McKinley-Thatcher Elementary Science Fair

Thursday, January 10, 2019 (projects due by 8:00am)

Informational Packet for Science Fair Participants

This packet contains detailed information on:

- ✓ Science fair timeline
- ✓ DPS science fair guidelines
- ✓ Choosing a project topic
- ✓ Research questions vs. testable questions
- ✓ The scientific method
- ✓ Preparing for your oral interview
- ✓ Display guidelines & examples
- ✓ Buying a display board from our school
- ✓ Scoring rubrics used by our science fair judges

Timeline

Dec. 14	**DEADLINE FOR REGISTRATION**
Dec. 14-21	Poster boards available for purchase in our main office. $5/board (scholarships available, too!)
Jan. 9 & 10	Project drop-off at McKinley-Thatcher: • Wednesday, Jan. 9: 3:00pm - 4:00pm • Thursday, Jan. 10: 7:30am - 8:00am
Jan. 10	8:30am - 11:30 am – Project judging & oral interviews (students only, please!)
Jan. 10	Family Science Night – 5:30pm - 7:00pm Join us to view our Science Fair and engage in other science activities
Jan. 10 & 11	Pick up projects after 7:00pm at Family Science Night or all day Friday, Jan. 11.
Feb. 1	Deadline for winning projects to register for district science fair in order to compete
Feb. 9	Denver Public Schools Science Fair @ DU

DPS Science Fair Guidelines

Project component	**Guidelines**
Project size	Depth (front to back): 30 inches or 76 centimeters Width (side to side): 48 inches or 122 centimeters Height (floor to top): 36 inches or 92 centimeters
Project type	K-2: research-style/demonstration projects are allowed. 3-5: all projects must be inquiry-based and have testable questions. Research-style or demonstration projects will not be judged at the district science fair.
Required forms	Return the attached contract to our main office. Our science fair winners may register for the district fair at https://sciencefair.dpsk12.org/registration/.
Allowed on table	During our fair, you may display on your table 3D objects used in your science project. Note that 3D objects are not allowed at the district fair – only photographs with captions.
Team projects	Maximum of three (3) members. One member should be appointed team spokesperson. Each team member must signed and submit their own contract.

Tips for Choosing a Topic

- Pick a topic that interests you. Conduct some research in library books & search the internet for information that will allow you to come up with a project.
- Determine if your project is a testable experiment or a research/demonstration project.
  - K-2nd graders: research/demonstration projects are allowed.
    - A demonstration/research project involves studying/observing nature or a natural process (e.g. researching types of volcanoes and building a model of a volcano)
  - 3rd-5th graders: your project must be a testable experiment.
    - A testable experiment involves posing a question, forming a hypothesis (based on preliminary research), and designing an experiment to find an answer to (test) the question.

Creating a Poster Board Display

The poster board is where you can mount a variety of documents and is described in greater detail later in this packet. If you feel it enhances your presentation, you can also display 3D objects used in your science project. However, this is not required and 3D objects are not allowed at the district fair. Neatness and visual interest in the presentation of graphics (tables, charts, narrative, photos, etc.) plus logical choice of objects are important.

Buying a display board: you may purchase a trifold display board from our main office for $5. Supplies are limited!

Preparing for Your Oral Interview

All students will be interviewed by judges during our science fair. The judges will ask a variety of unrehearsed questions about your student's science project in order to assess whether, and to what degree, the objectives of the science project have been met. The ability of the student to communicate clearly and knowledgeably about their project is important, so advanced preparation/rehearsal is advised. The tone of the interview is formal, but the judges are kind and encouraging, so it is not meant to cause stress! The judges will offer coaching where required and praise for all.

Is Your Project a Testable Experiment or a Research/Demonstration Question?

The research/demonstration category is available ONLY to K-2nd graders.

1. Aerodynamics/Fluid Mechanics: study of the movement of air/water or the movement of solids through them.

Research Question	*Testable Question*
How does an airplane fly?	Which paper airplane design will go farthest?

2. Botany: plant growth, effects of pollution, climate changes, insects on plants.

Research Question	*Testable Question*
How do plants grow?	How much water is necessary for a violet to thrive?

3. Chemistry: elements, evaporation, crystal growth, acid/base reactions.

Research Question	*Testable Question*
How do crystals grow?	Which type of crystal will grow the fastest?
How does water turn into gas?	Does temperature affect evaporation?

