Science Technology Engineering Mathematics

S T E M

Connecting Global Innovations

67TH ANNUALCHICAGO PUBLIC SCHOOLS STUDENT SCIENCE FAIR

SCIENCE FAIR CENTRAL

CHICAGO STATE UNIVERSITY (CSU)

9501 S. King Drive, Chicago, Williams Science Center, Rooms 106 & 108
Saturday, September 24, 2016

NORTHEASTERN ILLINOIS UNIVERSITY (NEIU)

5500 N. St. Louis Avenue, Chicago, BBH-102
Saturday, October 1, 2016

FALL, 2016 WORKSHOP HANDOUTS

Link to the PowerPoint presentation.

Science Fair Project Flow Chart

THE IDEA: The student thinks of a question to test for an independent science experiment or an innovation that can be developed as a design project and proposes that idea to their teacher/sponsor

Check the Science Fair Handbook to see that the project is safe for the student researcher and for the test subjects. See pages 6-13 for details about using humans as test subjects, vertebrate animals, vertebrate tissue, microorganisms and recombinant DNA.

If the project requires an endorsement (or multiple endorsements)

BEFORE beginning the experiment, fill out the endorsement request form and submit the request(s) to the SRC by the published due date. It is better to ask for permission than to be disqualified later.

If the project is NOT safe

SRC & student discuss alternate ideas to make the project safe, student revises project plan and re-applies for endorsement

If the project IS safe

Student receives SRC endorsement and may begin experimentation

If the project does not require an endorsement

Student conducts an independent science research project, collects and analyzes data, writes a conclusion and prepares a research summary paper.

If student wishes to exhibit at a science fair

Student prepares a display board for classroom or school science fair exhibition

If project is selected to participate in the Regional Science Fair

Student completes Entry Form for Regional and City Science Fairs, teacher/sponsor submits to Regional Science Fair Chair by December deadline (ask Regional SF Chair for specific date)

If paperwork (including applicable endorsements) is complete

Student exhibits project at Regional Science fair in January (ask Regional SF Chair for specific date)

If a top 6th grade project

Top two 6th grade project participants in each elementary Regional attend 6th grade recognition event

If a top 7th - 12th grade project

Student exhibits project at CPS Student Science Fair at the Museum of Science and Industry

If one of top 4 projects selected by judges for ISEF competition

Student exhibits at ISEF International Science Fair

If one of top 50 projects selected by judges for IJAS

Student exhibits at IJAS State Science Fair

If student wishes to present at symposium

HS student submits paper for screening by school fair coordinator

If chosen for submission to symposium committee

HS student completes the Symposium entry form, teacher/sponsor submits paper to symposium committee

If chosen at screening by symposium committee

HS student prepares Power Point or overhead slides of his/her research for presentation to symposium judges at CPS Science Fair Symposium Presentations

If selected by CPS SSF symposium judges for IJAS competition

15 students present at IJAS symposium competition

CPS Science Fair Endorsement Flow Chart

This flow chart does NOT include all the rules regarding requests for endorsements. Read the following sections for complete details.

Does your project involve the use of firearms or explosives?

- **YES** → **YOU MUST REQUEST A FIREARMS/EXPLOSIVES ENDORSEMENT AND SUBMIT IT WITH ALL REQUIRED MATERIALS IN A SINGLE PACKET.** See pages 18 - 19 for the complete list of all materials.
- **NO** ↓

Does your project involve asking your friends or other people questions? Experiments on yourself? Experiments on people in any way?

- **YES** → **YOU MUST REQUEST A HUMANS-AS-TEST SUBJECTS ENDORSEMENT. Details on p. 12** Does the procedure cause any stress (physical or emotional) to the subject?
  - **YES** → You will probably need to get the informed consent of your test subjects. The SRC will inform you of this on your endorsement. Subjects may also need a physical examination.
  - **NO** → You will not likely need to get informed consent of your test subjects. The SRC will inform you of this on your endorsement.
- **NO** ↓

Does your project involve using any animals that have bones (except people)?

