Baylor College of Medicine

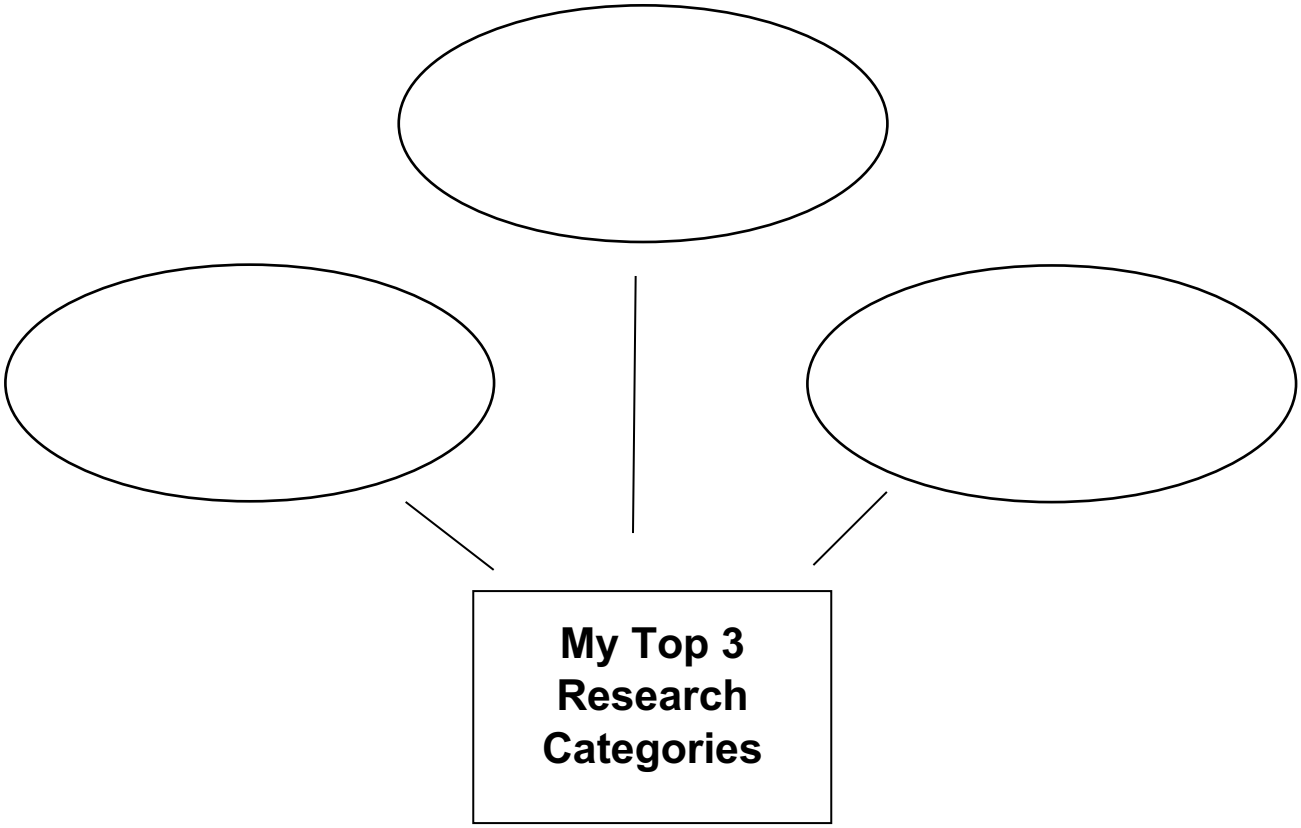
DEPARTMENT OF EDUCATION, INNOVATION & TECHNOLOGY

CENTER FOR EDUCATIONAL OUTREACH

Science Fair Planning Guide for Learners

PROPOSAL PREPARATION: Brainstorm

Using the Project Categories on the next two pages, write down three categories that interest you:



Pick one category (of the three you chose above) in which you are interested. Write your first choice category in the space below.

Category:_____

PROJECT CATEGORIES

It is time to organize your thoughts and ideas. Below is a list of typical science-fair-topic categories. Your project should fall into one of these. Read the brief descriptions and then use the graphic organizer above to select your top category of interest. (The categories and descriptions are from the Science and Engineering Fair of Houston resource page.)

Animal Science (ANIM): This category includes animals (mammals, reptiles, birds, insects, etc.), animal life, animal development, animal life cycles, animal interactions with each other and/or their environment, and the study of animals at the cellular and the molecular level.

