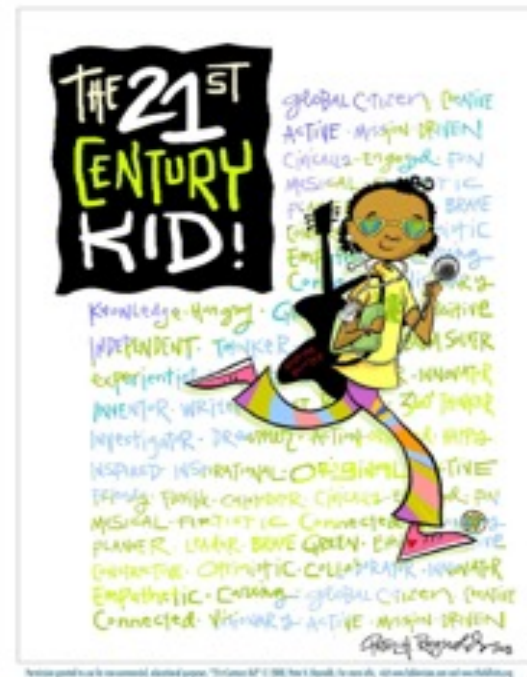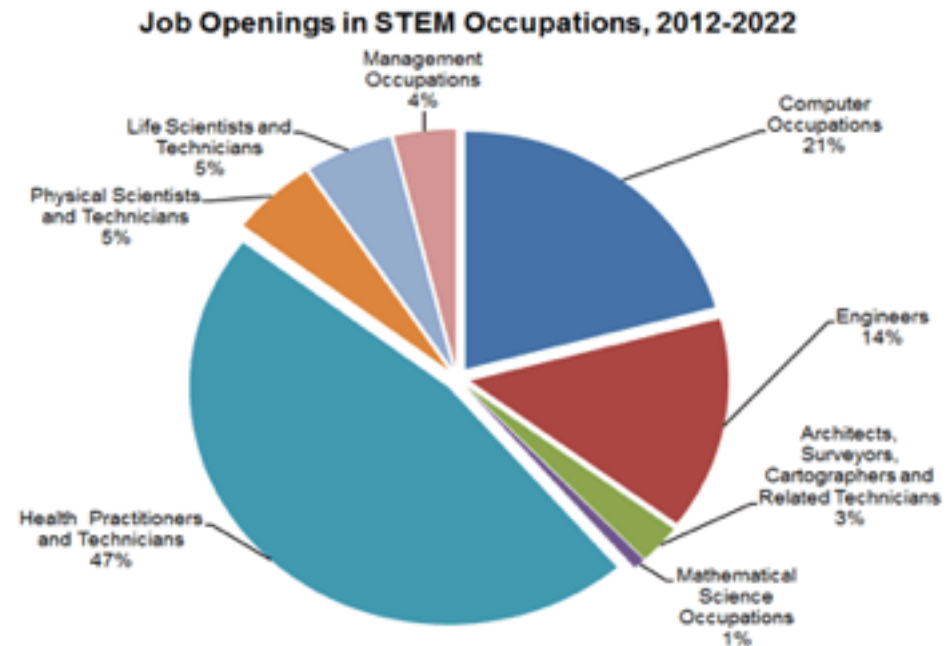# Why STEM?

STEM in Our World

- Science, Technology, Engineering, and Mathematics, STEM, are fields that are important to our future.

When do you experience STEM?

- **Science** – our natural world; oceans, plants, natural disasters, and food.

- **Technology** – medicine, computers, smartphones.

- **Engineering** – roads, bridges, wheelchairs or even a dining room table.

- **Mathematics** – grocery store, tax forms, banking, or family budget.

STEM and Our Children

- According to U.S. Department of Commerce, general STEM occupations are growing at 17% rate and most health care fields at 20%.

- These occupations include managers, engineering, doctors, home care aides, athletic trainers, and office personnel that can use computers effectively.

- Our children must develop the skills needed to be able to fill these jobs.

