BERKELEY HEIGHTS PUBLIC SCHOOLS
BERKELEY HEIGHTS, NEW JERSEY

COLUMBIA MIDDLE SCHOOL
SCIENCE DEPARTMENT

Mythbusters

Curriculum Guide

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Developed by:

This curriculum may be modified through varying techniques, strategies, and materials, as per an individual student's Individualized Educational Plan (IEP)

Approved by the Berkeley Heights Board of Education
at the regular meeting held on 4/29/2021.

VISION STATEMENT

The science curriculum aims to provide students with authentic and enriching experiences that enhance critical thinking and problem solving skills. Students gain a deeper understanding and appreciation of science and are exposed to real-world technologies. Students are challenged to analyze and evaluate data, construct new ideas, develop arguments and explanations, and apply concepts through engineering tasks.

To achieve this, the curriculum guides are based on the model science curriculum developed by New Jersey Department of Education and are aligned to the Next Generation Science Standards. The Next Generation Science Standards were created based on the work done by the National Research Council and summarized in their publication, *A Framework for K-12 Science Education (NRC, 2011).* The work shifts the focus of science education towards the development of overarching enduring concepts and emphasizes the process of science. The standards are no longer isolated components but rather a three dimensional approach to teaching that focuses equally on ***Disciplinary Core Ideas***, ***Science and Engineering Practices,*** and ***Crosscutting Concepts***.

Disciplinary Core Ideas have the power to focus K–12 science curriculum, instruction, and assessments on the most important aspects of science. These core ideas:

- Have broad importance across multiple sciences or engineering disciplines or be a key organizing concept of a single discipline;
- Provide a key tool for understanding or investigating more complex ideas and solving problems;
- Relate to the interests and life experiences of students or be connected to societal or personal concerns that require scientific or technological knowledge;
- Are teachable and learnable over multiple grades at increasing levels of depth and sophistication.

The ***Science and Engineering Practices*** describe behaviors that scientists engage in as they investigate and build models about the natural world. Additionally, they emphasize the key set of engineering practices that engineers use as they design and build models and systems. Scientific investigation requires not only skill but also knowledge that is specific to each practice.

Crosscutting Concepts have application across all domains of science. As such, they are a way of linking the different domains of science. They include patterns; cause and effect; scale, proportion, and quantity; systems and system models; energy and matter; structure and function; and stability and change. These concepts need to be made explicit for students because they provide an organizational schema for interrelating knowledge from various science fields into a coherent and scientifically based view of the world (NSTA, 2014).

Throughout the curriculum, engineering tasks have been embedded, which engage students in the design cycle, encourage the development of 21st century skills, and incorporate college and career ready practices.

MISSION STATEMENT

Mythbusters is a one quarter cycle class designed for 7th and 8th-grade students at Columbia Middle school that addresses 21st-century skills, career-ready practices, and technology standards. Students utilize problem-solving skills and design thinking. They are given the opportunity to utilize these skills as they examine different questions ("myths") and find ways of testing and analyzing their validity.

Throughout the course, students will be engaged in an authentic problem-based learning environment working as a team. Students will learn to utilize feedback from peers to revise their experimental designs. Throughout the course, students gain a deeper understanding of experimental design and the skills needed to analyze data. Additionally, this course lays the foundational knowledge needed to solve real-world problems across different areas of study and outside the classroom. The course also provides a cross-curricular opportunity for collaboration with the growing middle school TV program.

This elective class was designed as part of the revision project to update the Columbia Middle School Elective Classes. The project is structured to replace the existing cycle offerings with new courses better aligned to the new NJSLS and support the District Strategic Plan related to STEM development for students.

To foster student creativity and application of Science, Technology, Engineering, and Mathematics, through the middle school elective classes by exposing students to real-world problems where they can utilize the iterative design process while satisfying the NJSLS standards required for middle school in Visual and Performing Arts, Design and Technology, and Career and Job Skills. This course will also allow students to deepen their knowledge of experimental design and critical thinking/analysis skills.

COURSE PROFICIENCIES

COURSE OBJECTIVES

The middle school science electives consist of units aligned with the Next Generation Science Standards. Each unit is structured to emphasize a three dimensional learning environment and therefore incorporates science and engineering processes, disciplinary core ideas, and crosscutting concepts. The standards, which encompases these three components, that are addressed throughout these units are presented below and are sorted based on domain.