Behavioral and Social Science (BEHA): This category includes the study of psychology, sociology, anthropology, archeology, etiology, ethnology, linguistics, animal behavior (learned or instinctive), learning, perception, urban problems, gerontology, reading problems, public opinion surveys, and education testing, etc.

Biochemistry and Microbiology (BIO): This category includes molecular biology, molecular genetics, enzymes, photosynthesis, blood chemistry, protein chemistry, food chemistry, hormones, bacteriology, virology, protozoology, fungal and bacterial genetics, yeast, etc.

Medicine and Health (MED): This category includes medicine, dentistry, pharmacology, veterinary medicine, pathology, ophthalmology, nutrition, sanitation, pediatrics, dermatology, allergies, speech and hearing, optometry

Plant Sciences (PLNT): This category includes agriculture, agronomy, horticulture, forestry, plant biorhythms, palynology, plant anatomy, plant taxonomy, plant pathology, plant genetics, hydroponics, algology, mycology, etc.

Chemistry (CHEM): This category includes physical chemistry, organic chemistry (other than biochemistry), inorganic chemistry, materials, plastics, metallurgy, soil chemistry, etc.

Earth and Environmental Sciences (EAEV): This category includes studies of the environment and its effect on organisms/systems, including investigations of biological processes such as growth and life span, as well as studies of Earth systems and their evolution.

Energy and Transportation (EGTR): This category includes aerospace, aeronautical engineering and aerodynamics, alternative fuels, fossil fuel energy, green energy science & technology, vehicle development, renewable energies, etc.

Mathematics (MATH): This category includes calculus, geometry, abstract algebra, number theory, statistics, complex analysis, probability, topology, logic, operations research, and other topics in pure and applied mathematics.

Physics and Astronomy (PHYS): This category includes the science of matter and energy and of interactions between the two. Astronomy is the study of anything in the universe beyond the Earth.

Systems Software (SOFT): This category includes the study or development of software, information processes or methodologies to demonstrate, analyze, or control a process/solution.

Aerospace Engineering (AERO): Aerospace Engineering is the branch of engineering that deals with the study and design, development, testing, improving and production of aircraft and related systems (aeronautical engineering) and of spacecraft, missiles, rocket propulsion systems and other equipment that operate beyond the earth's atmosphere (Space Engineering). It includes the direction of the technical phases of their manufacture and operation.

Biomedical Engineering (ENBM): The projects that aim to improve human health and longevity by translation novel discoveries in the biomedical sciences into effective activities and tools for clinical and public health use**.**

Chemical Engineering and Materials Science (CEMS): Materials science is study of the integration of various materials forms in systems, devices, and components that rely on their unique and specific properties. Chemical engineering includes the application of the principles of chemistry, biology, physics, and mathematics to solve problems in the production, transport, or use of chemicals, fuel, drugs, food, and other products.

Embedded Systems (EBED): Studies involving electrical systems in which information is conveyed via signals and waveforms for purposes of enhancing communications, control and/or sensing.

Engineering Mechanics (ENMC): Studies that focus on the science and engineering that involve movement or structure. The movement can be by the apparatus or the movement can affect the apparatus.

Environmental Engineering (ENEV): Studies that engineer or develop processes and infrastructure to solve environmental problems in the supply of water, the disposal of waste, or the control of pollution.

Robotics and Intelligent Machines (ROBO): This category includes studies in which the use of machine intelligence is paramount to reducing the reliance on human intervention.

PROPOSAL PREPARATION: Read about Your Topic

Based on the title, write a general question you have about your topic. Closely read your topic article (be sure to look up new vocabulary), then try to answer your question when reading a second time and record at least 4 of the most important pieces of information that helped learn more about your topic and/or helped answer your general question.

Before you begin, what question(s) do you have about your topic? Record the question(s) in the square on the right.	**General Question(s):**

A quote from something you read about your topic	**Questions you have about what you read or wrote**	**Anything you wonder about or would like to learn more about after reading and writing what you learned**

Possible Testable Questions from Your Reading

After reading about your topic, pose two possible testable questions. Remember, a testable question requires an investigation (experiments or specific observations), not just reading.

1. _____

_____

_____

2. _____

_____

_____

PROPOSAL PREPARATION: Read About Your Possible Testable Question(s)

Look for and record information that helps to answer your possible testable question(s). Record at least 4 of the most important pieces of information that answer or help to answer your question.