4. Earth/Environmental: fossils, erosion, weather, crystals, geology, oceanography.

Research Question	*Testable Question*
What is a crystal?	Which crystal is the strongest?
What kind of soils are in CO?	Which type of soil will erode the quickest?

5. Electricity and Magnetism: solar power, battery life, lasers, magnets.

Research Question	*Testable Question*
How does an electrical current work?	What materials best conduct electricity?
How does a battery work?	What brand of battery last the longest?

6. Human Body / Health: nutrition, learning, exercise, color perception.

Research Question	*Testable Question*
What are healthy foods?	Does body weight determine strength?

7. Material Science: strength, insulating properties, flexibility of materials.

Research Question	*Testable Question*
How does wool keep you warm?	What material insulated the 3 Little Pigs the best?
How does paper absorb water?	Which paper towel is the strongest?

8. Microbiology: molds, yeast, bacteria, algae. (All microorganisms must be sealed in hard plastic container)

Research Question	*Testable Question*
What is that green stuff growing on my muffin?	Do molds grow better in humid or dry conditions?
	Who has a cleaner mouth, a dog or a human?

9. Physics: light, mass, liquids/solids/gases, machines / motion, rocketry.

Research Question	*Testable Question*
Why do things float?	Which liquid has more buoyancy?
What make things a certain color?	Which color absorbs more heat?

10. Zoology: pet studies, nutrition, life cycles of insects, food chains.

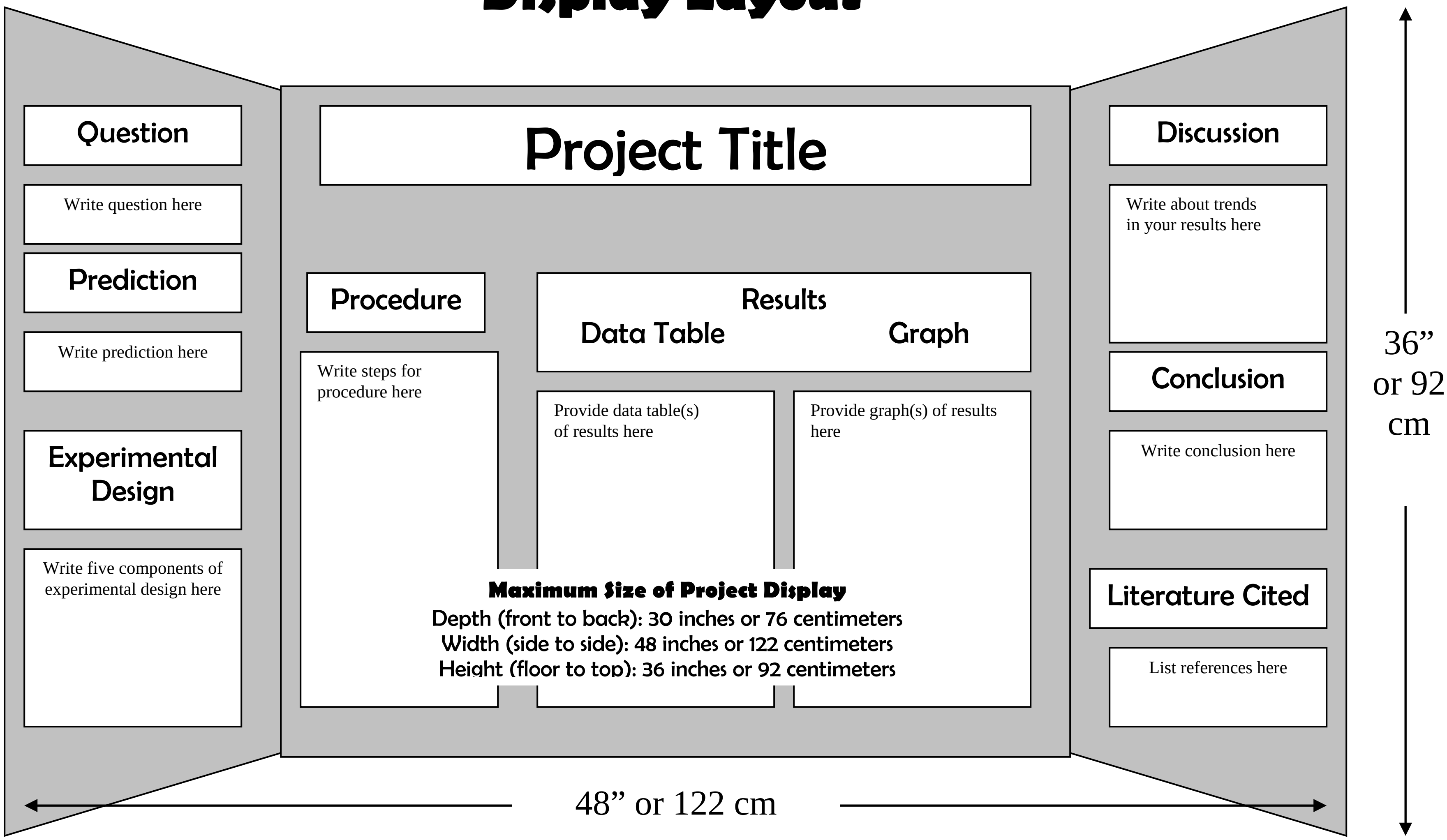
Research Question	*Testable Question*
What sounds do insects make?	Does temperature affect the number of chirps a cricket sings?