Job Openings in STEM Occupations, 2012-2022

- Management Occupations 4%
- Life Scientists and Technicians 5%
- Physical Scientists and Technicians 5%
- Computer Occupations 21%
- Engineers 14%
- Architects, Surveyors, Cartographers and Related Technicians 3%
- Mathematical Science Occupations 1%
- Health Practitioners and Technicians 47%

Developing The 21ˢᵗ Century Workplace…

- Businesses are always looking for individuals who are:
  - Critical thinkers
  - Creative
  - Have good communication skills
  - Show initiative and can self-direct
  - Productive and accountable

STEM vs. Traditional Science Fairs

- A STEM project is a demonstration of a solution that students have developed for what they deem a "real world" problem.

- A STEM project is a showcase of ingenuity, student self-reflection and product that solves a problem.

- A science fair project is a unique way for a student to pose questions for which they must seek out answers and to satisfy their own curiosity about the world around them.

- A science fair project is an experiment, a demonstration, a research effort, a collection of scientific items, or display of scientific apparatus presented for viewing.

STEM Fair Will Help Students Gain These Skills

- Following guidelines
- Investigating
- Conducting Research
- Interviewing
- Using scientific tools and techniques
  - Predicting and hypothesizing and inferring
- Identifying variables
- Observing
- Analyzing Data
- Preparing reports from research
- Preparing displays
- Speaking and networking with the public

Science and STEM Fair Supports Florida Core Standards such as…

- Reading, writing and research involved in student science fair projects are one way for students to achieve the rigor and critical thinking evident in the Common Core Standards

- Cite specific textual evidence to support analysis of science and technical texts

- Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks

- Integrate quantitative information expressed in words in a text including information expressed visually (graph, etc)

- Compare and contrast information

- Write informative/explanatory texts, including scientific procedures/experiments

- Summarize numerical data sets in relation to their context

Utilizing the 8 Practices of Science & Engineering
Essential for ALL students to Learn

NGSS

Defined as one Dimension in the Next Generation Science Standards Framework s K-12

- Asking Questions (for science) and defining problems (for engineering)

- Developing and using models

- Planning and carrying out investigations

- Analyzing and interpreting data

- Using mathematics and computational thinking

- Constructing explanations (for science) and designing solutions (for engineering)

- Engaging in argument from evidence

- Obtaining, evaluating, and communicating information

The Diocesan STEM Fair will …

- Bring attention to the scientific experiences in our schools.

- Provide students with authentic, hands-on experiences through scientific investigation.

- Engage students in scientific investigation beyond the routine classroom.

- Give students the opportunity to communicate what they have learned to others.

- Celebrate student achievement.

Your Role as a Teacher
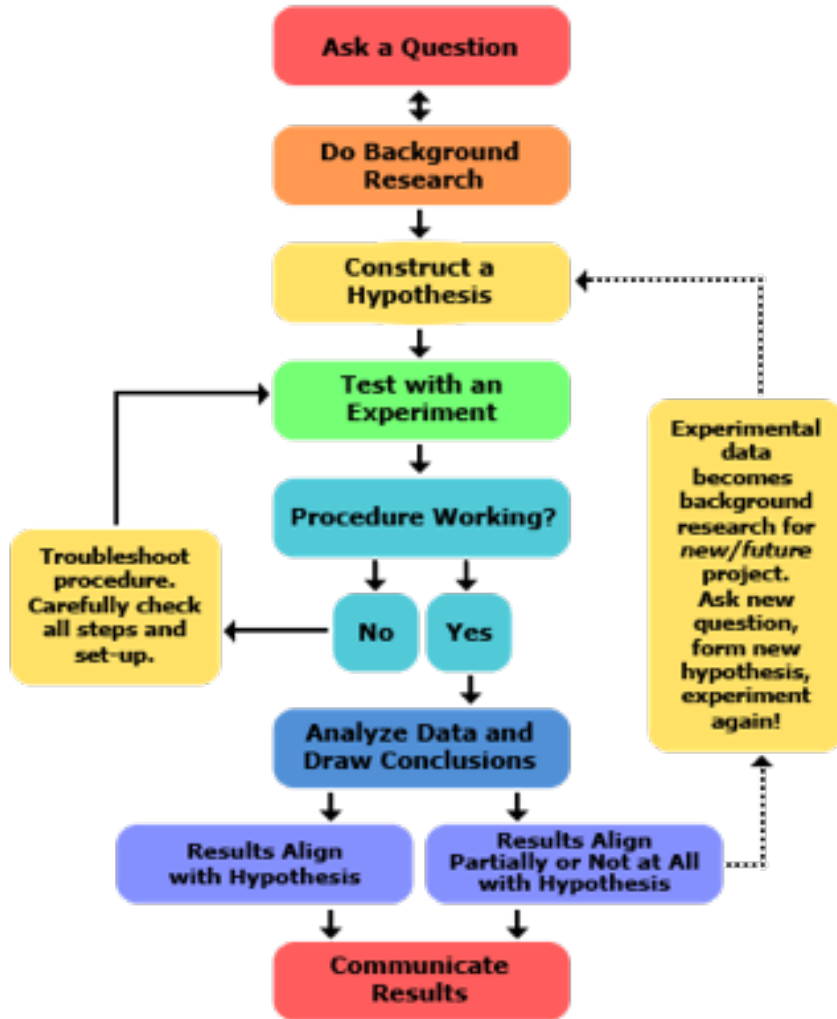
How to Lead the Students into the Stem Fair

How do we Inspire Students to Move Forward Towards the 21ˢᵗ Century?

- The formula for competing at home and globally begins in elementary and middle school.

- With the incorporation of STEM into the curriculum and with STEM driven fairs, the students can be challenged to use the scientific method and scientific principles as scientists would.
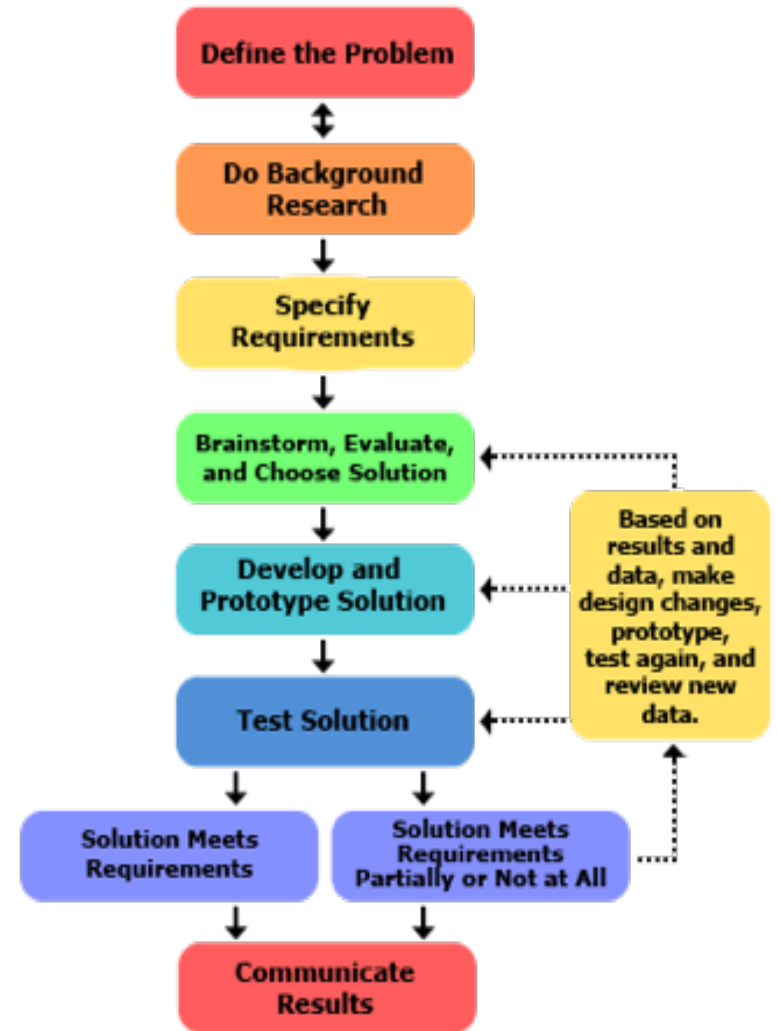
STEM Methods

Scientific Method

Ask a Question

Do Background Research

Construct a Hypothesis

Test with an Experiment

Procedure Working?

No **Yes**

Troubleshoot procedure. Carefully check all steps and set-up.

Experimental data becomes background research for *new/future* project. Ask new question, form new hypothesis, experiment again!

Analyze Data and Draw Conclusions

Results Align with Hypothesis

Results Align Partially or Not at All with Hypothesis

Communicate Results

Engineering Method

Define the Problem

Do Background Research

Specify Requirements

Brainstorm, Evaluate, and Choose Solution

Develop and Prototype Solution

Test Solution

Based on results and data, make design changes, prototype, test again, and review new data.

Solution Meets Requirements

Solution Meets Requirements Partially or Not at All

Communicate Results

Who will Participate?

- All middle school students, grades 6-8, may participate in your school's science fair **but** only **STEM based projects** will represent your school at the Diocesan STEM fair.
  - Student teams of up to three may participate.

- Authentic STEM projects aim to:
  - Answer a question that solves a problem and/or benefits our world.
  - Example:
    - Develop an erosion prevention landscape system for a sand dunes area.
    - Design garden tools for individuals with missing limbs.

- Two approaches to a successful STEM project:
  - Experimental approach - Traditional investigation
  - Design/engineering approach - Building or inventing something

Who will Judge?

- Each participating school will provide the names of 3 volunteer judges. Please include:
  - Area of expertise.
  - Preference in judging category.
  - Experience.
  - Contact information: phone # and e-mail address.

- Judges should be …
  - Knowledgeable in the areas of STEM.
  - Available on Saturday January 14th for a 45 minute meeting before the judging begins.
  - Well prepared for judging by becoming familiar with the rubrics set up by the Diocesan STEM fair committee.

How to Help the Student Develop a Question?

- What are your students' interests?

- Help students find a topic idea that is STEM based or "real problems" that they can address using science and math.

- Some experimental topics may include:
  - Water or air quality
  - Health topics
  - Endangered species

- Engineering topics may include:
  - Toilets that use recycled water
  - Band instruments
  - Emergency personal shelter for hiking

Before you speak:

THINK

T = Is it True?

H = Is it Helpful?

I = Is it Inspiring?

N = Is it Necessary?

K = Is it Kind?

Non Inquiry Based Research

Not all areas of study are best served by scientific method….BE AWARE.

- Engineering Projects – creating things that never were
  - Define a need and research what already exists…How can they make this better?
  - Develop or establish a design criteria.
  - Build and test a prototype. Consider reliability, cost, repair and servicing.
  - Retest and redesign as necessary.
  - Product testing.

- Computer Science Projects
  - Creating and/or writing new algorithms to solve a problem or improve existing one.
  - Simulations, models or virtual reality are other areas.
  - Computer surveys.

- Mathematics Projects
  - Involves proofs, solving equations.
  - Math is the language of science and used to explain existing phenomena or prove new concepts or ideas.
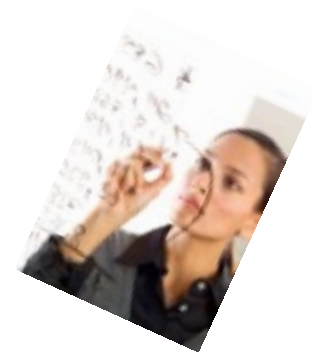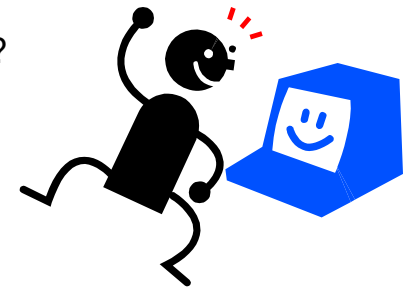
Experimental Project Approval…

- Help students define the question/problem. Then obtain…
  - Teacher approval
  - Parent approval

- What is the hypothesis and/or expected outcome(s)?

- Check plan of experimental procedures
  - Procedure – detail all procedures and experimental design to be used for data collection.
  - Include all safety procedures.
  - Must be a "controlled" experiment – one variable changed at a time.
  - Include sufficient number of trials (minimum of 7 trials).
  - Data Analysis – describe the procedures you will use to analyze the data/results that answer the research question(s)
  - Include list of materials.

- Bibliography –
  - List at least 5 major resources from your literature review.
  - APA format must be used to cite sources. Good reference is OWL Purdue.
  - Include resources used to develop experimental design and/or safety procedures.

Engineering/Design Project Approval…

- Help students define a "need" expressed as a goal. Then obtain…
  - Teacher approval
  - Parent approval

- Determine the criteria for the design and limitations
  - Examine details on building – materials needed, etc.
  - Evaluate prototype
  - Explain the testing phase
  - Describe improvement plan
  - Show how the analysis of results, design changes and retest should be done.

- Bibliography –
  - List at least 5 major resources from your literature review.
  - APA format must be used to cite sources. Good reference is OWL Purdue.
  - Include resources used to develop experimental design and/or safety procedures.

Logbook and Recoding Information
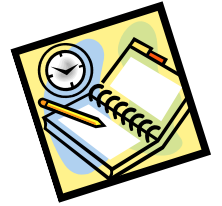
- All students participating in the STEM fair will have a logbook.

- Logbook will include all research conducted by the student.

- Students must keep detailed notes of metric measurements and observations in the log book.

- Develop and use data tables or charts to record quantitative and/or qualitative data.

- Student handwritten notes and original writing.

- Could be used to PROVE what they actually did.

Analyze Data

- Examine their findings.

- Check "pictures" (graphs).

- Have they identified patterns?

- Did they get expected results? Why or why not?

- Was the experiment performed EXACTLY as they described it?

- Are there any other explanations not originally considered?

- Were there any data or experimental errors?

- Statistically analyze your data and be able to explain their meaning.
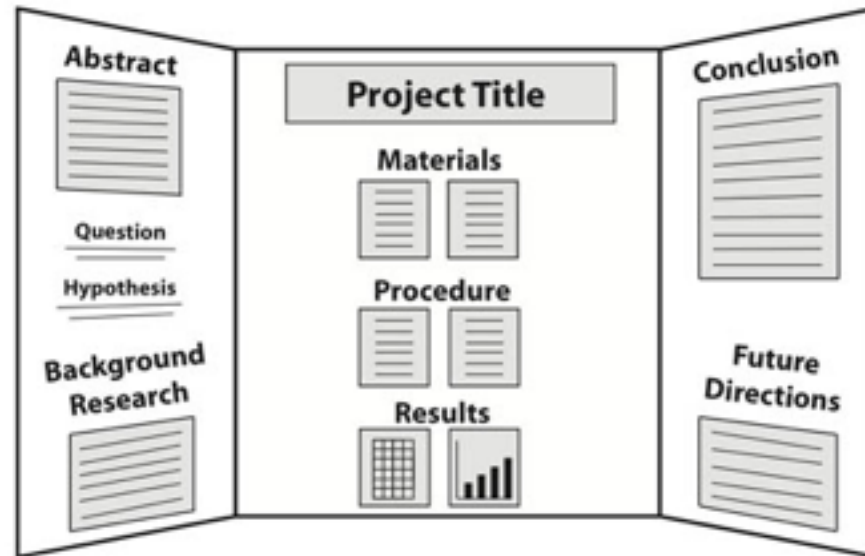
Conclusions

- Did the variable(s) tested cause change when compared to the standard?
- What <u>patterns</u> did they see from graph analysis?
  - Explain the data.
- Which variable(s) were important?
- Did they collect enough data?
- Was the experiment repeated often enough for accurate results?
- It's okay if results do not support the hypothesis.
- Were there errors that may have caused differences? If so, what?
- What are the practical applications of the project?
- How could this project be used in the real world?
- How would they improve the experiment and what would they do differently?

