IOWA JUNIOR SCIENCE AND HUMANITIES SYMPOSIUM (JSHS)

Student and Teacher Handbook

The University of Iowa | Belin-Blank Center

Version 19.3

Table of Contents

Section

1

Overview

Welcome to the Iowa Junior Science and Humanities Symposia (JSHS) Program hosted by the University of Iowa's Belin-Blank Center for Gifted Education and Talent Development.

JSHS is designed to challenge, engage, and publically recognize students (Grades 9-12) conducting scientific research in science, technology, engineering, or mathematics (STEM). Individual students compete for scholarships and recognition by presenting the results of their original research efforts before a panel of judges and an audience of their peers. Opportunities for career exploration, research lab visits, peer discussions, and networking are planned. By participating in regional and national symposia, students may:

- Participate in a forum honoring individual achievement in STEM
- Network with peers who have similar interests
- Hear research presentations by other students
- Develop skills to help prepare for undergraduate and graduate pursuits in STEM fields
- Hear nationally renowned scientists speak on their work
- Qualify for significant scholarships and other recognition
- Advance to the national symposia

JSHS includes several categories of research students can participate in**.** The organization of the sessions at the Iowa Regional JSHS is based upon a review of all submissions and the area of research suggested by the student. Student presenters must state on their submissions the major discipline and the sub-discipline of their research. The major disciplines in which scholarship awards may be made are:

- Environmental Science/Engineering (Bioremediation, Ecosystems Management, Environmental Engineering, Land Resource Management, Pollution, Toxicity—ecosystem impact)
- Biomedical Sciences & Cell/Molecular Biology (Biomedical Medicine, Microbiology, Molecular/Cellular Biology, Genetics, Immunology, Pharmacology, Virology)
- Life Sciences (Developmental Biology, Plant Physiology, Population Genetics, General Biochemistry, Microbiology)

- Medicine and Health/Behavioral Sciences (Behavioral Sciences, Biochemistry, Bioengineering, Disease Diagnostics & Treatment, Epidemiology, Immunology, Neuroscience, Physiology, Pathology
- Engineering and Technology (Aerospace, Aerodynamics, Electrical Engineering, Solar Energy, Vehicle Development, Devices, Mechanical Engineering, Robotics)
- Mathematics, Computer Science, and Computer Engineering (Probability & Statistics, Math, Computer Algorithms, Databases, Networking, Computer Engineering)
- Physical Sciences, including Physics, Astronomy, and Internet of Things (Astronomy, Theoretical Physics, Solid State Physics, Acoustics, Optics, Thermodynamics, Particle Physics, Quantum Physics, Nuclear Physics, Internet of Things—the network of physical objects or "things" embedded with electronics, software, sensors, and network connectivity)
- Chemistry, including Physical Chemistry, Materials Science, Alternative Fuels and Geochemistry (Physical Chemistry, Materials, Alternative Fuels, Organic Chemistry, Chemical Engineering, Earth Science, Geochemistry, Energy, Alternative Fuels, Material Science)

Students may collect their own research data, or they may utilize many open-source databases available on the internet. A list of suggested open-source databases can be found in Appendix A: Open Source Data.

JSHS is a collaborative effort with the research arm of the Department of Defense and administered in cooperation with nationwide colleges and universities. JSHS aims to prepare and support students to contribute as future scientists and engineers—conducting STEM research on behalf of, or directly for, the Department of Defense, the Federal research laboratories, or for the greater good in advancing the nation's scientific and technological progress.

Who can attend the Iowa Regional JSHS?

Iowa high school students interested in STEM studies can participate either as a presenter or as a student delegate. All teachers of STEM studies in the state of Iowa are encouraged to attend as well.

What are the costs associated with the Iowa Regional JSHS?

The first five (5) student delegates from each district attend free of charge. After the first five (5), fees for each additional student delegate total $25 to attend the Iowa Regional JSHS. Included in this fee is on-site accommodation. For more information, please refer to page 4.

Teachers and chaperones pay a fee of $50 per person. Included in this fee is on-site accommodation. This fee can be waived provided at least five (5) student delegates are in attendance per teacher or chaperone. For more information, please refer to page 4.

Thanks to generous sponsors (Academy of Applied Science, U.S. Department of the Army, the Office of Naval Research, the Air Force Office of Scientific Research, and the Division of Continuing Education at The University of Iowa), accepted presenters participate free of charge.

Who can present at the Iowa Regional JSHS?

Any high school student from the State of Iowa may submit a paper for consideration.

How do I present at the Iowa Regional JSHS?

STEP 1: Iowa students in grades 9–12 select one of the fields of research dictated by the guidelines set out by the National Symposium (see pages 1&2)

STEP 2: Students conduct original research

STEP 3: Students submit papers on their original research before the submission deadline (found at belinblank.org/JSHS). Paper submissions must follow the research paper format found in the Iowa Junior Science and Humanities Symposium Handbook

STEP 4: Papers are evaluated and top research papers are selected for oral presentation at the Iowa Regional JSHS

Where can I find the important dates for this year's Iowa Regional JSHS?