A quote from your readings that helps answer or address your favorite question	A paraphrase of the quote (rewrite the quote in your own words)	Source: Website Link

PROPOSAL PREPARATION: Read More to Develop and Find an Answer to Your Testable Question

Record information that provides background knowledge about your question, helps describe why your question is important and interesting, and provides reasons why you are making your hypothesis/prediction. You must have at least 5 citations for your manuscript. To help with citation formatting, you may use EasyBib (easybib.com).

A quote from your readings that helps answer or address your favorite question	A paraphrase of the quote (rewrite the quote in your own words)	Source: Website Link

PROPOSAL

Now You Are Ready to Write Your Proposal . . .

But first, your testable question needs to include the independent and dependent variables.

- **What I will change (independent variable):**

- **What I will measure (dependent variable/s):**

Testable Question:

Research (what others have learned and reported about the topic):

Hypothesis (what I think will happen/the answer I predict):

Reasons (why I think so/my "because" statement):

What will stay the same (control variable(s):

What will I collect and record in a data collection table?

Note: Subjects/Samples (what you are experimenting on or observing) and replicates (repeated experiments to see if the results are the same) usually go in the first columns. You can have more than one column for the independent variable and control variable, if needed.

Sample table

Samples, Subjects	Trial, Replicate	Date	Name of Independent Variable	Name of Dependent Variable

Your table (model your table after the sample table above):

Steps in your procedure (what you will do):

Materials (what do you need to carry out your procedure):

VALIDATION CHECKLIST (check all that apply)

- ☐ My project is safe.
- ☐ I can get the materials.
- ☐ I have enough time to build, test, and report on the project.
- ☐ My project will not harm organisms.
- ☐ My project will not harm or bother other people.
- ☐ I need special approval from the school committee because I am using microbes.
- ☐ I need special approval from the school committee because I am using chemicals or combustion.
- ☐ I need special approval from the school committee because I am studying animals.
- ☐ I need special approval from the school committee because I am studying humans.

Final Approval to Begin Project:

Project Approved: _____
(Signature) *(Date)*

Notes from approver:

TARGETED NOTES ON RESEARCH: ANNOTATED BIBLIOGRAPHY

Write your testable question here:

Once your proposal is approved, continue to research your question or part of your question and record (take notes on) any related work others have done. Use the graphic organizer below to take notes. You may include information you previously found as you were preparing your proposal. Use these notes for your introduction and to help you explain your results.

<table>
<tr><td colspan="2">1. Source (e.g., Weblink):</td></tr>
<tr><td>Quote</td><td>Paraphrase the quote:</td></tr>
<tr><td colspan="2">How will you use the information (as background or as part of your hypothesis and “because” statement for your hypothesis)?

Write the source in MLA format:</td></tr>
<tr><td colspan="2">2. Source (e.g., Weblink):</td></tr>
</table>

Quote	Paraphrase the quote:

How will you use the information (as background or as part of your hypothesis and "because" statement for your hypothesis)?

Write the source in MLA format:

3. Source (e.g., Weblink):

Quote	Paraphrase the quote:

How will you use the information (as background or as part of your hypothesis and "because" statement for your hypothesis)?

Write the source in MLA format:

4. Source (e.g., Weblink):	
Quote	**Paraphrase the quote:**
How will you use the information (as background or as part of your hypothesis and "because" statement for your hypothesis)? **Write the source in MLA format:**	
5. Source (e.g., Weblink):	
Quote	**Paraphrase the quote:**
How will you use the information (as background or as part of your hypothesis and "because" statement for your hypothesis)?	

Write the source in MLA format:	
6. Source (e.g., Weblink):	
Quote	**Paraphrase the quote:**
How will you use the information (as background or as part of your hypothesis and "because" statement for your hypothesis)? **Write the source in MLA format:**	

CHECKLIST OF MANUSCRIPT AND POSTER COMPONENTS

1. Format

☐ **Manuscript.** Typed, 12 pt. Times New Roman font, double spaced, 1–inch margins with the following headings for each section: Introduction, Procedures, Results, Discussion and Conclusions, References, and Acknowledgements.

☐ **Poster.** Minimum 14 pt. Times New Roman font (or another easy-to-read font). Exceptions: The title should be minimum 20 pt. font size and references should be a minimum of 10 pt. font size.

☐ **Poster.** The following headings for each section must be included and in the following order: Introduction, Procedures, Results, Discussion and Conclusions, and References.

