GLOBAL YOUNG INNOVATORS STEAM FEST

Powered by Expanding Boundaries International

STEAM FEST Guide

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Introduction

About the Global Young Innovators STEAM Fest

- The Global Young Innovators STEAM Fest, presented by Expanding Boundaries International, is an event dedicated to inspiring the next generation of leaders in **science, technology, engineering, arts, and mathematics**. Expanding Boundaries International is a nonprofit organization committed to promoting STEAM education and global experiences.
- The purpose of the STEAM Fest is to ignite a passion for discovery in students, sharpen their skills in inquiry and investigation, and instill a deep sense of pride in their work. This event is a unique platform for students to connect their classroom learning to real-world applications and showcase their innovative projects.

Elementary STEAM Fest

- This event allows students to **exhibit their projects** and **share ideas** with their peers and the community. It provides a supportive environment for young innovators to **receive feedback** from professional scientists and community members. Students are encouraged to choose a topic related to their science curriculum and apply the **scientific method** to investigate it, making learning an exciting, hands-on experience.

Secondary STEAM Fest

- Secondary students are invited to **showcase their research and projects** and **compete** for recognition. Participants will receive valuable feedback from a diverse group of **professional scientists** and community leaders. This event challenges students to apply **science process skills** and the scientific method to a topic of their choosing, connecting their academic knowledge to complex, real-world issues.

What is a STEAM Project?

A STEAM project is an educational approach that integrates **S**cience, **T**echnology, **E**ngineering, **A**rts, and **M**athematics. It goes beyond the traditional STEM (Science, Technology, Engineering, and Mathematics) by intentionally incorporating the arts to foster creativity, design thinking, and communication.[1]

The core idea of a STEAM project is to use these five disciplines to solve real-world problems in an interdisciplinary way. The "A" for Arts isn't just about drawing or painting; it includes a wide range of creative and human-centered skills, such as:

- **Design:** Applying principles of aesthetics and user experience to an invention.
- **Communication:** Using storytelling, visual media, or performance to explain a scientific concept.
- **Empathy:** Considering the human impact and user needs when designing a solution.

Key Characteristics of a STEAM Project

- **Interdisciplinary:** A single project draws on multiple disciplines. For example, a project on renewable energy might involve the **S**cience of solar power, the **T**echnology of circuits, the **E**ngineering of a solar oven, the **A**rts of designing a visually appealing and user-friendly interface, and the **M**athematics of calculating energy efficiency.
- **Problem-Based:** Projects are centered around a real-world problem or challenge.
- **Creative:** Students are encouraged to think outside the box and find innovative solutions.The artistic component helps them visualize and express their ideas in unique ways
- **Process-Oriented:** The focus is not just on the final product but on the entire process of inquiry, design, testing, and refinement.
- **Collaborative:** Many STEAM projects encourage students to work in teams, just as scientists, engineers, and designers do in professional settings.

In essence, a STEAM project is a holistic learning experience that teaches students not just to be analytical and logical, but also to be creative, collaborative, and communicative.[13] The goal is to produce well-rounded individuals who can innovate and address complex challenges with a broader perspective.

STEAM Fest Rules and Guidelines

1. Group projects of no more than 8 students may enter the exhibition challenge
2. Only two types of projects may be entered into the STEAM Fest, they are a scientific investigation or an invention.
3. Projects must fit in one of the 6 STEAM Fest project theme category criteria listed in this handbook.
4. No mold growth, or bacteria projects are allowed.
5. **No use of vertebrate animals is allowed except for human observational projects**.
6. **No use of prescription drugs, harmful, or illegal substances are allowed.** Grocery items (i.e., baking soda, vinegar, salt, lemon juice, etc.) are appropriate.
7. No Human subjects used to test (i.e., taste test, poking, pain reaction, sniffing, etc.)
8. Any projects that promote violence, weapons, or instill fear to the public, the exhibitor, or other exhibitors and the use of fire are PROHIBITED.
9. Project display boards must follow safety guidelines listed in this handbook.
10. Projects must be original work and not a copy and paste, you must document your process.

STEAM FEST Challenge Theme

Sustainable Agriculture & Food Security 🧑‍🌾

This theme challenges students to think about how we can grow food in a way that is good for the environment and makes sure everyone has enough to eat. It's about finding solutions to problems like feeding a growing population, using less water in farming, protecting soil, and reducing food waste. Projects can involve creating new farming methods like hydroponics, designing a system to reduce food spoilage, or investigating how to improve crop yields with sustainable practices.

Renewable Energy & Waste Management ♻️

This theme is about creating and using clean energy and finding smart ways to handle our garbage. Students are asked to innovate in two key areas:

1. **Renewable Energy:** Projects can focus on designing and building models of solar panels, wind turbines, or other systems that use natural, reusable resources. The goal is to show how we can power our world without relying on fossil fuels.
2. **Waste Management:** This involves finding new uses for old materials (upcycling), creating better recycling systems, or turning waste into energy. Projects might include building a device that turns food scraps into biofuel or designing a plan to reduce plastic waste in a community.

Clean Water & Sanitation 💧

This theme encourages students to develop solutions for two of the most critical global issues: access to clean drinking water and proper sanitation. It's about finding ways to purify water, manage wastewater, and prevent the spread of diseases. A project in this area might involve designing a low-cost water filter, building a device that uses solar power to disinfect water, or creating a system to safely manage and treat sewage.

Creative Industries & Digital Solutions 🎨

This theme combines art, technology, and problem-solving. Students are challenged to use their creativity and digital skills to address a need or tell a story. This could mean using code to create an educational app, designing an interactive website to raise awareness about a social issue, or developing an artistic project that uses technology to explore a scientific concept. The "creative" part is just as important as the "digital" part, pushing students to think about design, user experience, and communication.

Security & Safety Innovations 🚨
This theme is about inventing new tools and systems to make people and places safer. Students can explore solutions for personal safety, cybersecurity, or home security. Projects can range from building a model of a smart home alarm system that sends alerts to a phone, to creating an app that helps people learn about and avoid online scams, or even designing a safety device for athletes. The focus is on using technology and design to protect against threats.

Transportation & Infrastructure 🚗
This theme challenges students to find ways to make our transportation systems and public spaces smarter, more efficient, and more sustainable. It’s about building a better future by improving how we move people and goods. Projects can involve designing a model of a high-speed train, creating a traffic light system that reduces congestion, or designing a sustainable bridge that is both strong and eco-friendly. It’s a chance to think like a city planner or an engineer.

Types of projects: Scientific Method vs Engineering Design Method

For a the STEAM Fest, students should submit projects that fall into one of two main categories: **Scientific Investigation** or **Engineering Design**. Both project types are valid and encouraged, as they represent different approaches to problem-solving. It's helpful for both students and advisors to understand the distinction between these two project types to guide a project from conception to completion.

Scientific Investigation Projects (Science & Mathematics) 🔬

This project type is for students who are curious about how the world works and want to **discover** something new. The process is rooted in the **scientific method**. A successful scientific investigation project will clearly show:

- A **testable question** or **hypothesis**.
- A well-designed **experiment** to test the hypothesis, including a control group and variables.
- **Data collection** and analysis, often presented in charts, graphs, or tables.
- A **conclusion** that answers the initial question and is supported by the data.

Example: A student tests the hypothesis that a specific brand of fertilizer will make plants grow faster. They'll set up multiple plants, apply different fertilizers to each, and meticulously record the growth of each plant over several weeks.

Engineering Design Projects (Technology & Engineering) 🛠️

This project type is for students who want to **create** or **improve** something. The focus is on solving a practical problem through a design and build process. A strong engineering project will include:

- The identification of a **problem** or a **need**.
- The **design and creation** of a new product, system, or process to solve that problem.
- A **prototype** or model of the invention.
- **Testing and refinement** of the prototype to show that it works effectively.

Example: A student wants to solve the problem of wasted water. They design and build a simple device that recycles water from a handwashing sink to flush a toilet. The project would include their design drawings, a working prototype, and data showing the amount of water saved.

What about Arts and Mathematics? 🎨➕

Arts and Mathematics are the threads that tie everything together. They are often integrated into a project rather than being the sole focus.

- **Mathematics** is essential for **data analysis** in scientific projects and for **design calculations** in engineering projects.
- **Arts** are crucial for **communication**. A student might create a visual model, a short film, or an interactive presentation to explain their scientific findings or to showcase their engineering design. This can make a project more engaging and understandable.

By focusing on these two primary project types, students can select a challenge theme that best fits their interests and skills, while advisors can provide targeted guidance that ensures a successful project.

[Which should you choose? Scientific Method versus Engineering Design Process (youtube.com)]

The Scientific Method- Experiment Design Process

The Scientific Method is an organized way of figuring something out. There are usually six parts to it.

1. **Purpose/Question**- What do you want to learn?

Begin by exploring a scientific concept in which you are interested. This can be something that was read about or were introduced in the classroom. Go to the library or internet to learn more about your topic. Write a brief summary of the background information you gather for your STEAM Fest topic. Keep a record of where the background information came from. This information will be listed in your bibliography in Step 12.

At this point, your brain will start asking "What **if** " questions. One of these questions is what you will use to design your experiment. It is called the "**TESTABLE QUESTION**". This will become your problem statement. Make sure that this has been approved by your teacher.

Anything to do with your project should be recorded.

a. An example would be, "What doorknob in school has the most germs?" or "Do girls have faster reflexes than boys?" or "Does the color of a light bulb affect the growth of grass seeds?"

2. **Research**- Find out as much as you can.

a. Look for information in books, on the internet, and by talking with teachers to get the most information you can before you start experimenting. Record all information and sources

3. **Hypothesis**- After doing your research, try to predict the answer to the problem.

a. Another term for hypothesis is 'educated guess'. This is usually stated like " If I...(do something) then. (this will occur)" An example would be, "If I grow grass seeds under green light bulbs, then they will grow faster than plants growing under red light bulbs."
a. Think about what might happen in your experiment. This is called a **HYPOTHESIS**. Write down what you think will happen BEFORE actually doing the experiment.
b. How do you design the experiment to answer your question?
c. What measurements do you need to take to record your results?

d. Be specific.

4. **Experiment**- The fun part! Design a test or procedure to find out if your hypothesis is correct.

5. **Procedure**

   Write a detailed description of how to do your experiment. As you work through it, you may find that you have to change it. Make notes and change your procedure afterwards, to show the changes. Remember, any scientist should be able to take your procedure and repeat your experiment following your instructions.

   . It is easier to use a numbered list, like in a cookbook rather than write a paragraph.

   i. Start each sentence with an action verb: mix, stir, get, measure, etc.

   ii. Include quantities or amounts that you will measure using metric units.

6. **Materials/Equipment**

   Now that you have planned your experiment, gather all the materials you will need to do the experiment. As you begin the experiment, make detailed observations of what is happening. Take your measurements carefully. Keep written notes about what you do and how you do it. Display a list of materials used in column form with metric units identified. Make sure materials are available.

7. **Variables and Control Group**

   . Identify the **test variable** (independent/manipulated). This is the variable that you are changing on purpose in your experiment to observe what will happen. For example, the temperature of the water or the battery strength.

   i. Identify the **outcome variable** (dependent/responding variable), this is the one that reacts or changes in response to the **test** or independent/manipulated variable, i.e., amount of salt that dissolves or number of paper clips held by a magnet.

   ii. Identify the **constant variables** in your experiment. These are the variables in your experiment that you do not change so that you can compare the effects from only one **test** (independent/manipulated) **variable**. Constant variables are quantities that a scientist wants to remain the same or be held constant. Most experiments have more than one constant variable. Some people refer to controlled variables as "constant variables."

   iii. Use a **control group** if applicable in your experiment. A control group is the group that does not receive the experimental variable. Both it and the experimental group have what is usually considered normal conditions, i.e., room temperature, normal amount of water, normal amount of sunlight (constants). A control group helps you to be sure that what YOU DO in your experiment is affecting the test results.

a. Observe and record the results in a data table using metric units i.e., centimeters (cm); grams (g); or degrees Celsius (˚C).
b. If qualitative observations are made, a numbered scale must be developed to quantify the observations.
c. Use photographs and videos whenever possible to record observations. **(NO FACES IN PHOTOS).** These can be shown on the display board.
d. Then, ***REPEAT THE EXPERIMENT*** at least two more times. Record your results as carefully as you did the first time. ALL scientists repeat their experiments; we **INSIST** you repeat yours as well. All experiments must have a minimum of three trials.

e. In our example, you would set up grass seeds under a green light bulb and seeds under a red light and observe each for a couple of weeks. You would also set up grass seeds under regular white light so that you can compare it with the others. If you are doing this for a STEAM Fest, you will probably have to write down exactly what you did for your experiment step by step.

8. **Results/Data**- Record what happened during the experiment. Also known as 'data'.

a. As you observe your experiment, you will need to record the progress of your experiment.
a. Data can be whatever you observe about your experiment that may or may not change during the time of the experimentation.

b. When you have all of your results, you need to design the way that you will report the data. Many students use graphs, charts and written summaries of what happened in the experiment.

. Use photographs whenever possible to show changes **(Remember, if you choose to show your face, you are consenting to us sharing your images with our audience and community, both in-person and online).**

i. Display all your data in charts, graphs, and/or pictures even if it does not match what you thought was going to happen under the heading Data on your display board.
ii. Explain your results in words and display this narrative under the heading Results on the display board.
iii. Examples of data are values in pH, temperature, a measurement of growth, color, distance, etc. Data should be shown in more than one way. Examples of ways to show date; graphs, tables, charts, models, pictures, realia, etc.

9. **Conclusion**- Review the data and check to see if your hypothesis was correct.

Look again at your **HYPOTHESIS** and at the results of your experiment. Think about what happened and why it happened that way. Determine if your hypothesis was supported or not supported. You will use your observations to help you write your Conclusion in the next step.

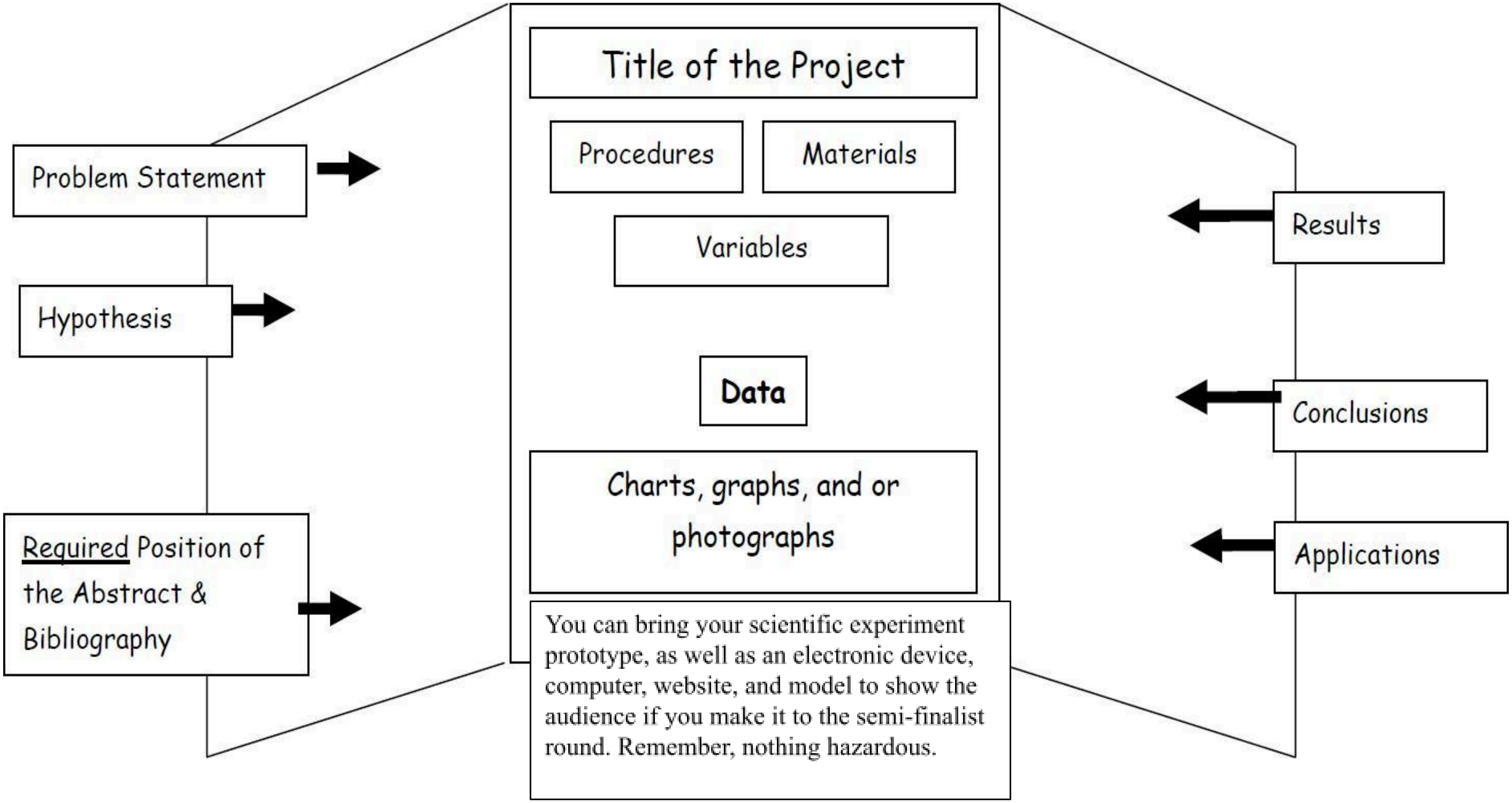
Answer the following questions to summarize what you have learned from the experiment.

