mrs. Kraus. The STEM Fair project grade will be an important part of the students' 3rd quarter science grades. A great website with lots of ideas for projects is www.sciencebuddies.org
- Every student must complete either a science **OR** an engineering project.
- All projects must be completed independently by the student. No group or partner projects will be allowed. Only minimal adult assistance is allowed. Projects are to be completed at home. Any student who would like to be provided with a display board and materials, and/or needs extra support completing their project should contact Mrs. Kraus and support will be provided.
- All projects will be judged by impartial judges. No names or identifying pictures should be on the front of the display board or on the journal. Please put the student's name on the back of these items. Students should be prepared to deliver an oral presentation explaining their projects to the judges.
- Awards will be presented to the students whose projects the judges deem best at each grade level.

  First, Second, and Third Place in each of the following areas:
  Biological Science, Consumer Science, Health and Behavioral Science, Physical Science, and Engineering. (15 awards possible for 4th graders and 15 awards possible for 5th graders.)
- Students who win an award at our Foothills STEM Fair will be invited to attend the Regional Science and Engineering Fair at Mitchell High School on a Saturday in April (date to be determined) from 8:00 am – 3:00 pm. These students will receive additional preparation and tutoring in April from Mrs. Kraus in order to be well-prepared for the more competitive Regional Science Fair.
- Any questions regarding the Foothills STEM Fair should be directed to Mrs. Kraus, STEM Coordinator, via email at paige.kraus@asd20.org

Foothills STEM Fair Important Dates

November 27	Informational Packet sent home with 4th and 5th Graders
December 4	Category and Question (Science) or Problem (Engineering) due with Parental Approval. See page 13 (Science) or page 15 (Engineering). A helpful resource for finding an appropriate project can be found at www.sciencebuddies.org
December 11	Research and Hypothesis (Science) or Design Statement (Engineering) due with Parental Approval. See page 14 (Science) or page 16 (Engineering).
February 20	4th Grade STEM Fair Projects due (including journal and display board)
February 21	5th Grade STEM Fair Projects due (including journal and display board)
February 28	4:00 – 4:30 Projects will be set up in the gym by a team of adult volunteers.
March 1	9:00 – 12 noon Judging of STEM Fair Projects (no parents allowed)
	6:00 – 6:30 pm Presentation of 4th Grade Awards
	6:45 – 7:15 pm Presentation of 5th Grade Awards
March 2	9:00 am – 3:00 pm STEM Fair open for public viewing
	3:45 Students take home STEM Fair projects

Rules for Projects

- Students must construct all projects independently, with minimal assistance from adults.
- The project must be an original project, not reused from previous years.
- Projects involving starvation or cruelty of any kind to animals will not be permitted.
- Projects involving dangerous chemicals and explosives will not be permitted.

Rules for Displays

- Emphasis should be placed on communicating the details of the students' work. The fair is not for demonstrating. The use of graphing, photographs and summaries are encouraged. The use of props is discouraged.
- Maximum table space for an entry is limited to the height of four feet above the top of the table. Space limit is three feet across the front and twenty-eight inches front to back. All posters and charts must be contained within the allotted space. No projects may be placed upon the floor.
- Live animals, plants, bacteria, or fungi will not be permitted in any display. This includes potted plants, mold, spoiled food, etc. The use of photography and graphing is encouraged.
- All wiring, switches, and metal parts that carry potentials of 100 volts or higher, such as in radio and electronic apparatus, must be located out of reach of observers and properly insulated. This rule is essential to prevent serious electric shock.
- If batteries are used, they must be sufficient to maintain operation throughout the time of the fair, at least four hours.
- No open fires will be allowed.

**** Any project that does not abide by these rules will be disqualified.**

Category Descriptions

Your STEM Fair Project must fall within one of these five categories.

Biological Science:

Projects with plants, animals, fungi, bacteria, or protozoan as subjects. Topics include ecological relationships and environmental problems related to organisms.

NO LIVE ORGANISMS ARE ALLOWED AT THE STEM FAIR! This includes live plants, mold, spoiled food, etc. Your project may involve a live organism; however, the organism cannot be brought into the STEM Fair.