The Scientific Method - Steps for a Successful Project

1. *Observation:* what do you wonder about? Choose a topic that interests you.
2. *Question:*
    a. Formulate a question about your observation. This may come as a result of doing some research on the general topic first.
    b. General or broad questions usually end up being research projects. (How does an airplane fly? What causes a tornado?)
    c. Testable questions are more specific. (What airplane design travels farthest? Do existing weather conditions affect the severity of a tornado?)
3. *Research:*
    a. Gather information about the topic.
    b. What do you already know?
    c. Find out more (library, internet, experts, videos, etc.). A variety of sources is better than only searching the internet.
    d. Record what you find out. Make sure to list your sources.
4. *Hypothesis:* form a hypothesis. A hypothesis is an educated guess on what you think is the best answer to your question. Your educated guess will come from your research.

    <u>Example</u>: You notice that the loaf of bread has green fuzzy stuff on it. You do a little research and find out it is called 'mold.' You wonder why mold grew on the bread. You do a little more research (talk to your parents and/or teacher, get a book from the library, search the internet) about how and why mold grows. You wonder what makes mold grow more or faster. You continue your research (recording your information). You decide that you think more mold would grow on a piece of bread if it were in a warm environment than in a cold environment. You design an experiment to test this. You clearly state your question and hypothesis and then begin your experiment.
5. *Procedure:*
    a. Design an experiment to answer your question.
    b. Write each step of your experiment.
    c. Gather the materials you'll need and determine what measurements you'll make.
    d. Identify these parts of your test:
        1. *Control* – the group or sample that does not receive the treatment. The group or sample to which the test results will be compared.
        2. *Independent Variable*: the thing that will be changed to answer your question.
        3. *Dependent Variable*: depends on the independent variable. The thing you measure to see the effects of changing your independent variable.
        4. *Controlled Variable*: variables that, if changed, would affect your results, so therefore you need to hold constant.
        5. *For demonstration-type projects:* write out the observations you predict and compare these to the actual observations
    e. Perform the experiment, make the observations, record measurements and data.
    f. *Repeat the experiment several times to confirm or measure variations in results.*
6. *Results:* write down the outcome. Have you answered the question? Did you get the answer you expected? If not, can you explain what happened?
7. *Conclusion:* summarize your project and what you learned. Relate back to your hypothesis.

Display Layout



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Creating Your Science Fair Display

- The display should be mounted on a display board that can sit on top of a table and stand up by itself.
- The display must fit into a space 36 inches high and 48 inches wide.
- Your display should be easy to read, neat, and organized. Please see the sample display layout for suggested organization.
- Use color, photographs, drawings, graphs, tables, and charts to emphasize your findings and draw viewers' interest.
- Your display should include all the sections listed below.