a. What was the purpose of the investigation?
a. Was your hypothesis supported by the data? (Indicate evidence and reasoning that supports your conclusion. This is called Conclusion Evidence Reasoning (CER).
b. What were the major findings? What are

possible reasons for the results? From our example:

If the grass under the green light bulb grew faster, then you proved your hypothesis, if not, your hypothesis was wrong. It is not "bad" if your
hypothesis was wrong because you still discovered something! Your conclusion should also include next steps.

Scientific Method/ Experiment Design Board Display



The Engineering Design Process/ Invention Design

The Engineering Design Process consists of a series of steps that engineers follow to create solutions to problems.

An invention can be anything that solves a real problem. It is something that no one has ever thought of before. It cannot be purchased in a store or found in a book. Sometimes an invention is an improvement to an object that was already invented. An invention must serve a purpose! If there is already a similar one out there, think of ways to improve yours and make it as original and relatable to your problem as possible.

1. **Identify The Problem**. It is crucial that this step not be completed without thorough consideration. Identifying the problem includes discerning what is needed as well as any constraints or rules that must be followed.

    - Focus on problems that you may have noticed during your daily life, i.e., opening a can of dog food, reaching the top shelf in your closet, having a place to sit as you wait in line.

2. Next comes **Brainstorming**! Creativity is king here, but it can also be overwhelming to know where to start in coming up with a feasible idea. Look at each material available and write out how each material may be useful in solving the problem.

    - What do you already know? Focus on originality. If an inventor has an idea, it is important to know what already exists so that the inventor does not waste time “reinventing the wheel.” Call around to stores and do research in catalogs to find out if the invention already exists. Your parents may have to help you call stores because they will be taken more seriously. Be sure to record all this information in your notebook log.

3. **Research and Planning:** Before an invention can be successful, you must make a plan. Your plan should include all the steps you can think of, from beginning to end. When writing your plan, ask yourself questions such as these.
    - What can I read about that will help me with my invention?
    - Who can I talk to about solving problems and planning properly?

- What materials will I need?
- How can I control the cost of my invention?
- What steps should I follow?
- How much time should I allow for each step?
- How can I test my invention?

Do not be surprised if you need to change your plans along the way. Sometimes a plan will not work as well as you first thought it would. So, keep an open mind for change. You may even discover a better way of completing a certain step.

Now for the **Design** phase! From the list made in the brainstorming step, a design may be drawn showing key components previously identified as important. Labeling each part in their sketch will help them in the next step as well as keep inventory of how much of each material is needed.

4. Then – Build! From their design sketch, engineers can bring their creations to life. Here, they may discover that some materials will not work as they had planned and some changes may be necessary.

5. Once the designs have been built, Testing may begin.

    - Follow your plan step-by-step. This step is where frustration may set in and engineers may become discouraged if their design continues to fail. The key is teaching that failure is an important part of the Engineering Design Process. Failure is what shapes designs to their optimal performance. Because of this truth, failure should be celebrated as an opportunity to make something better!