Consumer Science:

Projects with consumer products as subjects. Topics include comparison testing, consumer psychology, environmental impact, and waste management.

Health and Behavioral Science:

Projects involving the health or behavior of humans or the behavior of other organisms. Topics include, but are not limited to, hygiene, mental health, learning, social interactions, environmental health problems, and the behavior of organisms.

Physical Science:

Projects dealing largely with non-living materials. Topics include, but are not limited to, physical and chemical changes of matter, geology, astronomy, energy, electricity, magnetism, heat, light and sound.

Engineering Design: Any Engineering Project will fall into this category.

Projects that create a solution to a problem or need. Topics include designing, building, analyzing, modeling or improving a device. Testing and creating materials is also engineering design.

**Electrical Access: If your project requires electrical access, you will need to bring your own extension cords and duct tape.

PROJECT REQUIREMENTS

You may choose to do a project following the *Scientific Process* or by following the *Engineering Design Process*. For either, follow the basic steps that are provided in this information packet and document your work in a science notebook. Keep a timeline of your work. This is your daily journal of events as you study and learn about your project. Plan ahead. Don't wait until the last minute. **Provide your notebook as part of your project display and use it as a resource during your interviews.** The notebook is a requirement on the judging rubric.

Scientific Process:

1. Ask and select a testable question. This is a question yet to be answered.
2. Learn about the testable question. Do research at the library, online, or talk to a professional. Record your research and data in your science notebook.
3. Develop a hypothesis. Use what is learned from the research to predict and answer the question. Use an "if...then" statement.
4. Identify and state the variables. See page 7 for an explanation of variables.
5. Design an experiment. Carefully plan a test of the hypothesis. It must use comparisons and measurements with the correct units.
6. Collect data. Do the experiment! Take the measurements. Draw and label the graphs and complete summary tables. Identify the units for each axis.
7. Draw a conclusion. Compare the results of the data collection with the hypothesis. Was the hypothesis supported? Can what happened be explained? What was learned? Upon reflection, did your thoughts change? What would you change the next time?
8. Construct a display. See page 8 for a diagram of the display layout.
9. Practice your presentation. Do not just memorize it. Be able to talk about your project. Look the judges in the eye. Practice in the mirror or with people who know nothing about the project. Refer to your science notebook and explain the process, data, and results to the judges.

Engineering Design Process:

1. Define the problem. After narrowing down your interests to one problem, explain the problem.
2. Learn about the problem. Do background research about the problem, gathering possible solutions and existing solutions to similar problems.
3. Specify requirements. Your problem's solution must do or perform certain ways. List these as performance items. How well will your solution work?
4. Create alternate solutions. There has to be at least three ways to solve your problem. You will choose one based on your capability, costs, time and knowledge.
5. Build a prototype. Choose a solution from Step 4, and build your model to show how your solution solves your problem.
6. Test and redesign as necessary. While building your prototype, or after you've evaluated your prototype, change and retest to get a better result. Keep in mind your requirements from Step 3; these should not change very much.
7. Construct a display. You need to communicate your results. See page 11 for a diagram of the display.
8. Practice your presentation. Do not just memorize it. Be able to talk about your project. Look the judges in the eye. Practice in the mirror or with people who know nothing about the project. Refer to your science notebook and explain the process, data, and results to the judges.

STEM Project Notebook

A detailed notebook is a requirement for both science and engineering projects. The notebook will be a part of the project grade (given by Mrs. Kraus) and a part of the judges' scores at both the Foothills and the Pikes Peak Regional STEM Fairs. It is important to include as much information as possible in your STEM Project Notebook since you will utilize the notebook to answer questions posed to you by the STEM Fair judges.

Criteria for the STEM Project Notebook

- Write your name, grade and teacher on the **inside** front cover of your notebook. (No names should be visible on any part of the project.)
- Your notebook should include all the aspects of your STEM Project.

  Science Project – question, research from three reliable sources, hypothesis, materials used, procedure of experiment, variables, results and analysis of data, conclusion, and any other pertinent learning that occurred in the process of your project.