This year's Iowa Regional JSHS and National JSHS dates, as well as the application form for student research presenters can be found at belinblank.org/JSHS. Guidelines for presentation proposals are available at jshs.org/guidelines.

What scholarships are awarded to the top presentations?

In addition to the educational opportunity, the Iowa Regional JSHS also serves as a scholarship competition. The Academy of Applied Sciences will distribute $4,500 in academic scholarships to the top three Iowa finalists:

(1) $2,000 to first place
(2) $1,500 to second place
(3) $1,000 to third place
(4) Additionally, The University of Iowa contributes $750 scholarships to each of the top five finalists who attend The University of Iowa

The top five finalists attend an expense-paid trip to the National JSHS to present their research and compete for additional prizes. Scholarships awarded at nationals include:

- Seven $12,000 undergraduate, tuition scholarships, awarded to each of the 1st place finalists in the National research paper competition
- Seven $8,000 undergraduate, tuition scholarships, awarded to each of the 2nd place finalists in the National research paper competition
- Seven $4,000 undergraduate, tuition scholarships, awarded to each of the 3rd place finalists in the National research paper competition

What if my proposal is not accepted?

Students whose research submissions are not accepted for presentation at the Iowa Regional JSHS but were nonetheless complete and met all paper format guidelines will automatically be invited to attend as student delegates.

Do students have to submit a paper to attend the Iowa Regional JSHS?

No. All Iowa high school students are encouraged to attend the JSHS as student delegates, attend the student presentations, and hear University of Iowa faculty present their original research. Additionally, student delegates can participate in tours of University of Iowa laboratories. Accommodation for student delegates is provided on-site for the night following student presentations, and additional accommodation the night before JSHS is available to those students traveling more than two hours to Iowa City. The first five (5) students from each district attend free of charge, and fees per student total $25 after the first five (5) from each district.

How much does it cost to attend as a student delegate?

If you did not submit a complete research paper, or if your paper was not accepted for oral presentation, you are still encouraged to attend the Iowa Regional JSHS as a student delegate. The first five (5) student delegates from each district attend free of charge, and fees for each student after the first five (5) total $25 per student, which covers lodging, a sponsored evening activity, and the Awards Banquet. Student delegates are responsible for purchasing all other meals.

If five (5) students attend from a given district, therefore, fees total $0 for the district. If six (6) students attend from a given district, fees total $25 for all admission costs for the district. If ten (10) students attend from a given district, fees total $125 for all admission costs for the district, and so on. For further details regarding the JSHS venue and accommodations, the dates of this year's Iowa Regional JSHS, and the costs associated with attendance, please visit belinblank.org/JSHS.

What about teachers and chaperones?

All teachers of STEM studies in Iowa are encouraged to attend and bring students to the Iowa JSHS. The cost for a teacher or chaperone is $50 and includes lodging (2 adults per room) and the Awards Banquet. The $50 fee will be waived for every five (5) students in attendance from your school (e.g. 15 student delegates = 3 teacher/chaperone fees waived). Teachers will also be invited to a complimentary Networking and Collaboration luncheon. Teachers must complete the student, teacher, and chaperone form prior to the submission deadline to attend these events. All forms and deadlines are available at belinblank.org/JSHS. One teacher in attendance will be awarded $500 for their contribution to advancing student participation in research.

Further questions about the Iowa Regional JSHS

For more information about the Iowa Regional Junior Science & Humanities Symposium, please visit belinblank.org/JSHS, or contact the Belin Blank Center at 800-336-6463 or via email at JSHS@belinblank.org.

Section 2

Research Paper

All Iowa JSHS student presenters must submit an electronic Word version of their research paper for review by the Iowa JSHS judging team. The research paper is used to select student presenters for the Regional Symposium where they will give oral presentations of their research.

Paper Requirements

The research paper submission must follow the following guidelines:

- Graphs, tables, diagrams, charts, or other graphical representations should be large enough and simple enough to allow the judges to view them from the electronic file submitted
- Electronic research paper submission should not exceed 1.8 Mb
- Research paper submissions should be a minimum of 5-6 pages and a maximum of 20 pages, including appendices. The title page, abstract, acknowledgements, use of non-human vertebrates or human subjects, and table of contents do not apply to page count
- Page numbers should be placed at the bottom of each page

Research paper submissions should adhere to the following formatting guidelines:

- 1-inch margins
- Double spaced
- 10 or 12-point font (Times or Times New Roman)

The Recommended Outline for the Research Paper

The recommended outline for the research paper includes:

A. A title page stating the student's name, school address, and title of the research
B. Abstract
C. Acknowledgement of major assistance received
D. As applicable, statement that "research involving non-human vertebrates or human subjects was conducted under the supervision of an experienced teacher or researcher and followed state and federal regulatory guidance applicable to the humane and ethical conduct of such research"
E. Table of contents
F. Introduction (overview of research and relevant prior research)
G. Materials and Methods
H. Results (data or findings)
I. Discussion (of findings)
J. Conclusions
K. References, or literature cited
L. Appendices (if necessary but please keep in mind that the results and discussion are far more valuable in the judging process than appendices of raw data)

Please see video tutorials for research paper construction in APA format style (Appendix B: Webinars on Research Paper Format) or consult the *Publication manual of the American Psychological Association, 6th Edition* (APA, 2009).

Research Paper Sections

A. Title Page

The title page states the student's name, school address, and title of the research. In scientific writing, the title is always intended to convey information. Scientific writing is not creative writing, nor advertising. A good scientific title simply orients the reader to the content of your paper in the fewest words possible.

The title identifies the main topic of the paper and is:

- Concise
- Descriptive
- Informative

When writing a title:

- Do not write the title as a question
- Do not use abbreviations
- Avoid "excess" words such as a, an, or the, or phrases such as a study of or investigation of; and
- Consider length—a two or three word title may be too short, but a 14 or 15 word title is likely too wordy

Example of a Title Page:

Running head: TITLE OF PAPER

Title of Paper

First Name, Middle Initial, Last Name
Name of School
City, State
Name of Research Advisor
Date

B. Abstract

200-word abstract. Abstracts must be adequate in length but not exceed these specifications. The header preceding the abstract text includes:

- Title of the research
- Your name
- Name of your high school, high school city, and state
- Name of your teacher/sponsor/mentor and their organization. Precede their name with a subheading (i.e. teacher, mentor, sponsor)
- One line of space between the heading and the body of the abstract
- Abstract, single-spaced
- Major discipline and sub-discipline (if applicable) of research according to national JSHS guidelines (see pages 1&2), clearly stated

Abstracts are **published** as submitted in the Iowa JSHS publication, "Abstracts of the Research Finalists," and distributed to all symposium attendees. A good abstract is written to summarize the research paper. The abstract should accurately convey the essential nature of the research conducted and the most significant conclusions reached. A further purpose of the abstract is to attract the interest and curiosity of the non-specialist reader and thus encourage exchange, discussion, and elaboration between various authors and between authors and readers.

Example of an Abstract:

> Abstract
> Begin with the most important information, but do not repeat the paper title. Include only information that appears in the paper itself. State important theories and background information relating to your study. Summarize the most important findings of your study. Do not exceed 200 words.

C. Acknowledgement of major assistance received

If you received significant help in thinking up, designing, or carrying out your research, or if you received materials from someone, you must acknowledge their assistance and the service and/or the material(s) provided.

D. Use of non-human vertebrates or human subjects

As applicable, include the statement that "research involving non-human vertebrates or human subjects was conducted under the supervision of an experienced teacher or researcher and followed state and federal regulatory guidance applicable to the humane and ethical conduct of such research."

E. Table of Contents

The table of contents should serve as a resource for your readers, providing them with an overview of what will be found in your paper and enabling them to quickly locate chapters and/or sections. The table of contents should include:

- A list of all of the chapter and/or section titles included in your paper
- Page numbers associated with each of the chapters and/or sections in your paper

Example of a Table of Contents:

Table of Contents

F. Introduction

The introduction states the problem or topic of the scientific paper and explains, in context of your hypothesis, why you chose to study that particular topic. The introduction should include:

- Documented research on the topic being studied
- Independent and dependent variables of the experiment
- Methods used to collect your data
- Citations of all sources used

The purpose of the introduction is to provide background and rationale for your research. You should address the questions you researched and provide your readers with an understanding of the path you took to address the problem. While composing your introduction, follow the sequence below:

1. Describe the problem: Why does the topic need to be studied?
2. State your hypothesis: What do you hope to conclude from your experiment?
3. Entity to be studied: Common problems and issues
4. Independent variable: What variable did you manipulate, why did you chose to manipulate this variable, and what considerations had to be made in order to accurately and safely manipulate this variable?
5. Dependent variable: What variable did you measure in response to the independent variable and why was this variable beneficial to study?
6. Methods: Explain the ways you conducted the experiment and justify the quantitative and qualitative data collection methods you used

G. Materials and Methods

The Materials and Methods section is a narrative used to give the procedural details of your experiment, in such a way that another researcher could repeat your experiment by following what you wrote. It should describe how you conducted the study, what equipment and techniques you used, what procedures you followed, and the difference between the control and experimental groups. In this section be sure to include:

- Statement of your hypothesis (your hypothesis should be written as a testable statement or question and include the IV, DV, and predictions that can be supported or rejected)
- Overview of each item used in your experiment
- Explanation of how the project data will be collected and measured (including units)
- Explanation of how the independent variable changed
- Descriptions of statistical or graphical analyses performed on your data
- Descriptions of any surveys, assessments, etc. used in your research
- Any photos of your experimental setup or data collection procedures, including appropriate titles for each figure

H. Results

The results section should include the experimental evidence from your study, both qualitative and quantitative, and should be written in past tense. It is important to present the data from your research, but to refrain from interpreting or discussing its significance (interpretation of your data should be found in the discussion section). You should directly compare the data from various groups, if applicable. Be sure to report your data, most frequently organized into tables or figures with appropriate labels, only once.