- **YES** → **YOU MUST REQUEST A NON-HUMAN VERTEBRATE ENDORSEMENT. Details on p. 13** Does your project involve only non-manipulative observations of animals with bones?
  - **NO** → You must work with (and get the endorsement request signed by)a veterinarian, medical doctor or PhD in a field of biological research related to your project. If you need help finding one of these professionals see the Advise-a-Student application on page 83.
  - **YES** → You do NOT need the supervision of a veterinarian, medical doctor or PhD in the field of biological research related to your project.
- **NO** ↓

Does your project involve bacteria? Viruses or any fungus?

- **YES** → Does your project involve collecting microorganism samples from countertops, doorknobs, toilets, eating utensils?
  - **NO** → You must work in a biosafety level 1 environment such as most school laboratories with the supervision of a trained supervisor. Does your project involve only microorganisms listed on page 77.
    - **NO** → **YOU MUST REQUEST A MICROORGANISM ENDORSEMENT.** Details on p. 15
    - **YES** → You still need to request a microorganism endorsement to participate in the school, regional or city science fair.
  - **YES** → **YOU MAY NOT CONDUCT THIS EXPERIMENT.** Cultures of unknown bacteria, viruses or fungi may be very dangerous
- **NO** ↓

Does your project involve cutting and splicing or recombining DNA segments that would not normally occur together?

- **YES** → **YOU MUST REQUEST A RECOMBINANT DNA ENDORSEMENT. Details on p. 17** Are you working in a registered research laboratory under the guidance of a biomedical scientist trained in this field?
  - **YES** → You must get the signature and proper forms from your consultant scientist. Will your project produce oncogenes or other genes toxic to plants or animals, including humans?
    - **YES** → **YOU MAY NOT CONDUCT THIS EXPERIMENT. All rDNA work must be done under scientist supervision and must not produce toxic genes**
  - **NO** → **YOU MAY NOT CONDUCT THIS EXPERIMENT. All rDNA work must be done under scientist supervision and must not produce toxic genes**
- **NO** → You do not need a recombinant DNA endorsement (to simply extract DNA from plant or animal sources)
- **NO** ↓

Does your project involve using vertebrate tissues? These include skin, teeth, muscle (as in meat), bone, blood, saliva, or urine.

- **YES** → Is the tissue you will use… From a plant? Meat or meat products from a store or restaurant (and treated to inhibit bacterial growth)? Hair that has been naturally shed or cut? Fossilized tissue or an archaeological specimen?
  - **YES** → You do not need a vertebrate tissue endorsement
  - **NO** → Is the tissue from a biological supply house or catalog, hospital or laboratory? If using blood is it obtained from a blood bank, hospital or laboratory? If using teeth are they sterilized by a dentist?
    - **YES** → **YOU MUST REQUEST A HUMAN OR VERTEBRATE TISSUE ENDORSEMENT. Details on p. 16**
    - **NO** → **YOU MAY *NOT* CONDUCT THIS EXPERIMENT. Only tissues that are certified to not carry infectious agents may be used**
- **NO** → **You do not need any endorsements to conduct your project**

A Comparison of the Scientific Method and the Design Process

Most projects will be experimental in nature using the scientific method and will fall into the experimental category. However, if the objective of your project is to invent a new device, procedure, computer program, or algorithm, then your project may fall into the design category.

Scientific Method	Design Process
Identify and write a testable question	Define a need or real world problem
Perform background research	Perform background research
Formulate a hypothesis and identify variables	Establish design criteria
Design an experiment, establish procedure	Prepare preliminary design(s)
Test the hypothesis by conducting the experiment	Build and test a prototype
Analyze the results and draw a conclusion(s)	Test and redesign as necessary
Present results	Present results

Scientific Method

1. IDENTIFY AND WRITE A TESTABLE QUESTION

   Decide what question you want to answer or what problem you want to solve. A testable hypothesis is answered through observations or experiments that provide evidence. Be sure to have adequate technical and financial resources available to conduct your research. State your objective clearly in writing.