  Engineering Project – problem, research from three reliable sources, materials used, three preliminary designs with detailed descriptions and illustrations, detailed description of prototype and reasons why you selected this design to be your prototype, results of prototype testing, discoveries during testing, and any other pertinent learning that occurred in the process of your project.
- Neatness and organization of your notebook are important and will be a part of your grade.
- Your STEM Fair Notebook is due with your display board.

  4th Grade Due Date: Tuesday, February 20

  5th Grade Due Date: Wednesday, February 21

Scientific Process Criteria

This criterion should be documented on the exhibit and in your notebook.

Scientific Process:

- Title
- Testable question
- Background research
- Hypothesis (use an "If...then" statement)
- Variables. Clearly identify the **independent** (manipulated) and the **dependent** (responding) variables.
- Materials
- Procedures including measurements and comparisons
- Results (data in a table, chart, and/or graph form with corresponding units)
- Conclusion (supported or not supported)

Example of a Science Fair Experiment:

An experiment should follow a scientific process of which the results are not obvious. Variables should be used in the procedure/test methods. A rule to follow: If the hypothesis is easily obtained from resources or classroom science experiences, it usually is considered a demonstration.

The following testable question is a typical example: "Does light increase the reproduction of Paramecium?"

Title: Light and the Reproduction of Paramecium

Testable Question: Does light increase the reproduction of Paramecium?

Hypothesis: If light is increased, then the reproduction of Paramecium will increase.

Variables: **Independent variable**- amount of light

Dependent variable- number of Paramecium

Materials: Four culture dishes, microscope with camera, slides, Slo solution, light, and eyedropper.

Procedure: Steps used in the experiment; list only what's necessary, and use diagrams or photographs.

Measurement: the number of paramecia

Comparison: growth at different light levels

Results: Daily data table with data collection, photos, graph comparing the number of paramecia in the different cultures. (You cannot bring in live organisms such as these).

Conclusion: This is a detailed discussion of the student's findings as it relates to the hypothesis. The student should include inferences based on the results, state whether the hypothesis is supported or not supported, and explain the reasons for the statement. The student should not state that the hypothesis was proven or correct. The student should use evidence from the experiment to support the findings, and then reflect on what was learned. What might the next steps be? What was learned on reflection of the data?