Tables and figures should:

- Be constructed so they stand alone
- Have a title, labels, and figure legend
- Appear in chronological order in which you refer to them
- Clearly report data so readers can quickly draw conclusions

Example of a table:

Table 1

Title of Table

Header	Column Head	Column Head
Category1	Score	Score
Category 2	Score	Score
Category 3	Score	Score

Note. As necessary, include additional information needed to interpret your table.

Within the results section, you should provide a brief narrative presenting additional data, if necessary, and explain the figures and tables presented. If you conducted statistical analysis on your data, those results need to be reported in this section. An overview of the statistical analysis should include:

- Name of statistical test used and/or the mathematical computations performed
- Explanation of how you prepared the data for analysis
- Test statistics
- Degrees of freedom and/or sample size
- Significance level
- Probability value

As necessary, it may be useful to display statistical evidence to support your findings. There are two types of statistics presented in a research paper: descriptive statistics, and inferential statistics.

Descriptive Statistics

Descriptive Statistics describe the most typical values and the variations that exist within a data set (Salkind, 2008). A data set refers to numerical data that is recorded to represent the results of an experiment. Descriptive data is most commonly presented in terms of:

Measures of central tendency. These measures describe the central position of the distribution of scores in a dataset. The measures of central tendency are:

- Mean
- Median
- Mode

Measures of variation. These measures describe the distance between scores in a dataset. The measures of spread are:

- Range
- Interquartile range
- Variance
- Standard Deviation

Inferential Statistics

Inferential Statistics are mathematical calculations performed to determine whether the differences between groups are due to change or are a result of a treatment (Cothron, Giese, & Rezba, 2006). That is, inferential statistics determine whether or not the effects of your experiment are statistically significant. Results are deemed statistically significant when the mathematical differences between groups are more likely due to the change of the independent variable than to luck or chance (Statistics, 2011). There are many different ways to calculate inferential statistics, including:

- Linear regression analyses
- Logistic regression analyses
- Analyses of variance (ANOVA)
- Correlation analyses
- T-tests
- Longitudinal data analysis
- Survival analyses

I. Discussion

In the discussion section, you should interpret the results from your research, draw conclusions from your data, and suggest further hypotheses that can be tested based on any discrepancies or ambiguities found. The discussion section should:

- Restate the importance of your scientific research
- Declare whether your hypothesis was supported, not supported, or partially supported
- State whether your results were expected and explain why or why not
- List and explain possible explanations for your results
- Discuss the limitations of the study and provide suggestions for how future research on this topic could be improved
- Relate your research to work previously completed by others in the field

Each paragraph in the discussion section should address one aspect of the explanation of the results. For each paragraph, a topic sentence should be included that tells readers what will be discussed. This section will be used to restate your results, during which, you can refer the reader back to the tables and figures you provided in the results section. When explaining your results:

- Avoid using words such as: obviously, clearly, or proves
- Discuss, when appropriate, any groups that had irregular results compared to the other groups
- Address any foreseeable questions regarding your research
- Mention possible explanations for trends and patterns reported in the results section

J. Conclusion

The conclusion section should connect back to your introduction and explain whether or not your research provided any answers to your original research question. The conclusion section should:

- Include possible applications and extensions of your research
- Describe research studies that could be completed in the future
- Connect the research to possible real-world applications
- Apply the results of your experiment to the scientific community, including the scientific knowledge you've contributed in response to your research
- Discuss new questions that emerged from your study

The last paragraph of the conclusion section should summarize your analysis, declaring the degree to which your results show a relationship between the independent and dependent variables. Here, you will need to explain how that final conclusion was made and briefly support your conclusion with evidence.

K. References or Literature Cited

Virtually all scientific papers rely to some degree on previously published work. When a fact or an idea is borrowed (whether directly or paraphrased) from another source, it must be acknowledged, or cited, in the text and the origin of the information must be revealed.

It is important to give credit to sources for the ideas and information they provided you in the conduction of your research. Taking credit for someone else's work, ideas, or findings is plagiarism and is considered unethical in the scientific community. Resources allow readers to verify the validity of your claims and gather additional information if they so choose. As with conventional scientific writing, you will be using embedded references. In doing so, you will cite your sources in the text of your research paper using APA style of documentation.