2. PERFORM BACKGROUND RESEARCH

   Before you begin your project, you must become as knowledgeable as you can about your topic and about other research that has been done on that topic. You may use books, scientific literature, the Internet, or interviews with scientists or other knowledgeable people. This research not only helps you get ready to conduct your experiment, but will form the background for the Review of Literature **(page 15*)** required in your report.

Design Process

1. DEFINE A NEED

   Instead of stating a question, state a need. Can you describe in detail a problem that your design will solve? Does your research relate to a real world need?

2. PERFORM BACKGROUND RESEARCH

   For a design project, the background research may include:
   - A complete description of your target user(s)
   - Information about the science behind your design area
   - Answers to research questions about user needs
   - Information about products that meet similar needs
   - Research about design criteria
   - What existing solutions are out there already, and how well do they solve the problem?

   You may use books, scientific literature, the Internet, or interviews with scientists or other knowledgeable people. This research not only helps you get ready to conduct your experiment, but will form the background for the Review of Literature **(page 15*)** required in your report

*See IJAS Policy and Procedure Manual at https://sites.google.com/a/ijas.org/ijas/

Scientific Method	Design Process
3. FORMULATE A HYPOTHESIS AND IDENTIFY VARIABLES Based on the background research, write a statement that predicts the outcome of the experiment. Many hypotheses are stated in an "If... then" statement where the "If" statement pertains to the independent variable, and the "then" statement pertains to the dependent variable. For example: 'If plants are grown under various colors of light, then the plants grown under the blue and red lights will show the greatest increase in biomass.'	3. ESTABLISH DESIGN CRITERIA Engineering Projects: Decide what features your design must have, for example: size, weight, cost, performance, power, etc. Perhaps include a table showing how each design criterion will be addressed by the features of the product being designed. Computer Science Projects: Creating or writing a new algorithm to solve a problem or improve on an existing algorithm. Discuss the criteria of the algorithm. Mathematics Projects: Proofs, development of a new model or explanation, concept formation or mathematical model design.
4. DESIGN AN EXPERIMENT, ESTABLISH A PROCEDURE Decide what data you need to meet your research objective and how you will collect it. Be sure to consider possible hazards in your experimental approach and decide how you can conduct your research safely **(pages 10-14*)**. In addition, there are special rules concerning the use of human and non-human vertebrates in your research. Be sure to consult these rules before finalizing your experimental design. In order to obtain valid experimental results, consider the following items when designing the experiment: • Make sure the quantity and quality of data you collect provides a reasonable assurance that your research objectives will be met. • Identify all significant variables that could affect your results. • To the best of your ability, control any significant variables not manipulated in your experiment. • Include a control or comparison group in your experimental design. Be sure to establish deadlines for completing the different phases of your research. These phases might include building equipment, collecting data, analyzing the results, writing the report and construction your display board. Remember to use metric measurements whenever possible.	4. PREPARE A PRELIMINARY DESIGN Engineering projects should have a materials list, programming and mathematical projects do not need a materials list. Projects should include a block diagram, flowchart or sketch of the design that shows all of the parts or subsystems of the design. Describe how all of the parts of the design will work together.
5. CONDUCT THE EXPERIMENT Follow your experimental design to collect data and make observations. Be sure to keep a log as	5. BUILD AND TEST A PROTOTYPE (Programs, algorithms, and mathematical models may be considered prototypes)

*See IJAS Policy and Procedure Manual at https://sites.google.com/a/ijas.org/ijas/

Continued

you conduct the experiment to record your data, any problems you encounter, how you addressed them, and how these problems might have affected your data. This log will be used when you write your report. Keep these points in mind when conducting your experiment: • If you get results that seem wrong or inconsistent, do not just throw them out. Try to figure out what happened. Maybe the data is correct and your hypothesis is flawed. Try to explain these "outliers" in your Data, Analysis, and Discussion section. • Don't get discouraged when you encounter problems. Scientists often have to repeat experiments to get good, reproducible results. Sometimes you can learn more from a failure than you can from a success.	When others are conducting their experiment, investigators doing an engineering, computer programming, or mathematics project should be constructing and testing a prototype of their best design. For example, you may involve targeted users in your testing to get feedback on your design; or some projects may analyze data sets.
6. ANALIZE THE RESULTS AND DRAW CONCLUSIONS Make sufficient calculations, comparisons and/or graphs to ensure the reliability and repeatability of your experiment. In what way does this analysis confirm or refute) your hypothesis. What conclusion(s) can you draw from this analysis?	6. REDESIGN AND RETEST Evidence that changes in design were made to better meet the performance criteria established at the beginning of the project. Test results may be included in tables, if applicable. Data analysis/validation may also be a part of this step.
7. REPORT THE RESULTS Your report should provide all the information necessary for someone who is unfamiliar with your project to understand what you were trying to accomplish, how you did it, and whether you succeeded. It should be detailed enough to allow someone else to duplicate your experiment exactly. Be sure to include charts and graphs to summarize your data. The report should not only talk about your successful experimental attempts, but also the problems you encountered and how you solved them. Be sure to explain what new knowledge has been gained and how it leads to further questions. For IJAS judging, you must also prepare an oral report **(page 17*)** and a display board **(page l8*)** to accompany the written report. Be sure to consult the IJAS policy manual, section "Writing A Scientific Research Paper," for report guidelines **(page 15*)**. These guidelines must be followed exactly.	7. REPORT THE RESULTS Your report should provide all the information necessary for someone who is unfamiliar with your project to understand what you were trying to accomplish, how you did it, and whether you succeeded. The report should not only talk about your successful design attempts, but also the problems you encountered and how you solved them. Be sure to explain what new knowledge has been gained and how it leads to further questions. For IJAS judging, you must also prepare an oral report **(page 17*)** and a display board **(page 18*)** to accompany the written report. Be sure to consult the IJAS policy manual, section "Writing A Scientific Research Paper," for report guidelines **(page 15*)**. These guidelines must be followed exactly.

*See IJAS Policy and Procedure Manual at https://sites.google.com/a/ijas.org/ijas/

September 14, 2016

From: Luba Johnson, Science Fair Liaison and Communication/Publication Chairperson

To: Science Teachers,

Welcome back to the 2016-17 school year! When September comes around I know it is time for me to buckle down and begin planning, organizing and getting information out to all of you regarding the Regional and City Fairs. So, at this time I need to share with you some very important items regarding Regional and City Fairs.

First, our 2016-17 theme is **Science, Technology, Engineering and Mathematics *Connecting Global Innovations*.** Elizabeth Copper (Lindblom High School) is the Chairperson of the City Science Fair. Our Regional Fairs will be held during January 2017 and the City Fair will be held at the Museum of Science and Industry from March 16-19, 2017. The Illinois Junior Academy of Science (IJAS)(State Fair) will be held at NIU in DeKalb, IL on May 5-6, 2017. The International Science and Engineering Fair (ISEF) will be held in Los Angeles, California on May 14-19, 2017.

Every two years the State Fair evaluates their rules and regulations for the next two year period. As of this Monday IJAS posted their 2016-2018 Rules and Regulations. The new rules and regulations must now be incorporated into our guidelines and added to our 2017 Science Fair Handbook. Because of the lateness in this release, we are now editing our handbook and hope to have them in your schools no later than the 2nd week of October. We will have the 2017 Handbook posted on our website when all edits are complete. Our website can be accessed by www.cpsscifair.org or www.cssf.org

Those projects that need Endorsement may go ahead and proceed with using the Endorsements on our website. They have been updated and made ready for the 2017 science fairs. Please check the following pages for any changes or new requirements for endorsements.

The 2016 Handbook can be used as a guideline for science fair. Please check the attached page "2016-2018 Handbook Changes to Rules and Regulations". This "quick sheet" will give you all the updates you will need.

If you have any questions, concerns or need assistance please contact me at ljohnson131@cps.edu.

Luba Johnson

Continued

2016-2018 Handbook Changes to Rules and Regulations

Noted in red and underlined

Categories

- ✓ Projects in **any** **of the listed IJAS categories** below may need an endorsement sheet(s) Please make sure that all safety rules are followed, and that all endorsements are completed and displayed.
- ✓ A control group may not always be possible or necessary for all projects; a comparison among trials **is appropriate** and may be used instead.
- ✓ Zoology... is the science that **focuses on** animals with reference to their structure, physiology, health, behavior, development, evolution, and classification. Some topics that fall within this category are structural and functional studies of vertebrates and invertebrates, reproduction, heredity, and embryology.

Safety Guidelines for Experiment and Design Investigations

Fire, Firearm and Radiation Safety

- ✓ **Any student working with burning materials should perform the experiment under a fume or chemical hood.**

- ✓ New to IJAS, and **in addition to** the CPS Endorsement for Firearms **Any projects involving firearms must be supervised and the person operating the firearm must have a valid FOID card. Evidence of such must be provided along with the Safety Sheet. Proper eye and ear protection should be worn.**

Biological Safety

If using humans as test subjects, the following rules must be observed.

- ✓ Quantities of food and non-alcoholic beverages are limited to normal serving amounts or less and must be consumed in a reasonable amount of time. Normal serving amounts must be substantiated with reliable documentation**, such as a food label.** This documentation must be attached to the Humans as Test Subjects

Continued

Endorsement form. No project may use over-the-counter drugs, prescription drugs, illegal drugs, or alcohol in order to measure their effect on a person.

- ✓ **Any project involving human teeth must have the teeth sterilized prior to experimentation.**

- ✓ Projects that involve exercise or physical activity and its effect on pulse, respiration rate, blood pressure, and so on are allowed provided the exercise is not carried to the extreme. Electrical stimulation is not permitted. A valid, normal physical examination must be on file for each test subject. **A letter from authorized school personnel, such as a school nurse, stating that all of the participating students have a physical examination on file indicating that they are physically able to participate, must be attached to the Humans as Test Subjects Endorsement form.**

Use and Care of Non-Human Vertebrates

- ✓ No changes may be made in an organism's environment that could result in undue stress, an injury, or death to the animal **without prior approval.**

Use and Care of Microorganisms

- ✓ All microorganism experimentation must be conducted in a laboratory setting such as a science classroom or professional research facility. Experiments with microorganisms, **except for Saccharomyces cerevisiae (Baker's yeast),** may not be done at home.

- ✓ **Any projects involving growth of mold or rotting of organic material must be done in a science classroom or professional research facility.**

- ✓ This area of science may involve many dangers and hazards while experimenting. It is the sole responsibility of all teacher(s)/sponsor(s) to teach students proper safety methods and **aseptic** techniques. **Students should wear safety goggles, gloves and wash hands after each experiment.**

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Poster Session

Display Guidelines/Rules

- ✓ This is neither the time nor place to demonstrate your experiment. No apparatus will be allowed to be displayed - display board and computer only. Pictures, drawings, diagrams and video footage of experiment should replace equipment. **Computers may be used to enhance the presentation but media presentations, such as PowerPoint, Prezi or Google Slides, are not acceptable.**

Your display must not exceed the dimensions of 61 cm (24") front to back, 107 cm (40") from side to side, and 152 cm (60") from table to top. This applies to all parts of your project.

Paper Session

The Following Set of Rules Applies Exclusively to Entering the Science Fair Paper Session

- ✓ The presentation may be read, given from notes, or be a computer presentation (preferred). **Students may use programs such as PowerPoint, Prezi, or Google Slides to create their presentation.** The complete presentation may take no longer than 10-12 minutes, with additional time (3-5 minutes) allowed for questions and answers.

- ✓ Further research, conducted after the regional fair, may be presented **as a written addendum given to the judges at the time of the oral presentation,** but a revised paper may not be submitted to the exposition.

Please check the CPS Student Science Fair Website for updated information

www.cpsscifair.org

Goals and Standards

As a result of participation in scientific investigation and the science fairs at all levels, students fulfill several national, state, and local goals and standards. The experiences of participation in authentic research inquiry and presentation at the CPS Regional Network and City Science Fairs aligns with the first dimension of the Next Generation Science Standards (NGSS), the College Readiness Standards (CRS), and the Common Core State *Literacy in Science and Technical Subjects and Writing*, and *Writing for Literacy in Science and Technical Subjects: Research to Build and Present Knowledge.*

Next Generation Science Standards As students progress through a research investigation they will engage in the first dimension of the NGSS, which involve the processes of science. This dimension relates to the behaviors that scientists engage in as they investigate and build models and theories about the natural world and the key set of engineering practices that engineers use as they design and build models and systems.
1. Asking Questions and Defining Problems
1a. Ask and evaluate questions that challenge the premise of an argument, the interpretation of a data set, or the suitability of a design.
2. Developing and Using Models
2a. Develop a model based on evidence to illustrate the relationships between systems or between components of a system.
3. Planning and Carrying Out Investigations
3a. Design an investigation individually and collaboratively and test designs as part of building and revising models, supporting explanations for phenomena, or testing solutions to problems. Consider possible confounding variables or effects and evaluate the investigation's design to ensure variables are controlled.
3b. Design and conduct an investigation individually and collaboratively, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.
3c. Design and conduct investigations and test design solutions in a safe and ethical manner including considerations of environmental, social, and personal impacts.
4. Analyzing and Interpreting Data
4a. Use tools, technologies, and/or models (e.g., computational, mathematical) to generate and analyze data in order to make valid and reliable scientific claims or determine an optimal design solution.
4b. Evaluate the impact of new data on a working explanation of a proposed process or system.
5. Using Mathematics and Computational Thinking
5a. Use mathematical representations of phenomena to describe explanations.
6. Constructing Explanations and Designing Solutions
6a. Make quantitative and qualitative claims regarding the relationship between dependent and independent variables.

Goals and Standards as identified in the IJAS 2016-18 Rules and Regulations Manual

Continued

6b. Apply scientific reasoning, theory, and models to link evidence to claims to assess the extent to which the reasoning and data support the explanation or conclusion.
7. Engaging in Argument from Evidence
7a. Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments.
7b. Evaluate the evidence behind currently accepted explanations to determine the merits of arguments.
8. Obtaining, Evaluating, and Communicating Information
8a. Produce scientific and/or technical writing and/or oral presentations that communicate scientific ideas and/or the process of development and the design and performance of a proposed process or system.

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College Readiness Standards (CRS)

Engaging in authentic research investigations addresses the process standards of the College Readiness Standards (CRS), which align to the process of inquiry. The three CRS standards include:

1) Interpretation of data,

2) Scientific Investigation, and

3) Evaluation of Models, Inferences, and Experimental Results

College Readiness Standards — Science

	Interpretation of Data	Scientific Investigation	Evaluation of Models, Inferences, and Experimental Results
13–15	Select a single piece of data (numerical or nonnumerical) from a simple data presentation (e.g., a table or graph with two or three variables; a food web diagram) Identify basic features of a table, graph, or diagram (e.g., headings, units of measurement, axis labels)		
16–19	Select two or more pieces of data from a simple data presentation Understand basic scientific terminology Find basic information in a brief body of text Determine how the value of one variable changes as the value of another variable changes in a simple data presentation	Understand the methods and tools used in a simple experiment	
20–23	Select data from a complex data presentation (e.g., a table or graph with more than three variables; a phase diagram) Compare or combine data from a simple data presentation (e.g., order or sum data from a table) Translate information into a table, graph, or diagram	Understand the methods and tools used in a moderately complex experiment Understand a simple experimental design Identify a control in an experiment Identify similarities and differences between experiments	Select a simple hypothesis, prediction, or conclusion that is supported by a data presentation or a model Identify key issues or assumptions in a model
24–27	Compare or combine data from two or more simple data presentations (e.g., categorize data from a table using a scale from another table) Compare or combine data from a complex data presentation Interpolate between data points in a table or graph Determine how the value of one variable changes as the value of another variable changes in a complex data presentation Identify and/or use a simple (e.g., linear) mathematical relationship between data Analyze given information when presented with new, simple information	Understand the methods and tools used in a complex experiment Understand a complex experimental design Predict the results of an additional trial or measurement in an experiment Determine the experimental conditions that would produce specified results	Select a simple hypothesis, prediction, or conclusion that is supported by two or more data presentations or models Determine whether given information supports or contradicts a simple hypothesis or conclusion, and why Identify strengths and weaknesses in one or more models Identify similarities and differences between models Determine which model(s) is(are) supported or weakened by new information Select a data presentation or a model that supports or contradicts a hypothesis, prediction, or conclusion
28–32*	Compare or combine data from a simple data presentation with data from a complex data presentation Identify and/or use a complex (e.g., nonlinear) mathematical relationship between data Extrapolate from data points in a table or graph	Determine the hypothesis for an experiment Identify an alternate method for testing a hypothesis	Select a complex hypothesis, prediction, or conclusion that is supported by a data presentation or model Determine whether new information supports or weakens a model, and why Use new information to make a prediction based on a model
33–36†	Compare or combine data from two or more complex data presentations Analyze given information when presented with new, complex information	Understand precision and accuracy issues Predict how modifying the design or methods of an experiment will affect results Identify an additional trial or experiment that could be performed to enhance or evaluate experimental results	Select a complex hypothesis, prediction, or conclusion that is supported by two or more data presentations or models Determine whether given information supports or contradicts a complex hypothesis or conclusion, and why

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Common Core State Standards

Common Core Reading

Literacy in Science and Technical Subjects

Key Ideas and Details

RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.

RST.11-12.2 Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.

RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

Craft and Structure

RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.

RST. 11-12.5 Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.

RST. 11-12.6 Analyze the author's purpose in providing an explanation, describing procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.

Integration of Knowledge and Ideas

RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

Common Core Writing

Writing for Literacy in Science and Technical Subjects: Research to Build and Present Knowledge

W.11-12.7. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

W.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.

W.11-12.9. Draw evidence from informational texts to support analysis, reflection, and research.

QED
CHICAGO'S YOUTH MATH SYMPOSIUM

What are you wondering about?

Which Fibonacci numbers are divisible by 17?

* * *

Can you write a program to solve Sudoku puzzles automatically?

What regular polygons can be constructed by folding paper?

* * *

What's a good way to compute values of trigonometric functions?

Bring your (original) research and ideas to QED: Chicago's Youth Math Research Symposium!

Who: Students in grades 5-12, in and out of Chicago, with math or computer science projects

Where: Walter Payton College Prep

When: Online pre-registration deadline is November 12, 2016 (Senior High School papers submitted electronically; other students provide only title and abstract.)
Symposium on Saturday December 3, 2016

More info: Find guidance on papers and presentations, samples of projects from prior years, and more at our website: http://www.mathcirclesofchicago.org/qed
Email us at qed@mathcirclesofchicago.org --we provide online and phone support for research projects!

MC²
MATH CIRCLES OF CHICAGO