2. Abstract

☐ A condensed description of the project, including the results.
☐ 1–2 sentences summarizing the introduction: What is your project about and why is it interesting or important?
☐ 1–2 sentences summarizing the methods or procedures: How did you do it?
☐ 2 sentences summarizing the results and conclusions: What did you find out?

3. Introduction (Project Objectives and Project Design)

☐ Background: What is known about the topic, question, or hypothesis you are addressing?
☐ The problem or the question
☐ The hypothesis
☐ Research and/or observations that support the hypothesis.
☐ The purpose: Why is this research important?

4. The Procedure/Methods (Project Design)

☐ Materials (including equipment and chemical information).
☐ Steps taken to test the hypothesis or address a problem/question.
☐ Variables and controls for the investigation
☐ Scientific notation

5. Data and Results (Project)

☐ Graphs and/or tables
☐ Summarize in words the graphs and/or tables
☐ Graphs and tables with titles/labeled
☐ Graph axis properly labeled

6. **Discussion**
    - ☐ How do the results answer the question you had? Do the results support or refute the hypothesis?
    - ☐ How do the results compare to what is already known?

7. **Conclusion**
    - ☐ Main findings
    - ☐ Why the findings matter
    - ☐ If applicable, recommend new areas for future research based on the findings. (What might you do next in relation to your project?)

8. **References/Citations**
    - ☐ Five references in MLA format (references include the title, author [when available], and date of the source, at the very least).

9. **Acknowledgements (For manuscript only. Do not include in your poster.)**
    - ☐ Include a thank you statement to those who helped you.

POSTER AND PRESENTATION: ADDITIONAL COMPONENTS CHECKLIST

It is usually easiest to create your poster by making slides in power point. Here is a template to guide your work: https://tinyurl.com/2uhrnbyx. You will need to make and save a copy of the guide in order to edit it.

You may use your choice of font and colors as long as your poster is easy to read and not distracting. You may copy and paste from your manuscript and increase the size of your font. Your slides will need to be printed and pasted to a poster. You will use your poster to present. You may use your abstract to write your presentation and add more to the presentation to help your audience understand why you did your project and what you discovered.

- ☐ The project content is presented in the following order, and each section is clearly labeled as follows: Introduction, Procedures, Results, Discussion and Conclusions, and References/Citations (MLA format).
- ☐ Use a font size (minimum 14 pt.) large enough to allow your poster to be read from 5 feet away, except the references (these can be 10–12 pt. font size).
- ☐ Presentation is a short summary of your poster that includes what interested you about the topic, why the topic is important, what you hypothesized and why, what your research involved, and what you found out.

Presentation is 5–7 minutes long.

HELPFUL WEBSITES

Science Fair Resources

- Society for Science (main site for the INTEL ISEF)
- Scientific Reagents and Supplies (purchasing materials)
- Institute of Competition Sciences (ICS) (ages 13 – 18)
- How to Do a Science Fair Project (NASA)
- Science & Engineering Fair of Houston
- Texas Science & Engineering Fair

Project Ideas

Some of the links below show the types of data and projects scientists are doing and to which people like you are contributing. These sites may offer inspiration for a project idea.

- International Science and Engineering Fair (comprehensive searchable index of ISEF project abstracts from 2003–present)
- Science Fair Central
- SciStarter
- CitSci

Animals/Behavior

- Zooniverse

Animals/Birds

- Cornel Lab of Ornithology

Space

- NASA
- NASA at Home

Health

- Centers for Disease Control and Prevention (CDC)
- CDC Office of Science

Environmental Health

- Houston Air Quality Index

- Houston Drinking Water Quality Report
- Lake Observations by Citizen Scientists and Satellites

Environmental

- The Globe Program
- iNaturalist

Science Literature

- JSTOR (free open-source articles)
- Google Scholar (search engine for scholarly articles)
- Harris County Public Library (get a library card for free access to many science news journals)
- New York Times Science Section
- NPR Science Podcast Directory
- Science Daily
- Environmental New Network
- New Scientist
- Chem4Kids
- Discovery Education
- Nature
- ScienceNews
- PBS Nova
- NBC Nightly News Kids Edition
- Wired Science
- MIT Technology Review
- Science

Data Collection and Analysis

- Arduino Science Journal (data collection tool for iPhone/iPad that you can use to measure light, sound, and more)
- Arduino Science Journal Data (data collection tools for android devices that you can use to measure light, sound, and more)

Statistics

- National Center for Education Statistics (NCES)
- nCaculators