Project Displays

Experimental and Design Display Formats to Use

Formal Presentation of Experimental/Traditional Project

The display board for experimental projects should include:

- Abstract
  - 250 words on one page
- Testable question
- Hypothesis
- Background research

- Materials
- Procedure
- Results
- Analysis & Conclusion
- Future direction

Formal Presentation of Engineering Projects
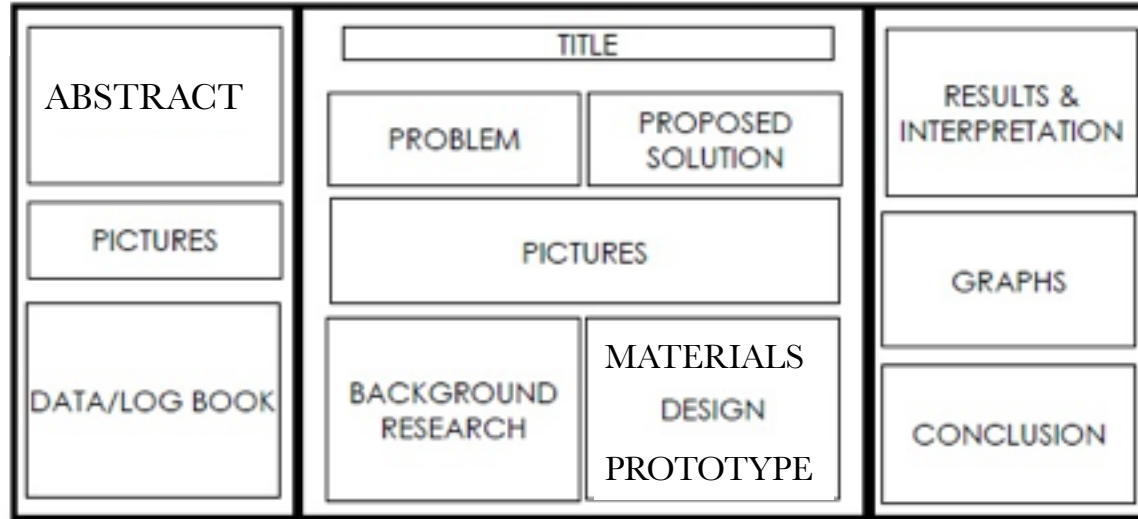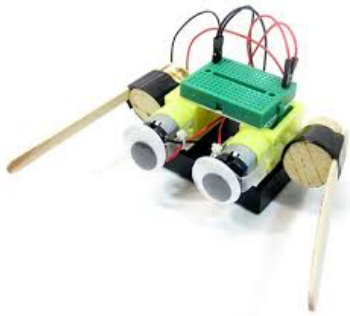
The display board for engineering projects **can vary** depending on the type of project the student has. However, they all should include:

- Abstract
    - 250 words on one page
- Purpose of the experiment
- Background research

- Design/Prototype
- Testing
- Results
- Conclusion/Redesign

What to Include in the Abstract?

Experimental project required elements…

- 250 words on one page only
- Purpose of the experiment
- Procedures used
- Summary of data and conclusions
- Research applications

Design project required elements…

- 250 words on one page only
- Purpose of the design
- Prototype building process
- Testing of prototype
- Summary of data and conclusions
- Practical use

Presentation of the Research
The Experimental Research Paper

- Title Page and Table of Contents

- Abstract

- Testable question, Variables, and Hypothesis

- Materials

- Procedure

- Results, Data, Observations

- Data analysis and discussion

- Conclusions, ideas for future research

- References/Bibliography

Presentation of the Research
The Engineering Research Paper

- Title Page and Table of Contents

- Abstract

- Purpose/need

- Materials

- Building/construction process of the prototype

- Testing phase

- Results, Data, Observations - final product

- Data analysis and discussion

- Conclusions, ideas for future research

- References/Bibliography

How will the Students be Judged

Experimental Judging Rubrics

Students will be judged on a modified competency-based rubric:

- Evidence of Science Process Skills
  - Science Process Skills (8)
  - Scientific Approach – Overall (8)
  - Scientific Approach – Variables (8)
  - Scientific Approach – Control/Comparison Group (3)
  - Accuracy of Data and Observations (8)
  - Data Analysis and Discussion (8)
  - Validity of Conclusion (8)
  - Originality (5)

Experimental Judging Rubrics

Students will be judged on a modified competency-based rubric:

- Communication
  - Display
    - Information - Experimental (3)
    - Artistic Qualities and Correctness (3)
  - Oral Presentation
    - Presentation Quality (3)
    - Dynamics (3)

Experimental Judging Rubrics

Students will be judged on a modified competency-based rubric containing:

- Experimental Log
  - Abstract (2)
  - Safety sheet (2)
  - Title Page and Table of Contents (2)
  - Acknowledgements (1)
  - Purpose and Hypothesis (2)
  - Background Research - review of Literature (5)
  - Materials (2)
  - Procedure (2)
  - Results (3)
  - Conclusion (3)
  - Reference List - Bibliography (2)

Engineering/Design Judging Rubrics

Students will be judged on a modified competency-based rubric:

- Evidence of Design Process Skills
    - Design Process Skills (8)
    - Design Approach – Overall (8)
    - Design Approach – Performance Criteria (8)
    - Design Approach – Preliminary Design Plan (3)
    - Constructing and Testing the Design Prototype (8)
    - Redesign and Retest (8)
    - Validity of Evaluation/Conclusion (8)
    - Originality (5)

Engineering/Design Judging Rubrics

Students will be judged on a modified competency-based rubric containing:

- Communication
  - Display
    - Information - Design (3)
    - Artistic Qualities and Correctness (3)
  - Oral Presentation
    - Presentation Quality (3)
    - Dynamics (3)

Engineering/Design Judging Rubrics

Students will be judged on a modified competency-based rubric containing:

- Experimental Log
  - Abstract (2)
  - Safety sheet (2)
  - Title Page and Table of Contents (2)
  - Acknowledgements (1)
  - Problem or Need (2)
  - Background Research - review of Literature (5)
  - Design Plan (2)
  - Technical Aspects (3)
  - Result of Testing and Redesign (2)
  - Neatness and Orderliness (2)
  - Evaluation and conclusion (2)
  - Reference List - Bibliography (2)

Works Cited

1. Judging Policy and Criteria. State Science & Engineering Fair of Florida. Web. 2014.

2. Townsend, J.F. & Naughton, J.A. IJAS State Exposition Project Session – Design Classification. Web. 2012.

3. Townsend, J.F. & Naughton, J.A. IJAS State Exposition Project Session – Experimental Classification. Web. 2012.

Preparing for Judging

Judging and Oral Presentation

The Interview for STEM Competition

- The interview is the final determination of the student's work.

- The student should be able to show…
    - How they come up with this idea?
    - Thorough and well-thought out research
    - How much thought and design is student's own work
    - If the data was collected and analyzed correctly
    - What future plans do they have to continue research?
    - What are the practical applications of the project?

The Interview for STEM Competition

- Encourage students to speak freely and confidently
- Greet the judge and introduce themselves– good first impression
- Appearance, good manners, appropriate attire, and enthusiasm for what you are doing will impress
- Relax, smile and enjoy the time

Suggested Timeline

Date	Goal
8/15	Website will be set up for schools and teachers to register for participation in STEM Fair.
8/29	Students must begin brainstorming for ideas; have logbook and begin research.
9/12	Soft deadline for review of literature.
9/19	Soft deadline for research plan; experimentation can begin.
10/24	Soft deadline for data collection; student work on display.
12/5	Site based finalist are identified by schools.
12/13	Regional Fair forms are to be completed and e-mailed; reviewed by county committee.

Day of the STEM Fair Timeline
January 14, 2017

Time	Goal
7:00	Doors open. All projects must be set up by 8:00 AM.
8:00	Judges meeting
9:00-12:00	Judging begins
1:00 - 3:00	Public Viewing
3:00-3:45	Project removal/clean-up
4:00-6:00	Closing ceremony

Hillsborough and Pinellas STEM Fair

Winners from the Diocesan STEM Fair qualify

- When:
, 2017

- Location:
, Tampa, Florida

- Time:

Required FORMS for Pinellas County STEM Fair

Presented by Karen Johnson:

Lead Teacher at "Nature's Classroom"

Sources

- http://atlantaschoolguide.com/wordpress/wp-content/uploads/2012/12/stem-education1.jpg
- http://3.bp.blogspot.com/-Toc5ZDiz3aU/VgQV3DRcvlI/AAAAAAAAAR4/du_PdmAoRSU/s1600-r/skills%2B21st.png
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