The research paper should:

- Include in-text citations for ideas or quotations that came from other sources
- Contain information from reliable sources only
- Ensure that all entries in the References section at the end of the paper are correctly formatted and are listed in alphabetical order

Iowa JSHS will use the "Author, Date" scientific style for references. Rules for the most common works cited are listed below.

- Mention the author by last name in the sentence and then give the year of the publication in parenthesis:

> According to Flynn (2007), atomic structure is difficult for middle school students to understand.

- Give the facts or ideas mentioned by the author and then attribute these facts or ideas by putting both his or her last name and the date in parenthesis:

> Atomic structure is a difficult concept for middle school students to understand (Flynn, 2007).

- Quote the author exactly-be sure to put the quoted phrase between quotation marks--and then list the author's name, the date, and the page number in parenthesis:

> "Students in middle school experience difficulty understanding atomic structure." (Flynn, 2007, p. 9).

You only need to include the page number in the citation if you are quoting directly, or if the source is very long and the specific fact or idea you are citing can only be found on a specific page. Direct quotations that are more than 4 lines long should be set off from the rest of your paper by use of narrower margins and single spaced lines.

If you have more than one source by the same author published in the same year, distinguish them both in the in-text citation and in the reference list, by appending the letters a, b, c... to the year, in the order in which the different references appear in your paper. (For example: Allen 1996a, 1996b.)

- If the reference you are citing has two authors, use the following format:

> Iowa JSHS is an outstanding program for emerging young scientists. (Flynn and Douglas, 2014).

- If the reference you are citing has more than two authors, use the following format:

> Iowa JSHS is an outstanding program for emerging young scientists. (Flynn *et al.,* 2014).

- If your source of information is from a personal verbal communication, use the following format for the first citation from that person:

> Students in middle school experience difficulty understanding atomic structure (Leslie Flynn, University of Iowa, personal communication).

- If your source of information is from written correspondence (a letter or e-mail), substitute the word "written" for the word "personal" above, and add the date of the letter (if dated). Personal communications are generally not included in the References Cited or Bibliography section, although unpublished papers, reports, or manuscripts should be.
- For internet sources without any identifiable author or date, use the URL address as the in-text citation:

> Iowa JSHS will be held in Iowa City, Iowa (http://www2.education.uiowa.edu/belinblank/Students/JSHS/)

L. Appendices

Appendices are optional and function to provide additional information. Information contained within the appendices provide further clarification that is otherwise non-essential in understanding the paper itself.

Each appendix should be identified by sequential Roman numerals and contain different materials. The following are examples of what you might find in an appendix:

- Raw data;
- Figures and tables;
- Maps;
- Photographs; and
- Explanation of formulas and/or statistical tests used.

Any data you provide in your results section should not be included in an appendix.

Section

3

Oral Presentation

Students chosen to present at the Iowa Regional JSHS give an oral presentation of their research to an audience of their peers, teachers, and judges. Approximately 15 students will be chosen from the pool of all paper submissions. The top 5 presenters will be invited to attend and compete at the National JSHS competition.

Requirements for the Oral Presentation

Timing of Presentation

- The research presentation may not exceed 12 minutes, followed by a maximum 6 minute question period
- A session moderator will aid the student speaker in maintaining this schedule and in fielding questions from the audience
- The procedure for maintaining the time includes a 10 minute signal for the student, and finally a 12 minute signal
- At the 12 minute point, the student speaker must stop the presentation even if he or she has not finished

Question and Answer Session

- Following the presentation, the session moderator will first ask the judges if they have questions followed by questions from the audience
- The speaker may entertain questions while the exchange appears interesting and relevant
- Questions intended to harass the student speakers will not be allowed by the session moderator
- The student may not have assistance from the audience when answering questions
- The speaker should repeat a question before answering so the audience may understand the entire dialogue

Use of Audio Visuals

Available audio visual equipment in each session at Regionals includes:

- An LCD projector
- A projector screen
- A laser pointer

Additionally, PCs will be in each session room configured with Microsoft 2010 PowerPoint and Adobe Acrobat. The use of Macintosh computers or use of other software requires students to bring their own equipment.

Suggestions to Prepare for the Oral Presentation

Remember, you are the expert. No one in the audience knows as much about your research investigation as you. Therefore, remember to explain your research in enough detail so the audience will understand what you did, how you did it, and what you learned. Whenever possible, avoid jargon or unnecessary terminology. If it is essential to use specialized terms, remember to explain the specialized term briefly. Give your audience enough time to understand what you are trying to convey. Your goal is to tell a compelling story about how you answered interesting scientific questions.

Graphs, tables and other representation help explain your results. Keep them simple and uncluttered. Focus on important information; for example, remember to name the variables on both axes of a graph, and state the significance of the position and shape of the graph line. Deliver your presentation at a comfortable pace. It helps to practice your presentation before a non-specialized audience. Practice will help perfect the presentation and the timing. Do listen to the advice of your non-specialized audience but also get help from a teacher or other advisors as needed.

Section 4

Judging Criteria for Iowa JSHS

Selection of Presenters at the Iowa Regional JSHS

The judges will read all submitted research papers that follow the paper requirements described in section 2. Judges will use the Research Paper Selection Rubric below to select students to present an oral presentation.

Research Paper Selection Rubric

Introduction ❑ Description of the problem provides critical background on the need for and/or importance of the current research project. ❑ Background on entity's qualities (and care and safety, if applicable) is sufficient and well described. ❑ Discussion of previous scientific research on the Independent Variable (IV) supports the manipulation of this variable and indicates that manipulation will help address the hypothesis or research question. ❑ Discussion of previous scientific research on the Dependent Variable (DV) indicates that it is a good variable to measure or observe in response to the IV. Known associations with the IV are described. ❑ Options for quantitative data collection and measurement are well described. Best methods are justified. ❑ Options for qualitative data collection and measurement are well described. Best methods are justified.	(Possible # of Points: 12)
Materials and Methods ❑ Description of how the experiment was prepared for data collection is detailed enough that another individual could	(Possible # of Points: 14)

replicate the experiment. Description of how quantitative data was collected is detailed enough for someone to replicate the research. ❑ Data collected is appropriate for answering the research question. ❑ Description of how qualitative data was collected is detailed enough for someone to replicate the research. ❑ Data collected is appropriate for answering the research question. ❑ Photographs of experimental setup and data collection are included, referred to within the text, and increase the reader's understanding of how the research was conducted. ❑ Regular tasks that occurred throughout the experiment are thoroughly described, including the tools used to complete them. ❑ Surveys, large assessments, or other measurement tools are included, labeled, and referenced correctly in the paper. ❑ Research design is well described and makes clear the difference between control and experimental groups. ❑ Extraneous variables are described. Explanations of how they were kept constant or monitored are given.	
Hypothesis • Hypothesis is written as a testable statement or question; it includes IV, DV, and predictions that can be supported or rejected.	(Possible # of Points: 4)
Results ❑ This section clearly describes how raw data was calculated and organized for analysis. ❑ Data is logically organized either by groups or by type of data. The organization chosen clearly highlights the groups and/or trials that had the most and least change. ❑ All quantitative data was accurately calculated and is appropriately represented in the text. ❑ All qualitative data is objectively described and correctly represented in the text. ❑ Direct statements compare how each of the groups compares to one another. ❑ The text specifically refers to aspects of the graphs and tables that help highlight trends or patterns.	(Possible # of Points: 16)

Graphical Representation of Data ❑ All figures and tables are appropriate for the type of data and best allow for comparison among groups. ❑ The number of figures and tables is appropriate for proper interpretation of the results. ❑ All calculations are mathematically correct and are accurately represented in graphical form. ❑ Titles of figures and tables accurately and completely depict what is contained within the figure or table. Labels on graphs allow readers to interpret the graphs without having to read the text. The labels include units and axes or columns and rows.	(Possible # of Points: 8)
Analysis and Conclusions ❑ This section of the paper contains a statement that accurately indicates which data support the hypothesis and which data do not. ❑ Paragraphs within this section are logically organized and connected, explaining data and results in the context of the hypothesis. ❑ Conclusions regarding quantitative data are logical, are based on study data, and have resources to support the position. ❑ Conclusions regarding qualitative data are logical, are based on study data, and have resources to support the position. ❑ Comparative explanations of the experimental and control groups are logical and have resources to support the position. ❑ Data that do not follow trends (outliers) are thoroughly and specifically explained. ❑ This section addresses the possibility of data collection errors and/or ways the research design may have introduced limitations. ❑ Limitations are correctly identified and described. Suggestions are provided for how future studies could improve the study. ❑ With appropriate certainty, the student researcher draws conclusions about the relationship between the IV and DV. ❑ The student researcher connects the research study to possible real-world applications and provides plausible ideas for future studies.	(Possible # of Points: 18)

Reference Documentation ❑ In-text citations for ideas or quotations that came from other sources use either (a) Author Name at End of Sentence style or (b) Author Name Inside of Sentence style. ❑ All citations within the paper can be found in the student researcher's notes (shows strong evidence that paper was not copied directly from resources). ❑ All citations within the paper are listed in References section and all references listed are cited in the paper. ❑ All entries in Works Cited are correctly formatted and are in alphabetical order and from reliable sources.	(Possible # of Points:12)
Spelling and Mechanics ❑ Paper contains proper spelling throughout. ❑ Paper contains proper grammar throughout. ❑ All paragraphs have well-written topic sentences that accurately describe the content within the paragraph. ❑ Transitions are used when comparing data and when shifting to new ideas.	(Possible # of Points: 8)
Scientific Writing ❑ Proper tense and voice are used throughout. ❑ Entire paper is written using formal grammar, in clear, focused language.	(Possible # of Points: 6)
Page Setup • Margins are 1 in. around entire paper; paper is double spaced throughout; and 10 or 12 point font for text.	(Possible # of Points: 2)
(Possible Number of Points: 100) **Points Earned:**	

Selection of Presenters for National JSHS

The Categorization Process

The organization of the oral presentation sessions at the Iowa Regional JSHS is based upon a review of all abstracts and the area of research suggested by the student. Student presenters must state on the abstract the major discipline and the sub-discipline of their research. Student research presentations will be organized by discipline and sessions are open to the public.

The major disciplines in which military-sponsored, undergraduate tuition-based scholarship awards may be made are:

- Environmental Science/Engineering (Bioremediation, Ecosystems Management, Environmental Engineering, Land Resource Management, Pollution, Toxicity—ecosystem impact)
- Biomedical Sciences & Cell/Molecular Biology (Biomedical Medicine, Microbiology, Molecular/Cellular Biology, Genetics, Immunology, Pharmacology, Virology)
- Life Sciences (Developmental Biology, Plant Physiology, Population Genetics, General Biochemistry, Microbiology)
- Medicine and Health/Behavioral Sciences (Behavioral Sciences, Biochemistry, Bioengineering, Disease Diagnostics & Treatment, Epidemiology, Immunology, Neuroscience, Physiology, Pathology
- Engineering and Technology (Aerospace, Aerodynamics, Electrical Engineering, Solar Energy, Vehicle Development, Devices, Mechanical Engineering, Robotics)
- Mathematics, Computer Science, and Computer Engineering (Probability & Statistics, Math, Computer Algorithms, Databases, Networking, Computer Engineering)
- Physical Sciences, including Physics, Astronomy, and Internet of Things (Astronomy, Theoretical Physics, Solid State Physics, Acoustics, Optics, Thermodynamics, Particle Physics, Quantum Physics, Nuclear Physics, Internet of Things—the network of physical objects or "things" embedded with electronics, software, sensors, and network connectivity)
- Chemistry, including Physical Chemistry, Materials Science, Alternative Fuels and Geochemistry (Physical Chemistry, Materials, Alternative Fuels, Organic Chemistry, Chemical Engineering, Earth Science, Geochemistry, Energy, Alternative Fuels, Material Science)

Iowa Regional JSHS Judges Oral Presentation Rubric

Regional judges evaluate the oral presentations using the criteria below. Judges will use a total score of 30 points for each of the six criteria with each criteria weighted on a scale from 1 to 5. The scores are tallied for each presenter and used as the basis for discussion among judging team members where each criterion is considered:

- Statement and identification of research problem
- Scientific or engineering thought—process skills, creativity and understanding of the relationship of the project to existing work
- Research or engineering design and procedures
- Discussion and conclusions—relationship of results to data, implications, next steps
- Skill in communicating the research results
- Acknowledgement of sources and major assistance received

Refer to the sample rubric on page 25 for a more detailed explanation of the metrics by which oral presentations are judged.

5=Superior; 4=Excellent; 3=Good; 2=Satisfactory; 1=Fair

Criteria	Score
Statement and identification of research problem • Is the problem clearly stated? • Does the presenter demonstrate understanding of existing knowledge about the research problem?	1 2 3 4 5
Scientific thought, creativity/originality • Process skills are demonstrated by the student in the solution to the research problem and/or the research design. • Student demonstrates his/her individual contributions to and understanding of the research problem. • Student's level of effort	1 2 3 4 5
Research design, procedures (materials & methods), results 1. Science • Appropriateness of research design and procedures; • Identification and control of variables; • Reproducibility 2. Engineering, computer science, technology • Workable solution that is acceptable to a potential user; • Recognition of economic feasibility of solution; • Recognition of relationship between design and the end product. • Tested for performance under conditions of use • Results offer improvement over previous alternatives	1 2 3 4 5
Discussion/Conclusions • Clarity in stating conclusion. • Logical conclusion that is relevant to the research problem and the results of experimentation or testing. • Recognizes limits and significance of results. Evidence of student's understanding of the scientific or technological principles. • Theoretical or practical implications recognized. • What was learned?	1 2 3 4 5
Skill in communicating research results • Clarity in communicating research results to non-specialized audience and to judges. • Definition of terms as necessary. • Appropriate use of audiovisuals. • Response to questions from audience and judges.	1 2 3 4 5
Acknowledgment of sources and major assistance received	1 2 3 4 5
Total Score (Out of 30)	

The Iowa Regional JSHS Judging Team

The Iowa Regional JSHS Judging Team includes individuals who 1) hold either a Ph.D. or equivalent experience, or 2) are actively engaged in research. Judges will have general experience in the fields of research that are represented by the Iowa Regional student presenters. Specialized experience in each field presented at the Iowa Regional JSHS is not possible; therefore, student presenters are reminded of their responsibility to communicate their results so that they may be understood by both the non-specialized audience and by the judges. Judges are selected also for their interest in encouraging the students' interests and future development in the sciences, engineering, or mathematics.

The Iowa Regional JSHS Judging Process

The judges review the student presentations as follows:

- All of the written reports (e.g. abstract and paper) are read. The paper is used as supporting documentation during the judging process. The oral presentations are evaluated by each member of the assigned session judging team. The questioning period which follows the oral presentations aids judges in clarifying the student's depth of understanding, the amount of work and level of effort, and the individual contributions to the research problem. Following the sessions, the individual session judging teams meet and deliberate to select finalists from each session.
- Judges utilize the "Iowa Regional JSHS Judges Oral Presentation Rubric" as a tool and consider the weight of each factor during their deliberations.

Section 5

References

Iowa JSHS would like to acknowledge the following sources of information used in creation of this handbook. Students and teachers seeking more detailed information on preparing students for scientific research, writing scientific papers, and methods of effective oral scientific presentations should consult these resources.

American Psychological Association. (2009). *Publication manual of the American Psychological Association, 6th Edition*. Washington, D.C.: American Psychological Association.

Bates College. 2002. How to Write Guide: Sections of the Paper. Retrieved September 24, 2014, From http://abacus.bates.edu/~ganderso/biology/resources/writing/HTWsections.html#acknowledgments

Conthron, J. J., Giese, R. N., & Rezba, R. J. (2006). *Science experiments and projects for students: Student version of students and research.* Dubuque, IA: Kendall/Hunt.

Harland, D. 2011. *STEM Student Research Handbook.* Arlington, Virginia: NSTA Press.

Illinois JSHS. 2005. Guidelines for Preparation & Presentation of Student Research. Retrieved September 28, 2014, from http://www.ijshs.siu.edu/_common/documents/ijshs/ijshs.pdf

Salkind, N. J. (2008). *Statistics for people who think they hate statistics*. Los Angeles: Sage Publications.

Shapiro, Martin J, et al. 2004. *Guiding Student Research.* Lynchburg, Virginia: NCSSSMST.

Statistics in science fair projects. (2011). Retrieved May 20, 2011, from www.scietechfestival.com/pdf/statisticsdocument.pdf.

Appendix A: Open Source Data

Water data from the United State Geological Survey:
http://nwis.waterdata.usgs.gov/nwis

Geographical data from the National Geographical Data Center:
http://www.ngdc.noaa.gov/ngdcinfo/onlineaccess.html

Astrological data from the Mikulski Archive for Space Telescopes:
https://archive.stsci.edu/

Astrological data from the National Aeronautics and Space Administration:
http://nssdc.gsfc.nasa.gov/

Wildlife data from the National Wildlife Federation:
http://www.nwf.org/Wildlife/Wildlife-Conservation/Citizen-Science.aspx

Geographical, astrological, and wildlife data from Citizen Science:
http://www.citizensciencealliance.org/projects.html

Climate data from the National Climatic Data Center:
http://www.ncdc.noaa.gov/

Iowa flood data from the Iowa Flood Center:
http://ifis.iowafloodcenter.org/ifis/en/

Various datasets from Citizen Science:
http://www.scientificamerican.com/citizen-science/

Various data from Zooniverse:
https://www.zooniverse.org/

Appendix B: Webinars on Research Paper Format

Overview of research papers in APA style:
https://www.youtube.com/watch?v=X6ywA8C0SDo

How to write a title page in APA Style:
https://www.youtube.com/watch?v=foYLdAuVIX4

How to write an abstract in APA style:
https://www.youtube.com/watch?v=r8ia-ambBXk

How to write a table of contents in APA style:
https://www.youtube.com/watch?v=aAkG46Se3Bc

How to write a methods section in APA style:
https://www.youtube.com/watch?v=IXT2RAJuiH0

How to make tables in APA style:
http://video.about.com/psychology/How-to-Make-Tables-in-APA-Format.htm

How to make graphs in APA style:
http://video.about.com/psychology/How-to-Make-Graphs-in-APA-Format.htm

How to cite resources in APA style:
https://www.youtube.com/watch?v=10eg_GB_A9E

How to write a reference list in APA style:
http://video.about.com/psychology/How-to-Make-Reference-Pages-in-APA-Format.htm

How to write appendices in APA style:
http://www.howcast.com/videos/383550-How-to-Write-an-Appendix

Understanding descriptive and inferential statistics:
https://www.youtube.com/watch?v=HpyRybBEDQ0