Examples of Variables

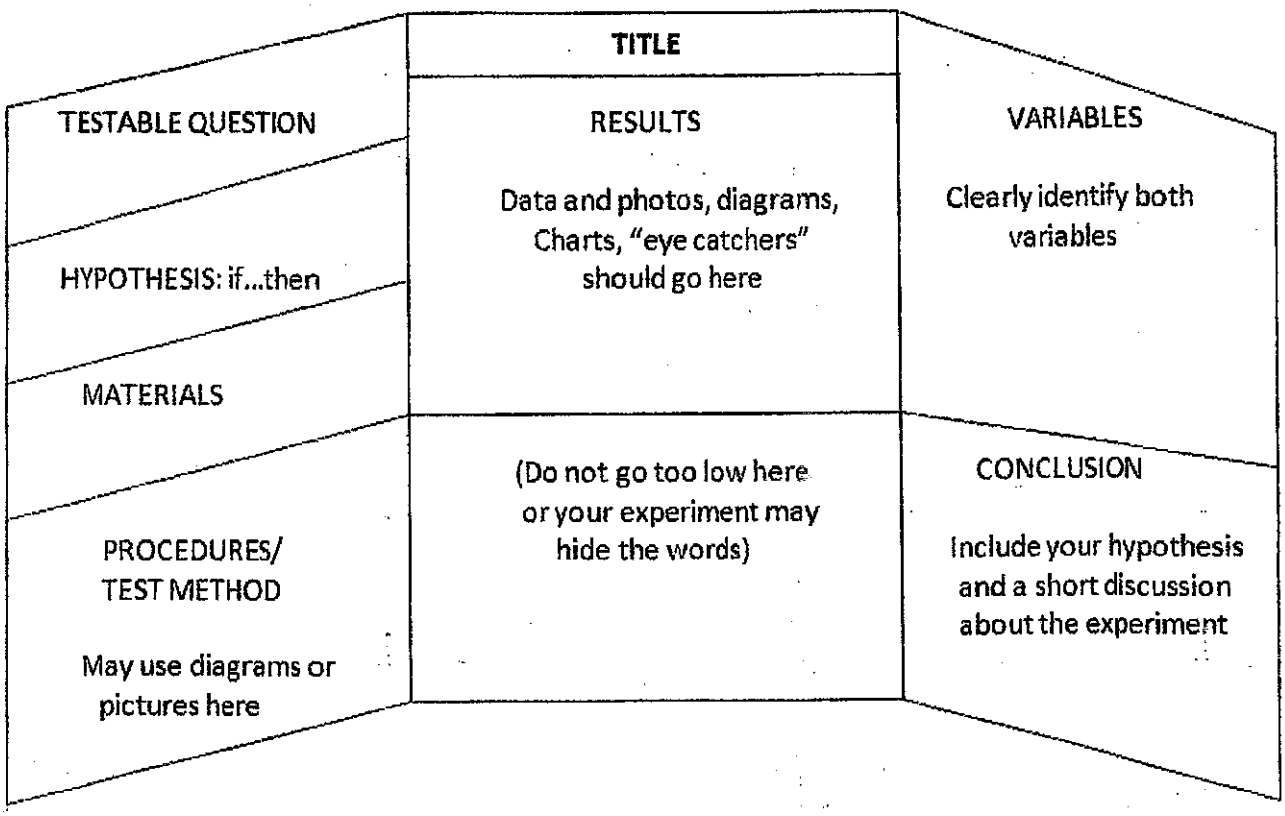
Independent Variable: What I change

Dependent Variables: What I observe

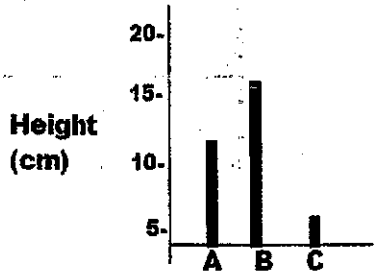
Controlled Variables: What I keep the same

Question	Independent Variable	Dependent Variables	Controlled Variables
How much water flows through a faucet at different openings?	Water faucet opening (closed, half open, fully open)	Amount of water flowing measured in liters per minute	• The faucet • Water pressure
Does fertilizer make a plant grow bigger?	Amount of fertilizer measured in grams	• Growth of the plant measured by its height • Growth of the plant measured by the number of leaves	• Same size pot • Same type of pot • Same type and amount of soil • Same amount of water and light • Make measurements of growth at the same time

Scientific Process- Display Board Template

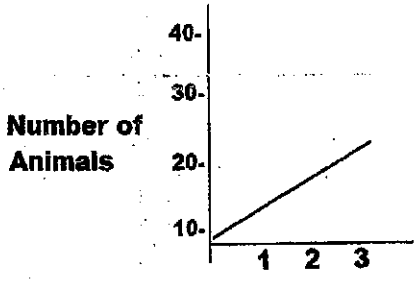


Fertilizer vs. Height



Average height of plants grown In different fertilizers

Animal Growth Rate



Number of animals per week

Complete graphs have a TITLE, SCALE on each axis, and a LABEL and UNIT for each scale.

Bar graphs are used for categories; i.e., type of fertilizer, type of trash, brand of product. Order does not matter.

Line graphs are used for continuous data; i.e., time, dates, amount of substance used. Order does matter.

SCIENTIFIC PROCESS Rubric **Judges Number** _____

Project Title _____

Category _____ **Project #** _____

Scientific Process	Needs Improvement	Satisfactory	Good	Excellent	Superior
Testable Question					
Research Present					
Hypothesis if....then statement					
Variables Defined- independent and dependent variables are present and correctly defined					
Design procedure					
Materials					
Results: graphs, charts & journals with units					
Conclusion/Reflection (supported not proven)					
Presentation	**Needs Improvement**	**Satisfactory**	**Good**	**Excellent**	**Superior**
Display: organized & attractive to audience					
Display: student uses notebook to discuss findings & data					
Oral Discussion Quality					
Time and Effort	**Needs Improvement**	**Satisfactory**	**Good**	**Excellent**	**Superior**
Thoroughness					
Effort					
Scoring					
Checks per column					
Multiply by	X 1	X 2	X 3	X 4	X 5
Totals	+	+	+	+	=
			Grand Total		

SCORING GUIDELINES

- Judges mark the appropriate column with a check.
- The check marks are tallied and the total is entered under "Checks per column".
- The check mark totals in each column are then multiplied by the specific factor (x1, x2, x3, x4, x5).
- The totals are recorded in the row marked "Totals".
- These individual "Totals" are then added together for the "Grand Total".

Engineering Design Process Criteria

This criterion should be documented on the exhibit and in your notebook.

Engineering Design Process:

- Title
- Problem Definition
- Background Research
- Requirements/Materials
- Preliminary Designs
- Prototype Description and Development (redesign, test methods)
- Results (tables/charts/graphs)
- Conclusion (Did the solution meet the requirements?)

Example of an Engineering Design Project:

An engineering design project should solve a problem. The work should create a solution for a specific need.

The following problem is a typical example: "What is the best material to put in a sandbag to block water, such as during a flood?"

Title: Stop the Water!

Problem Definition: What is the best material to put in a sandbag to block water during a flashflood?

Background Research: What is typically used for sandbags (inside as well as outside) and its effectiveness, other possible materials, absorption, etc.

Requirements/Materials: Sandbag must block/deflect water for an extended period of time and be safe for the environment as well.

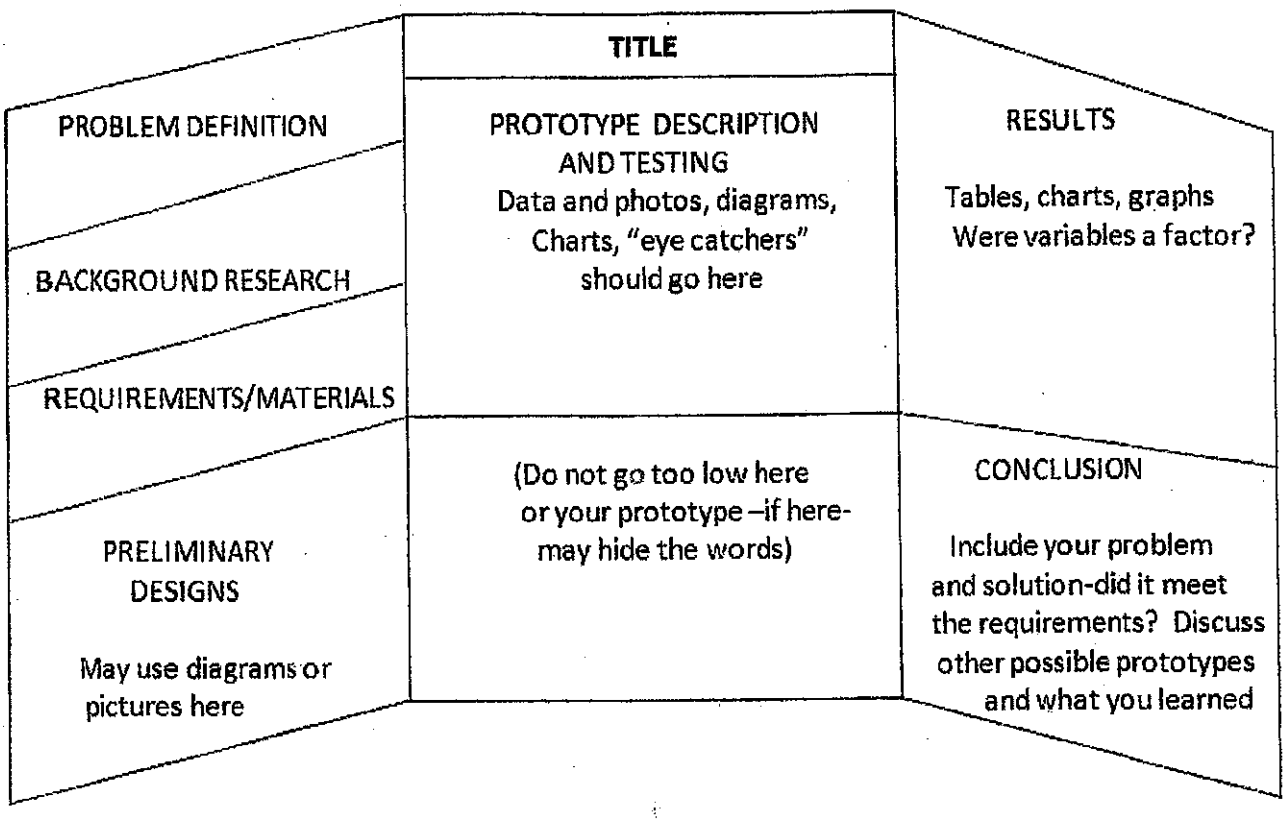
Preliminary Designs: From the research, possible designs are discussed, as well as how to test. First discussion of variables could happen here.

Prototype Description: Discussion of the material(s) chosen, creation steps and testing protocols.

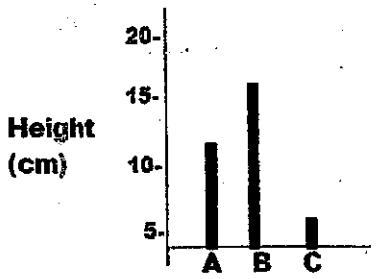
Results: How did the material(s) hold up? What was discovered during testing? Did other variables become apparent? Utilize tables, charts and/or graphs.

Conclusion/Communication: This is a detailed discussion of the student's findings as it relates to the problem. The student should state whether the problem was solved, including whether the solution was reliable and cost-effective. The student should use evidence from the prototype testing to support the findings. The student should reflect on what was learned. What might the next steps be?

Engineering Design Process - Display Board Template

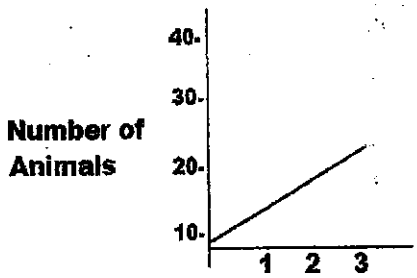


Fertilizer vs. Height



Average height of plants grown in different fertilizers

Animal Growth Rate



Number of animals per week

Complete graphs have a TITLE, SCALE on each axis, and a LABEL and UNIT for each scale.

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Line graphs are used for continuous data; i.e., time, dates, amount of substance used. Order does matter.

ENGINEERING DESIGN PROCESS Rubric **Judges Number** _____

Project Title _____

Category _____ **Project #** _____

Engineering Design Process	Needs Improvement	Satisfactory	Good	Excellent	Superior
Problem addresses a real and specific need					
Research Present					
Requirements and materials specified					
Preliminary design evidence (more than one solution)					
Well-developed prototype					
Defined prototype testing					
Results: graphs, charts & journals with units					
Conclusion/Reflection (supported with data)					
Presentation	**Needs Improvement**	**Satisfactory**	**Good**	**Excellent**	**Superior**
Display: organized & attractive to audience					
Display: student uses notebook to discuss findings & data					
Oral Discussion Quality					
Time and Effort	**Needs Improvement**	**Satisfactory**	**Good**	**Excellent**	**Superior**
Thoroughness					
Effort					
Scoring					
Checks per column					
Multiply by	X 1	X 2	X 3	X 4	X 5
Totals	+	+	+	+	=
			Grand Total		

SCORING GUIDELINES

- Judges mark the appropriate column with a check.
- The check marks are tallied and the total is entered under "Checks per column".
- The check mark totals in each column are then multiplied by the specific factor (x1, x2, x3, x4, x5).
- The totals are recorded in the row marked "Totals".
- These individual "Totals" are then added together for the "Grand Total".