PS: Physical Science

PS1: Matter and Its Interactions

- MS-PS1-5
- MS-PS1-6

PS2: Motion and Stability: Forces and Interactions

- MS-PS2-1
- MS-PS2-2
- MS-PS2-3
- MS-PS2-4
- MS-PS2-5

PS3: Energy

- MS-PS3-1
- MS-PS3-2
- MS-PS3-3

PS4: Waves and Their Applications in Technologies for Information Transfer

- MS-PS4-1
- MS-PS4-2
- MS-PS4-3

ESS: Earth and Space Science

ESS1: Earth's Place in the Universe

- MS-ESS1-1
- MS-ESS1-2
- MS-ESS1-3

ETS: Engineering, Technology and the Application of Science

ETS1: Engineering Design

- MS-ETS1-1
- MS-ETS1-2
- MS-ETS1-3
- MS-ETS1-4

STUDENT PROFICIENCIES

The student proficiencies represent the broad skills that students will gain by completing the course. These skills spiral throughout the K-12 science progression and are leveled appropriately according to grade level and science domain.

Science and Engineer Practice

- Asking Questions and Defining Problems - A practice of science is to ask and refine questions that lead to descriptions and explanations of how the natural and designed world works and which can be empirically tested.
- Developing and Using Models - A practice of both science and engineering is to use and construct models as helpful tools for representing ideas and explanations. These tools include diagrams, drawings, physical replicas, mathematical representations, analogies, and computer simulations.
- Planning and Carrying Out Investigations - Scientists and engineers plan and carry out investigations in the field or laboratory, working collaboratively as well as individually. Their investigations are systematic and require clarifying what counts as data and identifying variables or parameters.
- Analyzing and Interpreting Data - Scientific investigations produce data that must be analyzed in order to derive meaning. Because data patterns and trends are not always obvious, scientists use a range of tools—including tabulation, graphical interpretation, visualization, and statistical analysis—to identify the significant features and patterns in the data. Scientists identify sources of error in the investigations and calculate the degree of certainty in the results. Modern technology makes the collection of large data sets much easier, providing secondary sources for analysis.
- Using Mathematics and Computational Thinking - In both science and engineering, mathematics and computation are fundamental tools for representing physical variables and their relationships. They are used for a range of tasks such as constructing simulations; statistically analyzing data; and recognizing, expressing, and applying quantitative relationships.
- Constructing Explanations and Designing Solutions - The products of science are explanations and the products of engineering are solutions.
- Engaging in Argument from Evidence -Argumentation is the process by which explanations and solutions are reached.
- Obtaining, Evaluating, and Communicating Information -Scientists and engineers must be able to communicate clearly and persuasively the ideas and methods they generate. Critiquing and communicating ideas individually and in groups is a critical professional activity.

Crosscutting Concepts

- Patterns - Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them.

- Cause and Effect - Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering.
- Scale, Proportion, and Quantity - In considering phenomena, it is critical to recognize what is relevant at different size, time, and energy scales, and to recognize proportional relationships between different quantities as scales change.
- Systems and System Models - A system is an organized group of related objects or components; models can be used for understanding and predicting the behavior of systems.
- Energy and Matter - Tracking energy and matter flows, into, out of, and within systems helps one understand their system's behavior.
- Structure and Function - The way an object is shaped or structured determines many of its properties and functions.
- Stability and Change - For both designed and natural systems, conditions that affect stability and factors that control rates of change are critical elements to consider and understand.

Nature of Science

- Scientific Investigations Use a Variety of Methods
- Science Knowledge Is Based on Empirical Evidence
- Scientific Knowledge Is Open to Revision in Light of New Evidence
- Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena
- Science Is a Way of Knowing
- Scientific Knowledge Assumes an Order and Consistency in Natural Systems
- Science Is a Human Endeavor
- Science Addresses Questions About the Natural and Material World

College and Career Ready Practices

- Apply appropriate academic and technical skills.
- Communicate clearly and effectively and with reason.
- Consider the environmental, social and economic impacts of decisions.
- Demonstrate creativity and innovation.
- Employ valid and reliable research strategies.
- Utilize critical thinking to make sense of problems and persevere in solving them.
- Model integrity, ethical leadership and effective management.
- Use technology to enhance productivity.
- Work productively in teams while using cultural global competence.

METHODS OF EVALUATION

1. Homework and classwork
2. Class participation
3. Tests and quizzes
4. Unit Benchmark Assessments
5. Performance Tasks
6. Lab Reports
7. Cooperative learning assignments
8. Final exam, projects and/or reports

MODIFICATIONS & ACCOMMODATIONS

Modifications and Accommodations for Special Education students, students with 504s, English Language Learners and Gifted and Talented students may include but are not limited to the following:

Special Education

- Individualized Education Plans (IEPs)
- Exemplars of varied performance levels
- Multimedia presentations
- Sheltered instruction
- Consultation with ESL teachers
- Manipulatives
- Tiered/Scaffolded Lessons
- Mnemonic devices
- Visual aids
- Modeling
- