

SIEMENS COMPETITION

Math : Science : Technology



2017 SIEMENS COMPETITION GUIDELINES

**SUBMISSION DEADLINE: ALL COMPETITION MATERIALS MUST BE RECEIVED BY
TUESDAY, SEPTEMBER 19, 2017 by 11:59pm E/T**

siemenscompetition.discoveryeducation.com

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Siemens Competition

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IMPORTANT FOR 2017

MENTOR MATCHING NOW AVAILABLE! Need a Mentor for your 2017 Siemens Competition Research Project? Visit our *Resources* page to learn more!

REGIONALS ARE NOW DIGITAL!

Students selected as regional finalists will be required to submit presentation materials digitally and will interact live with judges (using WebEx) for their Regional Final event.

**Register and Submit Your Research Project by
TUESDAY, SEPTEMBER 19, 2017 by 11:59pm E/T**

**It is your responsibility to carefully review and adhere to all
2017 Siemens Competition Guidelines.**

I. OVERVIEW

The Siemens Foundation (the “Foundation”) established the Siemens Competition in Math, Science & Technology (“Siemens Competition” or “Competition”) in 1999. The Siemens Competition seeks to promote excellence by encouraging students to undertake individual or team research projects. It fosters intensive research that improves students' understanding of the value of scientific study and informs their consideration of future careers in these disciplines. You can compete as an individual or as a member of a team. Individual projects promote independent research. Team projects foster collaborative research efforts as well as individual contributions to the cooperative endeavor.

Scholarships for winning projects range from \$1,000 to \$100,000.

The Advantage of Participating

Participating in the leading science and mathematics research-based competition for high school students in the United States:

- Expands your inquiry-based research skills.
- Challenges you to solve some of the world’s toughest problems.
- Opens new doors in pursuit of your educational and career objectives.
- Provides the opportunity to interface with other students who share your interest in research.
- Allows you to engage with distinguished scientists.
- Offers you a chance to win a college scholarship.

II. ABOUT THE SIEMENS COMPETITION

A. Scholarship Awards

College scholarships are awarded to all students who are selected to attend and compete in the regional and national events.

Regional Awards (in six regions)		
Category	Individual	Team
Finalists	\$1,000	\$1,000 for each team member
Winners	\$3,000	\$6,000 divided equally among team members

The winners of the individual and team regional awards advance to compete at the national level. The national awards are announced at a special event hosted by the Siemens Foundation in Washington, D.C.

National Awards		
Standing	Individual	Team (divided equally among members)
1st Place	\$100,000	\$100,000
2nd Place	\$50,000	\$50,000
FINALIST	\$25,000	\$25,000
FINALIST	\$25,000	\$25,000
FINALIST	\$25,000	\$25,000
FINALIST	\$25,000	\$25,000

Students receive instructions regarding how to request a scholarship disbursement via email in May.

Scholarship award money is sent directly to the accredited college or university the winning students select. In order to continue receiving the scholarship, students must be enrolled full-time and in good academic standing with the college or university.

Your scholarship can be used for:

- Tuition and fees required for enrollment.
- Fees, books, supplies, research and equipment required for courses of instruction at the school that are required for graduation.
- On-campus room and board.

Students are required to be prepared to participate in all aspects of the Competition. This includes being available to participate in regional and national levels of the Competition if you are selected as a finalist.

B. Competition Schedule

Monday, May 8, 2017	2017 Registration Opens: siemenscompetition.discoveryeducation.com
Tuesday, September 19, 2017	All Competition Materials Due (Research Report and all Required Materials)
Tuesday, October 17, 2017	Announcement of Semifinalists
Wednesday, October 18, 2017	Announcement of Regional Finalists
Regional Competition	
Monday, October 30, 2017	Digital Poster, Presentation & Bio Due
Saturday, November 4, 2017	Virtual Regional Final events: University of Notre Dame, Notre Dame, Indiana and Massachusetts Institute of Technology, Cambridge, Massachusetts
Monday, November 6, 2017	University of Notre Dame and Massachusetts Institute of Technology Regional Winners Announced
Saturday, November 11, 2017	Virtual Regional Final events: The University of Texas at Austin, Austin, Texas and California Institute of Technology, Pasadena, California
Monday, November 13, 2017	The University of Texas at Austin and California Institute of Technology Regional Winners Announced
Saturday, November 18, 2017	Virtual Regional Final Events: Georgia Institute of Technology, Atlanta, Georgia and Carnegie Mellon University, Pittsburgh, Pennsylvania
Monday, November 20, 2017	Georgia Institute of Technology and Carnegie Mellon University Regional Winners Announced
National Competition	
December 1-5, 2017	The George Washington University, Washington, D.C.
December 5	National Winners Announced

C. Student Eligibility

- The Siemens Competition is open to high school students who are citizens or permanent residents (green card holders) of the United States. Students must be in good standing, enrolled in, and attending one of the following (during the 2017-18 school year):
 - High school (grades 9-12) in the United States, Puerto Rico, Guam, U.S. Virgin Islands, American Samoa, Wake and Midway Islands, or the Marianas.
 - Department of Defense Education Activity (DoDEA) school.
 - Foreign school as an exchange student or because your parent or guardian lives and works abroad.
 - Homeschool, provided that signatures are obtained from the school district responsible for such programs. If your state does not require district supervision, the parent or guardian responsible for the homeschooling must sign the appropriate forms.
- Students must be enrolled in high school (grades 9-12) during the 2017-18 school year.
- Students submitting **individual projects** must be in good standing, enrolled in, and be in their last year of high school (grade 12). Students must complete all high school courses required for college admissions no later than September 1, 2018.

- **Team projects** may have two or three members only and do not need to include a senior (grade 12).
 - All team members must be in good standing, enrolled in, and attending high school (grades 9-12), although team members may be from different schools.
 - Each team must designate a team leader who serves as the communication liaison between the Siemens Competition and the other members of the team. All team members must have active roles in the design, execution, and delivery of results of the research submitted to the Siemens Competition, and have made a substantial contribution to the effort.
 - If your team structure changes, either before or after registration, students are required to indicate (1) the nature of the change and (2) that all team members agree to the change in the Acknowledgements section of the Project Form in your Student Dashboard. Teams are required to list ALL current and past team members in the Project form, regardless of whether or not they were part of the final team.

You are also required to list the contributions of all previous team members in the Acknowledgements section. Please provide (1) how the team member(s) contributed to the project, (2) how the project changed or will change without their future contributions, and (3) contact information for the previous team member(s) associated with the project including student names, email addresses, and school names.

Failure to identify others who assisted you with any aspect of your research may result in disqualification at the sole discretion of Discovery Education and the Siemens Foundation, regardless of when such failure to identify comes to their attention.

- **NEW THIS YEAR:** Your team structure must be finalized by 11:59 PM E/T on Monday, August 14, 2017. After this date, you **cannot** make any changes to your team structure (adding or removing members). If for extenuating circumstances you need to do so, you must present your case in writing to the Siemens Competition Team for approval.
- Competition entrants who have parents, guardians, or Competition mentors employed at, or otherwise affiliated with, the Siemens Foundation's university partners (Carnegie Mellon University; Georgia Institute of Technology; Massachusetts Institute of Technology; The University of Texas at Austin; California Institute of Technology; University of Notre Dame; and The George Washington University) **may enter** the Competition but **may not be permitted** to compete at the partner university where the parent, guardian, or mentor is employed or otherwise affiliated. Furthermore, if lab or research work for the project was performed at any of these six universities, students may enter the Competition but may not be able to compete at that university. Students who do have such conflicts must disclose this information in the Student Profile during the registration process. Failure to disclose conflicts may result in disqualification.
- Children of employees of Discovery Communications and its subsidiaries **are not eligible** to enter the Competition.

D. Siemens Scholar Network and Future Communications

The Siemens Foundation maintains an alumni network, offering information and potential educational opportunities to Semifinalists, Regional, and National Finalists.

Upon submission to the Siemens Competition, you acknowledge and agree that you will be added to the Siemens Scholar Network. This will allow the partner universities, Discovery Education and the Siemens Foundation to notify you of future educational opportunities and provide you with scientific and technological information that may be of interest to you.

III. ABOUT YOUR PROJECT

A. Project Eligibility

Before you begin, you must determine that your project is eligible for the Competition.

- Each student can submit **only one** Research Project, which will include all of the materials set forth in these Competition Guidelines (collectively, the “Research Report”, “report” or “project”), either as an individual competitor or as a member of a team.
- You may submit a Research Report that has been or will be submitted to other science competitions.
- You may submit a Research Report that has been or will be published as long as you retain the rights and cite the publication in the submitted Research Report.
- Projects with Human Subjects and Other Vertebrates are allowed; however, students must follow the Human and Animal Protection Policy guidelines noted in Section III.C. All required sections must be completed.
- If you were a Semi-Finalist in a previous Siemens Competition and intend to submit a previously submitted project, you must be able to clearly demonstrate scientific advancement or submit a new Research Project. Entrants must disclose this information during the Registration process.
- If you were **NOT** selected as a Semi-Finalist in a previous Siemens Competition, then you may resubmit your Research Project with no changes or a new Research Project.
- Competition entrants who have parents, guardians, or Competition Mentors employed by, or otherwise affiliated with, the Siemens Foundation’s university partners (Carnegie Mellon University; Georgia Institute of Technology; Massachusetts Institute of Technology; The University of Texas at Austin; California Institute of Technology; University of Notre Dame; and The George Washington University) may enter the Competition but may not be permitted to compete at the partner university where the parent, guardian, or mentor is employed or otherwise affiliated. Entrant must disclose this information during the registration process. Furthermore, if lab or research work for the project was performed at any of these six universities, students may enter the Competition but may not be able to compete at that university site. Entrants are also required to disclose this information during the registration process.
- Children of employees of Discovery Communications are not eligible to enter the Competition.
- Projects that violate any laws, school, or Competition regulations or that may potentially place any student, judge, or observer in danger are not eligible for this Competition.
- Projects that fail to follow any of the guidelines set forth are not eligible to enter the Competition and will be disqualified.

B. Project Topics

Research Reports may be submitted on projects in the fields of mathematics, engineering, biological, and physical sciences. They may also involve combinations of disciplines such as:

- Astrophysics
- Biochemistry
- Bioengineering
- Bioinformatics
- Biology
- Biophysics
- Botany
- Cell/Cancer Biology
- Chemical Engineering
- Chemistry
- Civil Engineering
- Computer Science
- Earth and Atmospheric Science
- Electrical Engineering
- Environmental Science and Engineering
- Genetics
- Geology
- Immunology/Virology
- Materials Science/Nanoscience
- Mathematics
- Mechanical Engineering
- Microbiology
- Neuroscience
- Nutritional Science
- Physics
- Toxicology

Social and behavioral science research projects are **NOT** eligible. Social science is considered to be the study of society or social behavior. Behavioral science is considered any project that involves the study of the actions and reactions of humans and animals through observation and experimental methods.

Neuroscience projects that are based on the underlying sciences of biology, chemistry, and physics (i.e. mechanisms underlying a behavior) are allowed.

C. Human and Animal Protection Policy

The Siemens Competition recognizes that laboratory research using animals and/or human subjects has led to important discoveries. Because this is a high school competition, the program has set guidelines as to what is and is not allowable for purposes of entering this Competition. Therefore, students must understand and follow the guidelines below, and mentors must clearly document the use of human subjects and other vertebrates to be eligible for the Competition.

For the purpose of the Siemens Competition, live vertebrates include humans, mammalian embryo or fetus, bird eggs within three days (72 hours) of hatching, and all other vertebrates at hatching or birth. Zebrafish are considered vertebrates upon hatching. (Source: [NIH Animal Program Director Guidelines for Zebra fish Larvae Incubators](#). **If any of these types of vertebrates are used in the student's work, including obtaining tissue or cells from vertebrates even if the rest of the vertebrate was used for a different purpose, BOTH the student and mentor must fill out the following forms:**

Section V of the Mentor Form and the **Human and Animal Protection Policy Certification**, must be fully completed by the advisor, mentor, or supervising scientist. In addition, the student must complete the **Human and Animal Protection Policy Questions**.

Projects that involve in any way, including testing and questioning, the use of **live human subjects or other live vertebrates or the fluids, cells, tissues, or organs from vertebrates** are accepted only under the following conditions:

- The Research Project is conducted in a registered institution or laboratory in the United States where human or animal experimentation is authorized. The mentor is required to provide the following information as part of the Mentor Form:
 - Name of the research institution.
 - Title of the study.
 - In the case of human subjects, Institutional Review Board (**IRB**) approval number and approval date. A high school IRB **is not permitted**. If the project has been granted **EXEMPT STATUS**, this should be clearly stated with the date of

the granting of the exemption documented. **Copies of IRB approval or granting of exemption must be included with the application.**

- In the case of other vertebrate animals, Institutional Animal Care and Use Committee (**IACUC**) approval number and approval date. **Copies of IRB approval or granting of exemption must be included with the application.**
- A copy of IRB approval, IRB exemption, and/or IACUC approval letter/certificate should be included in the Research Project materials.
- The vertebrate animals **CANNOT be euthanized** for the **SOLE** purpose of the student's research project. Fluids, cells, tissues, and organs may be used only if the animals were euthanized for another purpose. This must be clearly documented by the mentor AND the student. Any Research Report that does not have a clear statement from the mentor and the student that the animals were not solely euthanized for the student's project will be **disqualified** from the Competition. **If the statements by the student and mentor are not consistent with each other, and thus, it is not clear whether these guidelines have been followed, then the project will be disqualified.**
- Projects using established commercially purchased human or animal cell lines **ONLY** do not require IACUC or IRB approval. However, the student must still complete the Human and Animal Protection Policy Questions and clearly state the cell line name. If possible, the student should include the ATCC catalogue number for the cell line, or if not available, the reference to the original paper establishing the cell line.

Research projects conducted outside of the United States must follow the same guidelines listed above when using **live human subjects or other live vertebrates or the fluids, cells, tissues, or organs from vertebrates** in accordance with the following:

- The research must be done in an institution that is affiliated with a U.S. registered institution or laboratory. The mentor must provide an IRB or IACUC approval number and a copy of IRB approval, IRB exemption, and/or IACUC approval letter/certificate should be included in the Research Report materials, or
- The country where the research is done must have, at a minimum, guidelines equivalent to the United States. The mentor must provide evidence of this. In place of an IRB or IACUC approval number, the mentor must provide a copy of the official certification used in that country and specifically for that research project. If the country or affiliate institution has a federal-wide assurance number, please provide. The documentation must be in English.

Failure to follow the Human and Animal Protection Policy may result in disqualification.

D. Academic Integrity

Academic integrity is a fundamental value of the Siemens Competition and scientific research. We expect the Research Report, presentation slides, poster, videos, and any other materials submitted to the Competition to be your own work. If you are using audio, text, or images from someone else, you are expected to ensure that all facts, techniques, images, and information (including the Internet) are properly cited. It is not sufficient to simply modify the words of an original source. If you have used the essential idea, you must properly cite the source. All direct citations with no modification to the wording should be in quotations. Improper use of citations may result in disqualification.

In addition, all of the materials submitted to the Siemens Competition, including, without limitation, the findings, results, conclusions, discoveries, research, data, software, code, and all other matters related to the materials, must satisfy the principles of academic and scientific honesty and integrity and cannot be designed, engineered, altered, or modified in any way to fraudulently or illegitimately produce (whether intentionally or unintentionally) a dishonest result.

Documentation may be requested at any time (including after the Competition, after winners have been selected, and after awards have been provided) including, but not limited to, computer source code, software, lab journals, cited references, and/or underlying mathematical formulas, to support the research submission and any unsubstantiated claims.

As part of the judging process, the Competition uses specific procedures to detect plagiarized or dishonest materials. If a Research Report or other materials are found to have improper citations, if citations are omitted, intentionally or unintentionally, or if the materials fail to satisfy in any way the principles of academic and scientific honesty and integrity, Discovery Education and the Siemens Foundation, at their sole discretion, will **disqualify** you from the Competition and notify your parents, mentor, lab director and/or high school about the disqualification. Grounds for disqualification may include, but are not limited to: plagiarism, claims of novelty and/or substantial significance that cannot be supported, and improper use of vertebrates (if applicable). Disqualification may occur at any time, including after the end of the Competition, after winners are selected, and after scholarship awards have been provided.

The integrity of the research project is the responsibility of the author (student), and violations of academic integrity will result in disqualification. Each applicant must indicate that they have read and understand the Academic Integrity Statement upon registration and submission.

E. Citing Your Sources

Any piece of information that is not your own original text or is not common knowledge must be properly cited and quoted within the Research Report. This includes facts, techniques, and information from other sources (e.g., print, web-based, oral). It is not sufficient to simply modify the words of an original source. All images, figures, histograms, diagrams, graphs, and data must be cited. If you used the essential idea (whether a primary or secondary source), you must properly cite the source. You must also cite and quote any text from other published papers where you are an author. If you plan to use an electronic source, you may use hyper-links. If that hyper-linked source requires a login, subscription, or any information that may not be available to Siemens Competition judges, you must provide the cited information as text within your resources. Improper use of citations may result in disqualification, regardless of when discovered. **NOTE:** It is the student's responsibility to ensure that all hyper-links are working before submitting the Research Report.

- **What is the difference between a primary and secondary source?** A primary source comes directly from the researcher. Examples are research articles in journals, patents, or reports. A secondary source comes from information that was originally collected elsewhere by someone other than the researcher. Examples are review articles and books. Both types of sources must be cited.
- **What if I want to cite an article/publication that I've written or contributed to?** For the purpose of this Competition, if you are citing a previously self-authored article/publication, please refer to the author as "Competition Entrant".
- **What if I want to cite an article/publication that my mentor wrote or contributed to?** For the purpose of this Competition, please refer to the author as "Mentor." If your mentor co-authored an article/publication, it is fine to list the other contributors' names in the citation, so long as you have no personal affiliation with them.
- **How do I cite a graph, figure, or illustration that I created?** For the purpose of this Competition, please cite the author as "Competition Entrant."
- **Am I required to cite a photograph or graph that was created by someone else in the lab where I am doing research?** Yes. This is not your own original work and must be properly cited. Examples include images and other graphical materials that have previously appeared in publications or other documents, whether or not they come from the same lab. This requirement also applies even if you were an author of these earlier materials. Failure to properly cite one's own previous work is regarded as self-plagiarism. **Remember:** when citing a lab you worked in, remember **not to mention** the name of your lab in your citation. Instead, refer to the lab simply as "research facility" or "institution."
- **What is a peer-reviewed source?** Professional journal articles are almost always reviewed by 'peers' or experts to help ensure that the material submitted is legitimate and original. Whether the information comes from a peer-reviewed source or not, it must be cited if you take information from the source.
- **How do I cite my source code?** You need to place the code in a repository, for example GitHub, and link to your GitHub account in your references (please also list the log-on information). Keep in mind any sites you post to must be **anonymous**. There is usually a name associated with the account, so you would need to name the account "Competition Entrant" to avoid being disqualified for personally identifiable information.

F. Sharing Your Results

Research Reports and findings are the property of the students. You agree to permit the Siemens Foundation and Discovery Education to utilize and share the reports, including any parts and any other documents or corroborating materials (in any form or medium) submitted to supplement the original report, with third parties as it deems appropriate in their respective sole discretion.

Students selected as Regional or National Finalists grant the Siemens Foundation and Discovery Education nonexclusive, non-royalty bearing worldwide rights to showcase the project design, results, and findings, as well as the student(s) themselves who worked on the project.

By participating in the Competition, the competition entrants agree to have their photos taken and used publicly and to have their names and images used publicly with respect to the Competition.

IV. RESEARCH REPORT

The Research Report enables the judges to evaluate the scientific work completed as part of the Competition. Semifinalists and Regional Finalists are selected on the basis of their Research Report. To ensure that the judges focus on the quality of the work completed, rather than on the manner of presentation, strict requirements for the Research Report must be followed. **Research Reports that do not adhere to these guidelines may be disqualified from the Competition.**

A. Overall Report Requirements

The Research Report must be written by the student(s). Mentors are permitted to minimally edit the report, but they may not function as the main author. To ensure fairness, Research Reports are initially evaluated without reference to any personal information about the students.

Absolutely NO student names or references to gender ("he" or "she"), high schools, school officials, advisors, mentors, affiliated research organizations, acknowledgements, or any other identifying information of the entrants are to appear anywhere in the Research Report. This includes headers, footers, within the text of the Research Report, citations, and references. If you are citing a previously self-authored article/publication in your References section, please refer to the author as "Competition Entrant". Research papers that include any personally identifiable information will be disqualified.

- Can I put my name on the first page of my research report? No. DO NOT include your name ANYWHERE in your research report. This includes the first page, headers and footers, the body of the report, and citations.
- Can I use my team member's name when referring to the work he/she did? No. Instead, refer to other team members as "Team Member." Also refrain from making any references to gender when referring to yourself or your teammate(s).
- Can I refer to my mentor by name? No. You may refer to your mentor as "Mentor."
- Can I mention the name of the lab where I worked? No. Instead, simply refer to the lab as "research facility" or "institution."
- Can I mention the name of the lab or university where my mentor works? No, as this also counts as personally identifiable information. You may use "Mentor's Institution" if you need to refer to your mentor's lab, university, or other place of work.

Any piece of information that is not your own original text or common knowledge must be properly cited and quoted within the Research Report. You must also cite and quote any text from other published papers where you are an author. See Section III.E. for additional information.

All claims of novelty and/or substantial significance must be documented. If you choose to use superlatives such as "never before discovered," "state of the art," "best study to date," "new and novel idea," and similar superlatives, be prepared to provide extensive detail to support these statements.

B. Format Requirements

The Competition submission will include the Research Report, Abstract and all references. The Research Report must be in the following format:

- Written in English.
- Adhere to an 18-page limit. This limit includes the introduction, text, tables, data, illustrations, and appendices. **NOTE: The Abstract and References are NOT included in the 18-page limit. Please do not include a title page.**
- Double-spaced, with page numbers at the bottom.
- Have page margins of at least 1 inch.
- Written in **12 point or larger Arial or Times New Roman** font for the body of the report. [LaTeX](#) font is permitted for mathematical equations.
 - Graphs, tables, and charts may be single spaced and in a smaller point font (no smaller than size 9).
 - Captions accompanying pictures and graphs, as well as citations for references, may also be single-spaced and in a smaller point size (no smaller than size 9).

- Written without the use of name(s) in the title when saving your Research Report as a PDF (ex: ProjectTitle.pdf).
- Uploaded only as a PDF document.

C. Content Recommendations

The suggested guidelines in this Section IV.C. are provided to help you understand the goals of each section of the Research Report. While the overall Research Report should provide the content as outlined under the following headings, the specifics stated below may vary slightly from one discipline to another. Subheadings should be used in Materials and Methods, Results, and Discussion to clarify the content, but sections, such as Results and Discussion, may be combined. The pages noted for each section are suggestions only.

Introduction: the "why" section (2-3 pages)

- Start with a broad picture of the problem you have chosen to study and why it is interesting. Provide a brief review of pertinent scientific literature, describe what information is missing and how your work addresses this gap in the literature. Previous relevant publications and patents must be properly cited in the text of the Research Report and included in the Reference section of your report.
- Describe the specific problem to be solved, the research question to be answered, the hypothesis(es) to be tested, or the product to be developed (if any). Provide a brief rationale for the research and why the work is important.

Materials & Methods: the "how" section (2-5 pages)

- Describe how you performed your work, giving sufficient detail so that someone trained in the field is able to understand what you did and can replicate it.
- Include the methods you used, written in a format commonly used in publications in your field of study. Do not merely restate a protocol or copy blocks of text; instead, use your own words to describe what you did, referencing key papers where appropriate. It is not necessary to report every detail; only detail the methods as is common to your discipline and allows replication of your study.
- Explain your personal role in the work and the roles played by others in supporting this work. Include, for example, acknowledgments to others in the laboratory for running key instrumentation or other protocols. You may refer to others who assisted you by title but do not include any specific names in the body of your Research Report.
- Mention common procedures, but there is no need to describe them in detail; provide references to where the method is published. All modifications of existing methods should be described.

Results: what did you find? (4-5 pages)

- Present your findings in sufficient detail so that the reader understands the results that were obtained or can follow each step of a mathematical proof.
- Describe how the results address the problem to be solved, the research question to be answered, or the hypothesis to be tested.
- Present all experiments, controls, and statistical tests that show that the results are reliable and statistically significant. State all statistical tests used and the p values if appropriate for your discipline. In theoretical work, present the experimental findings against which the work was tested, the extent to which it was validated, or both.

Illustrations: documenting your findings (2-4 pages)

- Use illustrations to document the textual description of your results. Each illustration should be numbered in sequence and should be accompanied by its own legend. The illustration plus its legend should stand alone — the reader should understand it without having to read the text of the paper. Labels and axes should be clear, and figures and tables should be of high quality. While we recommend having an Illustrations section, you may also intersperse your illustrations throughout the body of the paper if you choose, as long as you follow the guidelines regarding illustrations.

Discussion: what do your results mean? (3-4 pages)

- Provide readers with an interpretation of the results, enabling them to understand the implication(s) of your findings.

- Describe what makes your work unique in the context of published findings and what distinguishes it from that of others in the field or in your laboratory. In other words, put the work in context with other reports that ask the same or related questions and address whether or not your observations are consistent with or enhance other findings in the field.

Conclusions and Future Work: what did you learn and what's next? (1-3 pages)

- Recap briefly what was learned from your research and how your work addresses the unanswered question(s) that you posed in the introduction.
- Assess the validity of the conclusions, which is an important component of any scientific report. In particular, are your conclusions fully supported by the results described in the report alone or in conjunction with prior literature? Are there alternative explanations for your observations that cannot be ruled out?
- Determine what experiments could be performed in the future to refine your conclusions.
- Indicate what you would do next if you had more time, and what would you do differently if you were to start the work today.
- Consider what questions still remain to be answered.

D. References (NOT included in 18-page limit for the Research Report)

Citations and references must be in complete and correct standard format for the discipline. Consult with a teacher in your science or math department or your mentor for assistance.

References must be included in the Research Report. Each individual reference should be single-spaced with a double space between references.

Any piece of information that is not your own original text or is not common knowledge must be properly cited and quoted within the Research Report. This includes facts, techniques, and information from other sources (e.g., print, web-based, oral). It is not sufficient to simply modify the words of an original source. All images, figures, histograms, diagrams, graphs, and data must be cited.

If you plan to use an electronic source, you may use hyper-links. If that hyper-linked source requires a login, subscription, or any information that may not be available to Siemens Competition judges, you must provide the cited information as text within your resources. If you used the essential idea (whether a primary or secondary source), you must properly cite the source. You must also cite and quote any text from other published papers where you are an author. For the purpose of this Competition, if you are citing a previously self-authored article/publication, please refer to the author as "Competition Entrant". Please review Section E, "Citing Your Sources," on page 8 for more information regarding how to properly cite without using personally identifiable information.

E. Abstract (NOT included in the 18-page limit for the Research Report)

The Abstract should be the first page of the submitted report and is a technical synopsis of the problem, methods, results, and conclusions. It should be double-spaced using 12 point or larger Arial or Times New Roman font, 100-200 words long, and include the Research Project title at the top.

No identifying information, such as name, high school, or references to gender or research facilities should be included in the Abstract. [Click here](#) for Sample Abstracts from previous winners.

The Abstract is **not included** in the 18-page limit for the Research Report.

V. ADDITIONAL REQUIRED MATERIALS

In addition to your Research Project, which includes the 18-page Research Report, the Abstract, and References, students must also provide the following information and materials via the online submission system.

A. Registration Information

The purpose of the Registration process is to collect relevant information required before submission to the Siemens Competition. The accuracy of this information is vital to the academic integrity of your Research Project.

B. Required Authorizations

- Student Affirmation Statement

Upon submission, each student will be required to review and agree to the Affirmation Statement. The Affirmation Statement summarizes the Competition requirements and expectations for academic integrity.

- Parent or Guardian Authorization
- School Endorsement Authorization
- Mentor Authorization
- Lab Director Authorization (only required if research was conducted at registered lab or university facility)
- Human and Animal Protection Policy Form (even if your Research Project did not use vertebrate animals and/or human subjects, each individual/team lead is required to fill out the HAPP form).
- **If a student dishonestly obtains any of the above authorizations, the student will be disqualified.**

C. Executive Summary

The Executive Summary on its own, separate from the Research Report, should convey the essence of your project and should be understood by someone without scientific expertise. **Do not simply replicate what you wrote in your Abstract.** The summary should clearly present three content areas - the question asked, the methods used, and the lessons learned and must be written in layperson (non-specialist) language. **NOTE:** The summary will be used to explain your project to the general public and in preparing press releases for the media.

The Executive Summary must be double-spaced and use 12 point or larger Arial or Times New Roman font and include the exact Research Project title at the top. Margins should be 1 inch or larger. No identifying information, such as name, high school, references to gender, or research facilities should be included.

The Executive Summary may not exceed one page and is **not included** in the 18-page limit for the Research Report.

D. Human and Animal Protection Policy Questions

Each individual/team lead must answer the Human and Animal Protection Policy questions. Please pay special attention when completing this section if your Research Project uses vertebrate animals and/or human subjects or commercially purchased human or animal cell lines. Your response provides you an opportunity to describe your use of vertebrates to the judges.

Like the Research Report, the responses must be written by the student(s) and **no** student names or reference to gender, high schools, school officials, advisors, mentors, affiliated research organizations, or acknowledgements of the entrants are to appear anywhere in the answers below. For teams, the Team Leader is required to answer these questions on behalf of all team members. The form asks the following questions:

1. Why was it necessary for you to use live animals and/or humans or fluids, cells, tissues, or organs from vertebrates in your research? Justify the species used.
2. Describe how you used the animals and/or humans in the research.

3. Further, describe whether the animals were euthanized before or after your experiments and for what purpose. Were the animals euthanized solely for your research?
4. If human subjects were used in your research, specify what procedures were used to inform participants about the purposes of the study, to obtain their consent for participation, and to protect them against harm during the conduct of the study.

The Human and Animal Protection Policy Questions are **not included** in the 18-page limit for the Research Report.

E. Mentor Form

Individuals and teams must have their mentor complete the Mentor Form. The mentor is the individual most closely associated with the Research Project, such as the student's research supervisor or another qualified scientist who gave support throughout the course of the Research Project. Each Research Project can only have one mentor.

If a student or team does not have a mentor, a teacher or other high school administrator must complete the form. If the student is interested in finding a Mentor for their Siemens Competition Research Project, the student may also visit the *Resources* page of the Siemens Competition website to learn more about national Mentor Matching services. *Additionally, if any of the research was conducted at a university or other registered laboratory facility, **the signature of the lab director or head of the research group is required via the separate Lab Director Form.**

If the Research Project involves vertebrate animals and/or human subjects, **Section V of the Mentor Form, Human and Animal Protection Policy Certification**, is required and must be completed and signed by the advisor, mentor, or supervising scientist. This section of the form is carefully reviewed to determine the project's eligibility, in accordance with the Competition Guidelines.

* In no event shall Discovery Education, Inc., the Siemens Foundation, Siemens Corporation or any of its their respective affiliates or subsidiaries be liable for any damages, including but not limited to direct damages, lost or prospective profits or any other special, punitive, exemplary, consequential, incidental or indirect losses or damages (in tort, contract or otherwise) that arise from or are related to any student's (i) use of the Siemens Competition website to utilize resources outside of the Siemens Competition website, including but not limited to the Mentor Matching Service or (ii) participation in the Mentor Marching Service. The students acknowledge that the Mentor Matching Service is a third party service and is not endorsed by Discovery Education, Inc., the Siemens Foundation or Siemens Corporation, and such parties bear no responsibility for any students use of such service.

F. Lab Director Form

Form must be completed by a lab director or head of the research group if your research was conducted at a university or registered laboratory/institution.

VI. REGISTRATION AND SUBMITTING YOUR PROJECT

A. Registration

Registration opens Monday, May 8, 2017 at siemenscompetition.discoveryeducation.com

- Individuals and Teams must register at siemenscompetition.discoveryeducation.com prior to the project submission deadline of Tuesday, September 19, 2017.
- Each Team must identify a Team Leader during the registration process.
- Registering does not guarantee your entry into the Competition. Research Reports and all Additional Required Materials **MUST** be submitted by Tuesday, September 19, 2017 by 11:59 PM E/T.
- Upon successfully submitting your Research Project, you will receive a confirmation email acknowledging receipt.
- If you do not have access to the Internet, please consult your teacher or mentor and consider the resources available to you at your school or local library.
- If you experience technical difficulties, or have questions, please contact Discovery Education at siemenscompetition@discovery.com or 800-323-9084.
- Please note that it is the Individuals' and Teams' sole responsibility to ensure submission of the project by the Tuesday, September 19, 2017 deadline. **Individuals and Team Leaders will need to provide the following information to Register and complete the Project and Student Profiles.**
- Legal name, address, home telephone number, cell phone number, and email address. **NOTE: Only use your legal name as it appears on your passport, driver's license, or other legal documents.**
- Date of birth.
- Citizenship Status (U.S. Citizen or Permanent Resident). For Permanent Residents, your card number is required.
- Official high school name, address, telephone number, and principal's name.
- Mentor's name, address, telephone number, and email address.
- Type of Research Project: Individual, Two-person, or Three-person Team
- Primary area of scientific research for your Research Report

If your project involves Human Subjects and/or Other Vertebrates, carefully review the [Human and Animal Protection Policy](#). If you or your team members have submitted a project(s) to the Competition in the past, please see Project Eligibility.

B. Submitting Your Project

Your Research Report, Abstract and References and all Additional Required Materials must be **submitted** by Tuesday, September 19, 2017 by 11:59pm E/T. **Submissions are completely online and will not be accepted by mail, fax, or email.**

You will not be able to edit, retrieve, append, or resubmit your Research Report information, PDF or any supporting documents after your final submission.

VII. JUDGING

The Siemens Competition recognizes student Research Projects that display originality, creativity, academic rigor, and clarity of communication. Discovery Education assembles a panel of PhD level research scientists to conduct the initial review of all project submissions.

Judges identify projects that exhibit not only scientific excellence but also the collaborative teamwork that is often characteristic of successful scientific and technological endeavors.

Students should consider the audience who is judging the Research Projects. For the initial review and for the national level of the Competition, judges are selected by their field of expertise, have advanced degrees (PhD, MD) and come from both academic and laboratory settings. At the regional level, judges are selected by the Siemens Foundation's partner universities.

Team projects are evaluated separately from individual projects, using the same criteria. Additional attention is given to the collaboration among team members and to each team member's contribution to the project effort.

A. Judging Process

Initial Judging

During the initial judging, only the Research Reports are evaluated. These Research Reports are judged solely on project merits. The initial judges do not have any information about you (such as legal name, gender, school, age, or state).

Semifinalists

Up to 300 outstanding projects are selected as finalists. From those 300 projects, up to 60 will advance to the Regional Finalist stage of the Competition, and the others will be honored as Semifinalists. Students chosen as Semifinalists may have their names publicly announced, including having their names posted on the Siemens Foundation website (www.siemens-foundation.org).

Regional Finals

Up to 10 projects (up to five individual and up to five team projects) from each of six geographic regions are selected to compete virtually at the regional level of the Competition.

At the regional levels of the Competition, judges evaluate the Research Report (18 page max), Abstract, and the References cited in the Research Report, the digital poster, and private online oral presentation (12 mins) with question-and-answer session (15 mins). Factors such as knowledge of the science involved, your role in the project, and ideas extending from the work are also considered.

National Finals

The six individual and six team regional winners compete at the national level. National Finalists are required to display their printed posters, give oral presentations, and respond to questions before an in-person panel of national judges.

B. Judging Criteria

The regional and national judges use these criteria to evaluate all aspects of the projects and presentations.

- **Scientific importance:** Does the project address an important scientific, technical, or mathematical question or major issue? Does the student's work demonstrate a high level of intellectual input and is it innovative? Do the findings substantially add to the understanding of the area investigated?
- **Creativity:** Is the project original and imaginative? What is the origin of the student's interest in the topic? Did the student develop new solutions or procedures? To what extent were the student's talent and insight incorporated into the project? How did the student address any surprising or unforeseen developments?
- **Field knowledge:** Does the student demonstrate strong knowledge of the area of inquiry and the underlying scientific or mathematical issues?
- **Comprehensiveness:** Are sufficient details given so that others can replicate the work? If the work is experimental, are the variables and controls clearly defined? Did the student use the correct quantitative measures? Are the procedures well-

defined? Were tools for measurement and analysis chosen and used appropriately? Does the Research Report fully explain the project itself or is further explanation needed?

- **Interpretation:** Has the student stated the interpretations and conclusions clearly? How scientifically reasonable and credible are the data, interpretations, and conclusions? Do the conclusions and interpretations follow from the results presented? Are appropriate statistical tests employed, if appropriate? Can claims of novelty or improvement be justified? What are the limits of the interpretations and the conclusions? Are there alternative conclusions that fit the results?
- **Literature review:** Does the report reference appropriate related works and place the study in a proper context? Are all sources used in the research listed as references? Are the references cited within the text? **Future work:** Is there a discussion of future or follow-up research? If so, what further data would be needed? What are possible applications of the work?
- **Clarity of expression:** Is the project understandable? Is the material presented logically and coherently? Are the key points, problems, and solutions stated clearly and precisely? Does the student use tables and figures appropriately, including correct labeling of axes? Was the Research Report carefully proofread for spelling and grammar?
- **Presentation:** Is the method of presentation consistent with the nature of the work and with scientific practice in the discipline involved?

Additional Criteria for Team Projects

- **Teamwork:** Is it clear how each team member contributed? Was there an appropriate distribution of workload and responsibilities? All team members must have active roles in the design, execution, and delivery of results of the research submitted to the Siemens Competition and have made a substantial contribution to the effort.

VIII. REGIONAL AND NATIONAL FINALISTS

Discovery Education will assign students to compete virtually at one of the six regional competitions. The Siemens Competition uses the regional structure shown in the regional map. This map can be viewed at siemenscompetition.discoveryeducation.com website by clicking on the "Regional and National Finalists" tab. The Competition selects up to 10 projects (up to five individuals and up to five teams) from each of the six geographic regions. Finalists (including **all** team members) must participate in all required Competition events, including a run-through session with Discovery Education the week prior to the Regional Final event.

If you are chosen as a Regional Finalist, you will be required to submit a digital poster and presentation slides by Monday, October 30, 2017. A panel of judges appointed by the host institution reviews the projects, and if selected as a Regional Finalist you will present your project virtually at one of the six Regional Final events.

Students who win at the regional level compete at the national level. The National Finalists receive an expense-paid trip with a parent chaperone, to Washington, D.C. in December 2017.

Regional Finalists, both individual and team, are required to:

- Submit a digital poster and a copy of their presentation slides via a secure cloud-based technology by October 30, 2017. Posters **MUST** be created using the template provided. See the [Regional Finalist Guidelines](#) for more information. **Research completed after the original submission may not be presented in the presentation slides, included in the Regional Finals poster, or presented as part of the oral presentation.**
- Participate in a private, proctored oral presentation and Q&A session with the judges from each partner university via WebEx. The oral presentations will be 12 minutes in length and the Q&A session will be 15 minutes. Discovery Education will assign the time that the individuals and teams will conduct their oral presentation and Q&A session. The school administrator/principal of the student is responsible for identifying the assigned proctor. Student/Team members must secure approval from school administrators regarding the use of school facilities during these scheduled presentation times. (Regional Finalists will be provided with Regional Finals Guidelines with more information regarding the use of video/animations in presentations.)

School Access/Proctor Requirements for Regional Finalists

If selected as a Regional Finalist, the Regional Finalists' School Administrator/Principal/Headmaster will be required to provide access to school grounds and school internet on the date of the Finalists' Regional Final event. The School Administration should also understand that if the student is selected as a Regional Finalist, the student will be required to participate in a technical run-through the week prior to their assigned Regional Final event, where they will also require access to the Internet and the room in which they will be presenting from during their assigned Regional Final event. Lastly, if the student is selected as a Regional Finalist, Discovery Education requires the Administrator to secure an educational professional to serve as a Proctor during the students' Regional Final event. The Proctor may work within the same school (or school district) that the Regional Finalist attends, however **they may not currently teach the Regional Finalist**. Additionally, proctors cannot be a student's principal, mentor, or anyone related to the project. By signing the School Administrator endorsement form required for submission, the School Administration agrees to these responsibilities.

National Finalists are required to attend and participate in ALL events during the National Finals weekend. Events will include but are not limited to the following:

- A 12-minute oral presentation about the research and findings.
- A private, 12-min question-and-answer session with the judges.
- An exhibition of student's printed poster, which must follow the specifications outlined in the [National Finalist Guidelines](#)
- **If you do not attend the National Finals event, you will forfeit your status as a National Finalist.**

Finalists are evaluated on these items, in addition to the Research Report and all Additional Required Materials.

Judges expect to hear concise presentations and responses to their questions during the question-and-answer session. Each student must also be able to describe further aspects of your project, including the fundamental science behind what you have done. All aspects of the projects and presentations inform the final decisions of the judges.

All results and data presented in the poster, oral presentation, and Q&A session must be documented in the original Research Report. Research completed after the original submission may not be presented in the presentation slides, included in the National Finals poster, or presented as part of the oral presentation. Corrections are permitted (e.g., fixing a typo from the report) as long as the correction does not reflect new data or findings.

IX. FAQs

For a full list of frequently asked questions, please visit the Competition website FAQ page at siemenscompetition.discoveryeducation.com/FAQs.

I still have questions. Whom do I contact?

Discovery Education– Siemens Competition

Email: siemenscompetition@discovery.com

Phone: 800-222-323-9084.

X. SIEMENS COMPETITION CHECKLIST

- Register Online**
REGISTER EARLY! You must complete the online registration early enough to obtain all required permissions. It is recommended that you should allow at least 4 weeks for all required permissions to be obtained.
- Write Abstract and Executive Summary**
- Mentor Form Complete and Submitted**
- Obtain necessary permissions (Parent and School Administrator)**
- Complete Human and Animal Protection Policy Questions**
Required for all projects, even if your project did not use animal and/or human subjects.
- Review Research Report for the following:**
 - No names of student(s), high school(s), mentor/advisor(s), affiliated research organization(s), acknowledgements(s), or terminology that depicts your gender (e.g. "he" or "she")
 - Review citations and references to ensure proper format for the discipline.
 - Spelling and grammatical errors. Project does not exceed 18-page maximum limit that includes the introduction, data, illustrations, text, and appendices.
 - Include the Abstract as part of your Research Report
- Summary of all Required Materials:**
 - Research Report including Abstract and References
 - Executive Summary
 - Mentor Form
 - Parent/Guardian Authorization
 - School Endorsement
 - Student Affirmation Statement read and Check Box
 - Human and Animal Protection Policy Questions (all projects) and supporting documentation (if applicable)
 - Laboratory Director/Research Group Director Information (if applicable)
- Submit your Research Project and all Required Materials by Tuesday, September 19, 2017.**

XI. SIEMENS COMPETITION: REGIONAL FINALIST CHECKLIST

Regional Finalists Will Be Announced Wednesday, October 18, 2017

- Submit digital poster and presentation by Monday, October 30, 2017**
Individuals and teams will be required to submit a copy of their presentation slides and their digital poster via a secure cloud-based technology.
- Complete Technological Rehearsal with Discovery Education Staff**
Discovery Education will assign individuals and teams a rehearsal time slot based on the date of their regional final.
- Participate in Virtual Regional Final**
Regional judges will watch the student's live oral presentations followed by a question-and-answer session with Individuals and teams.

XII. SIEMENS COMPETITION: NATIONAL FINALIST CHECKLIST

See Section II.B for National Finalist Announcement Dates

- Complete Travel Profile Form by November 24, 2017**
Provided by Discovery Education.
- Create poster for presentation at National Finals**
Finalists will be required to bring a printed poster with them to National Finals.
- Bring materials for presentation at National Finals**
Materials include: Printed Poster and presentation (hard copy and digital)