MOORESTOWN TOWNSHIP PUBLIC SCHOOLS
MOORESTOWN, NEW JERSEY

Moorestown High School
Science Department

Course Design and Research
Grades – 11th & 12th

Date : February 14, 2020
Prepared by: ***Richard Wilczewski***
Supervisor: Gavin Quin

Contents

Back to Table of Contents

Board of Education

Dr. Sandra Alberti, President

Ms. Caryn Shaw, Vice President

Mr. Jack Fairchild

Ms. Alexandria Law

Ms. Katherine Mullin

Ms. Lauren Romano

Dr. Mark Snyder

Mr. Mark Villanueva

Mr. David Weinstein

Administration

Dr. Scott McCartney, *Superintendent of Schools*

Ms. Carole Butler, *Director of Curriculum & Instruction*

Dr. David Tate, *Director of Special Education*

Mr. Jeffrey Arey, *Director of Educational Technology*

Mr. James Heiser, *Business Administrator/Board Secretary*

Ms. Debora Belfield, *Director of Personnel*

Principals

Mr. Andrew Seibel, *Moorestown High School*

Mr. Matthew Keith, *William Allen Middle School*

Ms. Susan Powell, *Moorestown Upper Elementary School*

Ms. Michelle Rowe, *George C. Baker School*

Mr. Brian Carter, *Mary E. Roberts School*

Ms. Heather Hackl, *South Valley School*

Supervisors of Curriculum and Instruction

Ms. Jacqueline Brownell, *Language Arts & Media K-12*

Ms. Julie Colby, *Mathematics K- 12*

Mr. Shawn Counard, *Athletics, Physical Education/Health K-12*

Ms. Kat D'Ambra, *Guidance K-12*

Ms. Cynthia Moskalow, *Special Education 7 – Post Graduation*

Mr. Gavin Quinn, *Science K-12*

Ms. Roseth Rodriguez, *Social Studies & World Languages K – 12*

Ms. Patricia Rowe, *Arts, Technology, Business K-12*

Ms. Leslie Wyers, *Special Education Pre-K – 6*

Back to Table of Contents

Course Description and Fundamental Concepts

In this course, students will research and design a solution to a problem of personal interest and global importance. Research areas may be engineering / STEM based, but students may also explore topics, problems, and careers outside of traditional science and engineering fields, while applying techniques that enhance creativity and promote non-traditional "outside the box" solutions.

This course is a pathway to Engineering / STEM based careers as well as a means to explore non-STEM careers that encourage "non-science like" creativity unlike that seen in traditional science courses. Students in this course may be able to add to their college applications and resumes that they obtained college credit while conducting research through dual credit with RCBC. This course is open to students of all levels and abilities because the methods applied in the course are diverse and will accommodate students who have challenges and students who seek challenges. Grades are based upon hands-on activities, and projects. The course is designed for doers who make a difference. Students of all levels are able to explore the design space using the creative part of their brains. They experience the importance of developing critical thinking skills that can be applied to all areas of their lives.

Fundamental Concepts and Course Overview

This course will utilize many methodologies including but not limited to the Innovative Conceptual Engineering Design (ICED) methodology developed by NASA astronaut and Senior Advisor for Innovation, Dr. Charles Camarda. In this methodology students will focus on developing solutions to current real world and real time "Epic Challenges." Many of these challenges are identified by NASA experts and passed to the students as they arise in our nation's quest for space exploration. Many of these are current problems which as of yet have no tested solutions.Experts from NASA are looking towards students at all levels for innovative ideas and novel approaches to these challenges. Student solutions to these problems may be shared with NASA experts and others by posting videos of student presentations on the internet and by conducting live video conferences and possibly during in person presentations at locations such as but not limited to Kennedy Space Center, Cape Canaveral, Florida.

Students will be expected to become proficient in the ICED methodology as they tackle the challenges. Through collaboration, when available, with Penn State University and NASA and other involved institutions the students may be given access to the expertise of relevant subject matter experts from academia, industry and the government. The focus of the Epic Challenges will change as the program advances and may change suddenly without warning. The current challenge at the time of this writing is to capture, retrieve and utilize an asteroid and the colonization of the Planet Mars. The scope and purpose of this course runs independent of outside institutions such as but not limited to NASA, and is not dependent on the funding or the existence of these institutions.

The Units described below are an incomplete list of optional pedagogical paths that may be taken in order to prepare students to become proficient in the performance expectations as set forth in The New Jersey Student Learning Standards for Science. The changing landscape of science and science education requires that instructional methodologies be adaptable at the instructor's discretion.

Back to Table of Contents

New Jersey Student Learning Standards (NJSLS)

Subject/Content Standards
Include grade appropriate subject/content standards that will be addressed

Standard #	Standard Description
HS-ETS1-1.	*Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.*
HS-ETS1-2.	*Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.*
HS-ETS1-3.	*Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.*
HS-ETS1-4.	*Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.* *PNB copy top 4 above into each unit*
NJSLS	*Students will address specific disciplinary core ideas based on their topic of research. Student projects can cover content from Life Science, Physical Science, and Earth Space Science standards*

English Companion Standards
List grade-level appropriate companion standards for History, Social Studies, Science and Technical Subjects (CTE/Arts) 6-12. English Companion Standards are required in these subject/content areas.

Unit Addressed	Standard #	Standard Description
1,6,7	*RST.9-10.7*	*Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. (HS-PS1-1)*

Back to Table of Contents

1, 3	*RST.11-12.1*	*Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-PS1-3),(HS-PS1-5)*
7, 8, 9	*WHST.9-12.2*	*Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-PS1-2),(HS-PS1-5)*
7,8	*WHST.9-12.5*	*Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. (HS-PS1-2)*
1, 5,7	*WHST.9-12.7*	*Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (HSPS1-3),(HS-PS1-6)*
1,4	*WHST.11-12.8*	*Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. (HS-PS1-3)*
1,2	*WHST.9-12.9*	*Draw evidence from informational texts to support analysis, reflection, and research. (HS-PS1-3)*

21st-Century Skills and Technology Integration (Standard 8)
List appropriate units below for which strands (A through F) will be addressed

Standard 8.1 (K-12)		**Educational Technology:** *All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.*
Unit Addressed	**Strand Letter**	**Standard Description**
1-8	**Strand A**	**Technology Operations and Concepts:** *Students demonstrate a sound understanding of technology concepts, systems, and operations.*

Back to Table of Contents

7,8	**Strand B**	**Creativity and Innovation:** *Students demonstrate creative thinking, construct knowledge and develop innovative products and process using technology.*
1-9	**Strand C**	**Communication and Collaboration:** *Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others.*
8,9	**Strand D**	**Digital Citizenship:** *Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior.*
1-8	**Strand E**	**Research and Information Fluency:** *Students apply digital tools to gather, evaluate, and use information.*
4, 5	**Strand F**	**Critical thinking, problem-solving, and decision making:** *Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.*

Career Ready Practices (Standard 9)
List appropriate units below for which CRPs will be addressed

Unit Addressed	Standard #	Standard Description
1-8	**CRP1**	*Act as a responsible and contributing citizen and employee.*
1,4,6,7	**CRP2**	*Apply appropriate academic and technical skills.*
1-8	**CRP3**	*Attend to personal health and financial well-being.*
6,7,8	**CRP4**	*Communicate clearly and effectively and with reason.*
6,7,8	**CRP5**	*Consider the environmental, social and economic impacts of decisions.*
1-8	**CRP6**	*Demonstrate creativity and innovation.*
1,4,8	**CRP7**	*Employ valid and reliable research strategies.*
1	**CRP8**	*Utilize critical thinking to make sense of problems and persevere in solving them.*

Back to Table of Contents

1-9	**CRP9**	*Model integrity, ethical leadership, and effective management.*
1	**CRP10**	*Plan education and career paths aligned to personal goals.*
1-8	**CRP11**	*Use technology to enhance productivity.*
1,2,3,8	**CRP12**	*Work productively in teams while using cultural global competence*

Interdisciplinary Connections
List any other content standards addressed as well as appropriate units

Visual & Performing Arts Integration (Standard 1)
List appropriate units below for which standards (1.1 through 1.4) may be addressed

Unit Addressed	Standard #	Standard Description
5	**Standard 1.1**	**The Creative Process:** *All students will demonstrate an understanding of the elements and principles that govern the creation of works of art in dance, music, theatre, and/or visual art.*
5	**Standard 1.2**	**History of the Arts and Culture:** *All students will understand the role, development, and influence of the arts throughout history and across cultures.*
5	**Standard 1.3**	**Performing/Presenting/Producing:** *All students will synthesize those skills, media, methods, and technologies appropriate to creating, performing, and/or presenting works of art in dance, music, theatre, and/or visual art.*
5	**Standard 1.4**	**Aesthetic Responses & Critique Methodologies:** *All students will demonstrate and apply an understanding of arts philosophies, judgment, and analysis to works of art in dance, music, theatre, and/or visual art.*

Other Interdisciplinary Content Standards
List appropriate units below for any other content/standards that may be addressed

Unit Addressed	Content / Standard #	Standard Description
1,4,7,8	*MP.2*	*Reason abstractly and quantitatively. (HS-PS1-5),(HS-PS1-7)*
1,4,5,6,7,8	*MP.4*	*Model with mathematics. (HS-PS1-4),(HS-PS1-8)*

Back to Table of Contents

1,6,7,8	*HSN-Q.A.1*	*Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (HS-PS1-2),(HS-PS1-3),(HS-PS1-4),(HS-PS1-5),(HS-PS1-7),(HS-PS1-8)*
1,2,3,4,6,7,8	*HSN-Q.A.2*	*Define appropriate quantities for the purpose of descriptive modeling. (HS-PS1-4),(HS-PS1-7),(HS-PS1-8)*
1	*HSN-Q.A.3*	*Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-PS1-2),(HS-PS1-3),(HS-PS1-4),(HS-PS1-5),(HS-PS1-7),(HS-PS1-8)*

Back to Table of Contents

Pacing Guide (All Dates are approximate based on the school calendar)

Unit/ Topic	Month (w/Approx number of Teaching Days)
Unit 1: Introduction to the ICED Methodology Innovative Conceptual Engineering Design	**September (~19 days)**
Unit 2A: Introduction to Research Literature Review & Citations	
Unit 3A: Conqueror of the Hill Car Engineering: Phase 1	
Unit 2B: Continued Introduction to Research Literature Review & Citations	**October (~19 days)**
Unit 4: Introduction to Problem Solving Skills Creativity Enhancement, Concept Ideation and Rapid Development Strategy	
Unit 5: Current Epic Challenge Overview: Mars Habitat Research & Design	
Unit 2C: Continued Introduction to Research Literature Review & Citations	**November (~16 days)**
Unit 6: Actual Research, Experimentation and Presentation	**December (~15 days)**
	January (~18 days)
	February (~18 days)
	March (~15-20 days)
	April (~15-20 days)
Unit 3B: Conqueror of the Hill Car Engineering Phase 2	**May (~18 days)**

Back to Table of Contents

Unit 7: Alternate Epic Challenge: Land Landing of the Orion Capsule	**June** **(~15 days)**
Unit 8 (Optional Alternative Lesson): Asteroid Capture, Retrieval, and Utilization	
Unit 9 (Optional Alternative Lesson) Bridge Engineering	

Back to Table of Contents

Units

Contact the Content Supervisor for unit details.

Back to Table of Contents