



GREAT NECK PUBLIC SCHOOLS

"Where Discovery Leads to Greatness"

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Phipps Administration Building
Office of Instruction
345 Lakeville Road
Great Neck, New York 11020

516.441.4009
516.441.4010
Fax 516.441.4992

Course Profile: Science Research 12/Senior Seminar

<u>Department</u>	Science		
<u>Course Name</u>	Science Research 12/Senior Seminar		
<u>Course Length</u>	1 year		
<u>High School Credits</u>	1 credit		
<u>Description</u>	This seminar will enable all research students to polish their papers, receive support in their editing efforts, and prepare all entry materials for a variety of competitions. Research students may select to do work in the biological sciences, social/behavioral sciences, computer science, mathematics, physics, engineering, or chemistry. They may elect to seek out a lab internship at a University, or to work from home/ the high school classroom, in order to gather data. There will be ongoing correspondence with their teacher in the form of comments on iterative work, as they complete all components required for competition. A course requirement for all high school seniors is the successful completion of an application to the Regeneron Science Talent Search. While winning or placing in any science competition will not impact a student's grades, successful submission of work, done with integrity will. In addition to application to science competitions, students may work on a literature review that is outside of the scope of their original project, as well as read nonfiction works that expand their knowledge of the scientific world. Students will be expected to create presentations, both digital and physical, as well as to prepare speeches for these presentations. Public speaking is a key component of this course. Finally, seniors may also be asked to support underclassmen in their research endeavors as a way to provide peer review and support to the younger students in the research program.		
<u>Target/eligible students</u>	Science research for 12th graders follows after the prerequisite courses, Science Research Methods/Research 9 and Science Research 10,11/RPS.		
<u>State Learning Standards Link(s)</u>	NYSED Science Learning Standards NYSED English Learning Standards		
<u>Primary texts and materials</u>	Students will have access to primary and secondary literature through PubMed Central and sciencedirect.com		
<u>Scope/Sequence</u>			
<u>Identifying and problem/ Developing a Research Question</u>	HS-LS2-7 WHST 7	Students will identify a problem that is of interest to them, drawing inspiration from Science Daily or Nature.com They will draft up a research proposal outlining their idea and presumable hypothesis. They will indicate their independent and dependent variables. ————— <i>"Design, evaluate, and refine a solution to a complex real- world problem, based on scientific knowledge, student- generated sources of evidence, prioritized criteria, and trade-off considerations."</i> pg. 67 <i>"Draw evidence from informational texts to support analysis, reflection, and research."</i> pg20	pg. 67

<u>Developing an Introduction</u>	HS-LS2-2 WHST 6	Students will first read and annotate several primary papers. They will then be taught to write an introduction structured from general to specific. This introduction will include a substantial literature review, in which students are responsible for identifying 3 key points, and supporting them with data from several studies. <i>"Most scientific knowledge is quite durable, but is, in principle, subject to change based on new evidence and/or reinterpretation of existing evidence." pg. 67</i> <i>"Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience as well as by applying discipline-specific criteria used in the social sciences or sciences; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation." pg20</i>	pg. 67
<u>Designing a Study</u>	HS-PS1-3	Students will design a novel* study, based on previous literature. The design of the study will include the development of an ISEF Research Plan. This research plan should include a rationale, some background information on their chosen topic, a statement of the research question/ research goals and an outline of the proposed methodology. They should read academic literature to inform their hypothesis/ expected outcomes. <i>"Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly" pg. 54</i>	pg. 54
<u>Confirming Viability and Safety of Proposed Methods</u>	N/a. Here approval from any IRB committee might be obtained	Students will design their study, focusing on developing methods that are cost effective, reasonable given the constraints of the lab (Biosafety Level 1 lab). They will read the MSDS sheets, fill out the risk and safety assessment for their Research plan, and update their methods to be more detailed, and based on peer-reviewed studies.	
<u>Conducting the Study and Gathering Data</u>	HS-LS2- 7, HS-LS2-8	Students will methodically collect data, ensuring to implement the proper controls, and to address any possible confounding variables. <i>"Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects." pg. 67</i>	pg. 67
<u>Data Analyses</u>	HS-PS3-6	Students will conduct statistical analyses in Microsoft Excel or IBM SPSS. They will then consider ways to visualize the data, including the appropriate types of graphs, which include error bars, and descriptive figure legends. <i>"Mathematical representations can be used to identify certain patterns." pg. 60</i>	pg. 60

<u>Results/Discussion</u>	AI-S.ID.1, HS-LS2-1, HS-PS1-9	Students will outline their findings, including any trends/ patterns, any significant differences between groups observed, anything consistent or inconsistent with pre-existing literature. Then students will come up with an explanation for what they observed. <i>“Represent data with plots on the real number line (dot plots, histograms, and box plots). (HS-LS2-6)” pg. 68</i> <i>“Use mathematical and/or computational representations of phenomena or design solutions to support explanations.” pg. 67</i> <i>“Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution.”</i>	pg. 67, 68, 54
<u>Conclusion</u>	HS-LS2-6	Students will make claims about their findings, and outline future directions for their study. <i>“Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments.” pg. 67</i>	pg. 67
<u>Oral Presentation of Findings</u>	11-12.SL.5, HS-PS2-6	Students will design a tri-board poster to visually display their work. This should include an Introduction, Methods, Results, Discussion, Conclusion and Bibliography. Additionally, students will create PowerPoints and oral presentations, which will be filmed for competitions and/or presented live at events such as Research Roundtable. <i>“Make strategic use of digital media and/or visual displays in presentations to enhance understanding of findings, reasoning, and evidence, and to add elements of interest to engage the audience. (HS-LS1-5),(HS-LS1-7)” pg. 66</i> <i>“Communicate scientific and technical information (e.g. about the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).” pg. 54</i>	pg. 66, 54
<u>Written Presentation of Findings- Research Manuscript</u>	11-12.WHST.5	The research manuscript will be the culmination of the course. This is to be tailored to the field of science/ topic of interest and the customary primary paper format for papers within that field. It should be approximately 20 pages long and should be submitted to Turnitin.com to ensure academic integrity is upheld. <i>“Conduct short as well as more sustained research projects to answer a question (including a self-generated question), analyze a topic, or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (HS-LS2-7),(HS-LS4-6)” pg. 68</i>	pg. 68
<u>Evaluation of Scientific Literature</u>	RST 1 and 2 RST 4 - 9	For both the main research project and further research and reading of scientific articles, students will need to evaluate the work of other scientists, interpret their graphs, charts, and data sets, and evaluate the validity and impact of the work(s) read.	

		<i>"Cite specific evidence to support analysis of scientific and technical texts, charts, diagrams, etc. attending to the precise details of the source, and attending to important distinctions the author makes and to any gaps or inconsistencies in the account." pg. 14</i> <i>"Determine the key ideas or conclusions of a source; summarize complex concepts, processes, or information presented in a source by paraphrasing in precise and accurate terms." pg. 14</i> <i>"Determine the meaning of symbols, key terms, and other content-specific words and phrases as they are used in scientific or technical sources" pg. 14</i> <i>"Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas." pg. 14</i> <i>"Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved. Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible." pg. 14</i> <i>"Evaluate the data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information." pg. 14</i> <i>"Compare and contrast findings presented in a source to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts." pg. 14</i>	
<u>Additional Notes</u>	This course is intended to enable students to identify a problem that is of interest to them, and to design a novel solution to this problem. In order to do so, they will need to read academic (peer-review) literature to inform their rationale and the design of their study. They will then conduct the study, and be responsible for creating an intelligible poster presentation, PowerPoint presentation, and research manuscript. They will compete in Regeneron STS, the International Science and Engineering Fair, and Cleantech Manuscript Competition.		