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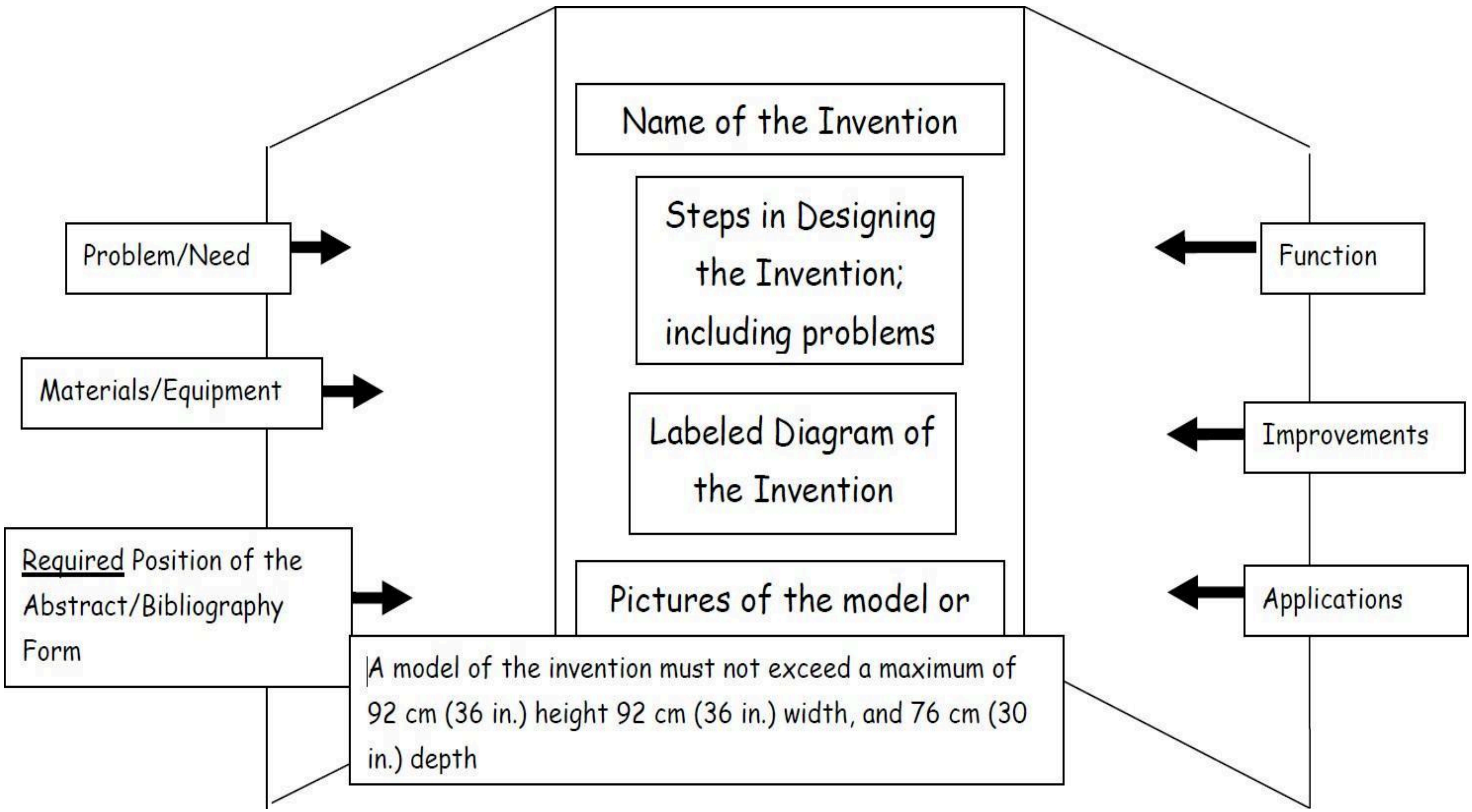
*Inventors are encouraged to use recycled materials. The cost of the invention must not exceed 200 Ghana Cedis or 30 US Dollars.

Remember to have fun, and don't beat yourself up if you must try another way, because that's what makes you an innovator.

Engineering Design Process/Invention Display Board



Scientific Research method Workbook:

https://docs.google.com/presentation/d/11TUrFZefk3_xh8VGSzPnaYnsPyo25xdkHm6cDfyp8cM/edit?usp=sharing

Websites That May Be Helpful for Projects and Inventions:

http://www.sciencebob.com/sciencefai

r/index.php

http://www.invention-help.com/inventi

on-help-books.htm

http://pbskids.org/designsquad/pdf/parentseducators/DS_Invent_Guide_Full.pdf **(teachers only)**

http://www.inventivekids.com/2010/10/05/step-by-step-guide-to-inventing/

http://www.sciencebuddies.org

http://www.showboard.com

http://science.dadeschools.net/

http://www.proteacher.com/110031.sht

ml http://www.sciedunet.org

http://sciencepage.org/scifair.htm

http://my.integritynet.com.au/purdic/science-fair-projects-ideas.h

tm http://www.ipl.org/div/kidspace/projectguide/

http://www.super-science-fair-projects.com/elementary-science-f

air-projects.html www.kidsinvent.org

www.howstuffworks.com

http://edweb.sdsu.edu/courses/EDTEC596/Project1/Inventors.html (teachers only)

http://ctinventionconvention.org