Science Project Category and Question

DUE: Monday, Dec. 4

Name_____

Grade_____ Teacher _____

STEP #1: Check the one category your Science Project fits into.

_____ **Biological Science**: Projects with plants, animals, fungi, bacteria, or protozoan as subjects.

_____ **Consumer Science**: Projects with consumer products as subjects. Topics include comparison testing, consumer psychology, environmental impact, and waste management.

_____ **Health and Behavioral Science**: Projects involving the health or behavior of humans or the behavior of other organisms. Topics include: hygiene, mental health, learning, social interactions, environmental health problems, and the behavior of organisms.

_____ **Physical Science:** Projects dealing largely with non-living materials. Topics include physical and chemical changes of matter, geology, astronomy, energy, electricity, magnetism, heat, light and sound.

STEP #2: Write your testable question. Examples of testable questions: Does soil temperature affect the growth of plants? Which type of detergent removes stains most effectively?

_____

_____

_____

STEP #3: Parent Signature. It is very important that your parents give their permission for you to complete this Science Project.

Parent Signature: _____

STEP #4: Approval from Mrs. Kraus, STEM Coordinator

_____ Yes, I approve of this project. Great work! ☺

_____ No, I do not approve of this project. Please make the following changes and return it to Mrs. Kraus by Thursday, Dec. 7

Science Project Research and Hypothesis

DUE: Monday, Dec. 11

Name_____

Grade_____ Teacher_____

STEP #1: List three sources of your research. Sources must be **reliable** websites, books or journal articles (no websites such as Wikipedia.com or Ask.com are allowed).

1._____

2._____

3._____

STEP #2: Write your hypothesis. Your hypothesis is a prediction of what you think will happen in your experiment. A hypothesis must be written in an "If..., then..." format. Here are some examples of a good hypothesis:

- If I remove plants from the sunlight, then they will not grow.
- If I place my hamster in a maze, then it will go faster when there is a food reward at the end.
- If three types of glue are tested for strength, then Elmer's glue will be the strongest.

Your hypothesis:

_____

_____

_____

_____

STEP #3: Parental approval.

Parent signature: _____

STEP #4: Approval of Mrs. Kraus, STEM Coordinator

____ Yes, I approve of your research sources and your hypothesis. Well done ☺

____ No, I do not approve of your research sources and/or your hypothesis. Please see my comments below, make the necessary changes, and return this form to me by Thursday, Dec. 14

Engineering Project: Problem to be Solved

DUE: Monday, Dec. 4

Name_____

Grade_____ Teacher_____

Your engineering project must solve a problem. Some sample problems are:

- Water is wasted when the toilet is flushed. How can that water be reclaimed and recycled?
- My dog's back legs are paralyzed. How can I construct a device that will allow him to walk again?
- My plants die when I am unable to water them. How can I create an automatic watering system?

STEP #1 State your problem.

_____

_____

_____

_____

_____

_____

STEP #2 Parental Approval. It is very important that your parents give their permission for you to complete this engineering project.

Parent signature:_____

STEP #3 Approval of Mrs. Kraus, STEM Coordinator

_____ Yes, I approve of this project. Great work ☺

_____ No, I do not approve of this project. Please make the changes listed below and return to Mrs. Kraus by Thursday, Dec. 7

Engineering Project Research and 3 Preliminary Designs

DUE: Monday, Dec. 11

Name_____

Grade_____ Teacher_____

STEP #1: List three sources of your research. Sources must be **reliable** websites, books or journal articles (no websites such as Wikipedia.com or Ask.com are allowed).

1._____

2._____

3._____

STEP #2: Create 3 Preliminary Designs. A simple illustration and a brief description of each preliminary design are required. If you need more space, you may attach extra pages.

Description	Illustration
1.	1.
2.	2.
3.	3.

STEP #3: Parental approval.

Parent signature: _____

STEP #4: Approval of Mrs. Kraus, STEM Coordinator

____ Yes, I approve of your research sources and preliminary designs. Well done ☺

____ No, I do not approve of your research sources and/or your preliminary designs. Please see my comments below, make the necessary changes, and return this form to me by Thursday, Dec. 14