Sections to include in your Science Fair Display

1. **Title** *is a statement describing an investigation.*
    - The title of your project should be a complete sentence.
    - The title should state how the independent variable and the dependent variable in your investigation are related.
      Sample: "The Effect of the Changes in the independent variable on the dependent variable."
2. **Question** *describes the focus of the investigation.*
    - You question should be testable.
    - Write your question so someone else can easily understand what you are asking.
3. **Hypothesis/Prediction** *is a statement of the relationship of an independent and dependent variables to be tested in an investigation; it predicts the effect that the changes purposely made in the independent variable will have on the dependent variable. It may or may not include a justification.*
    - Your hypothesis/prediction should make a statement about what you think will happen.
    - Your hypothesis/prediction should relate the independent variable to the dependent variable.
4. **Experimental Design**
    - Using the five components below, describe the design of your investigation.
        - o **Independent variable:** *the variable that is changed on purpose by the experimenter*
        - o **Dependent variable:** *the factor or variable that may change as a result of changes purposely made in the independent variable*
        - o **Constant/control variables:** *factors in an investigation that are kept the same and not allowed to change or vary*
        - o **The control group:** *the part of an experiment that serves as a standard of comparison; a control is used to detect the effects of factors that should be kept constant, but which vary; the control may be a "no treatment" group or an "experimenter selected" control*
        - o **Number of repeated trials:** *the number of times that a level of the independent variable is tested in an investigation or the number of objects or organisms tested at each level of the independent variable*
5. **Procedure**
    - Describe the steps you followed to complete your investigation.
    - Write the steps in the order you completed them.
    - Check the procedure carefully for accuracy, ensuring that a stranger would be able to follow your procedure if you gave it to them.
    - If you are using part of a procedure from your textbook or from the teacher, you may reference that procedure instead of re-writing it.
6. **Results**

Adapted from *Students and Research*, 2000, Cothron, Giese, and Rezba

- Include at least one data table and one graph to represent your data. In addition, other representations of data may be used to show results.

  Data Table
  - Give your data table a title.
  - Make a table containing vertical columns for the independent variable and dependent variable.
  - Subdivide the column for the dependent variable to reflect the number of trials.
  - Order the values of the independent variable, preferably from smallest to largest.
  - Record values of the dependent variable.
  - Calculate the average results of each trial and record the values.
  - Use correct units of measurement.

  Graph
  - Give your graph a title.
  - Draw and label the *x* and *y* axes of the graph. Place the independent variable on the *x*-axis, and the dependent variable on the *y*-axis.
  - Determine an appropriate scale for the *x* and *y* axes; subdivide the axes.
  - Use correct units of measurement.
  - Provide a legend.
  - Decide the most appropriate form to plot the data (line, bar, or pie graph)

7. **Discussion**
   - Write a paragraph summarizing the results in words.
   - Summarize data trends on the graph/table.
   - Write a second paragraph including the trends or patterns in your results.
   - Write a third paragraph that describes the science knowledge that supports your results.
8. **Conclusion**
   - Restate your question.
   - State a claim on whether the hypothesis/prediction is supported by evidence.
   - State your most important result.
   - Give an explanation that relates your evidence to something you have learned about science.
   - Provide suggestions for further investigations based on your results.
9. **Literature Cited:** *If you referenced any sources, such as books, articles, or websites, list them in this section with the title, author, year, and URL (if website).*
10. **Oral Presentation**
    Effective communication of project including:
    - Relating scientific concepts to project
    - Describing design principle
    - Explaining data analysis
    - Discussing future studies

Scoring Rubric

Title	Scientific Investigation	Engineering Design Challenge
3	The title clearly states both the independent and dependent variables and is written as a clear declarative statement.	The title clearly states the engineering design challenge or problem to be solved.
2	The title is clearly connected to the investigation, but does not mention the dependent or independent variables.	The title is clearly connected to the investigation, but does not specifically state the design challenge or problem to be solved.
1	The title is present but not does relate directly to the investigation.	The title is present but does not relate directly to the investigation.
0	Not attempted	Not attempted
Question/Problem	**Scientific Investigation**	**Engineering Design Challenge**
3	The question that the investigation was designed to answer is well articulated and testable.	The design challenge or problem to be solved is one that is novel and can be solved through the design of a solution or prototype.
2	The question that the investigation was designed to answer is testable.	The design challenge or problem to be solved is one that could be solved through the design of a solution or prototype, but already has solutions in place.
1	The question is present, but is not testable.	The design challenge or problem to be solved is present, but cannot be solved with the design of a solution or prototype.
0	Not attempted	Not attempted
Hypothesis/Prediction	**Scientific Investigation**	**Engineering Design Challenge**
3	The hypothesis/prediction is clearly stated and shows a reasonable relationship between the independent variable on the dependent variable.	The proposed solution directly addresses the design challenge or problem to be solved, and includes a measure of success demonstrating a solution.
2	The hypothesis/prediction is stated but is not reasonable or only mentions one variable.	The proposed solution partially addresses the design challenge or problem to be solved, or does not include a measure of success demonstrating a solution.
1	The hypothesis/prediction is present but does not show a relationship between the variables.	A proposed solution is present but does not address the design challenge or problem to be solved.
0	Not attempted	Not attempted
Experimental Design	**Scientific Investigation**	**Engineering Design Challenge**
3	At least four of the five components of experimental design are clearly stated.	At least four of the five components of engineering design are clearly stated: research, prototyping, design, testing, refinement.
2	At least three of the five components of experimental design are clearly stated.	At least three of the five components of engineering design are clearly stated.
1	At least two of the five components of experimental design are clearly stated.	At least two of the five components of engineering design are clearly stated.
0	Not attempted or only one of the five components of experimental design is clearly stated.	Not attempted or only one of the five components of engineering design are clearly stated.
Procedure	**Scientific Investigation**	**Engineering Design Challenge**
3	A detailed, logical step-by-step procedure is provided.	A detailed, logical step-by-step procedure of the solution/prototype design is listed.
2	A logical step-by-step procedure is provided, but some steps are missing or incomplete.	A logical step-by-step procedure is listed, but some steps are missing or incomplete.
1	A logical step-by-step procedure is provided, but many steps are missing or incomplete.	A logical step-by-step procedure is listed, but many steps are missing or incomplete.
0	Not attempted	Not attempted
Results - Data Tables	**Scientific Investigation**	**Engineering Design Challenge**
3	Data table(s) are accurate, easily understood, and complete including title, appropriate labels, appropriate placement of variables, and use of correct units of measurement.	Data table(s) are accurate, easily understood, and complete including title, appropriate labels, appropriate placement of variables, and use of correct units of measurement.
2	Data table(s) include most of the above components.	Data table(s) include most of the above components.
1	Data table(s) include some of the above components.	Data table(s)include some of the above components
0	Not attempted	Not attempted

Results - Graphs	Scientific Investigation	Engineering Design Challenge
3	Graph(s) are accurate, easily understood, and complete including title, appropriate labels, appropriate placement of variables, and use of correct units of measurement.	Graph(s)are accurate, easily understood, and complete including title, appropriate labels, appropriate placement of variables, and use of correct units of measurement.
2	Graph(s) include most of the above components.	Graph(s) include most of the above components.
1	Graph(s) include some of the above components.	Graph(s) include some of the above components
0	Not attempted	Not attempted

	Discussion
3	Discussion includes at least three paragraphs that summarize the results/solution in words, describe trends or patterns in the results, and relate the science knowledge that supports the results.
2	Most parts of discussion are complete and accurate.
1	Some parts of discussion are complete and accurate.
0	Not attempted

	Conclusion	
3	Conclusion clearly restates the question and whether the prediction was supported with evidence; includes an explanation that effectively connects results to scientific knowledge; and also provides suggestions for further investigations.	Conclusion clearly restates the design challenge/problem to be solved and whether the prototype/solution was successful, includes an explanation that effectively connects results to scientific and engineering concepts or knowledge, and provides suggestions for further investigations.
2	Most parts of conclusion are complete and accurate.	Most parts of conclusion are complete and accurate.
1	Some parts of conclusion are complete and accurate.	Some parts of conclusion are complete and accurate.
0	Not attempted	Not attempted

	Creativity
3	Project is clearly the original creative work of the student researcher. Input into the project by adults is limited.
2	Project is mostly the original creative work of the student researcher.
1	There is evidence of some input from adults beyond encouragement and assistance in obtaining materials.
0	There is evidence of significant input from adults beyond encouragement and assistance in obtaining materials.

	Display
3	Display is easy to read and well-organized. Color, graphics, and other visual components add to the display.
2	Two out of the three qualities listed above are present.
1	One out of the three qualities listed above is present.
0	Display is difficult to read, poorly organized, and visual components, such as graphics or color, are missing or distracting.

	Oral Presentation
3	Effective communication of scientific concepts, design principles, data analysis, and further studies.
2	Two out of the four qualities listed above are present.
1	One out of the four qualities listed above is present.
0	Communication was not effective.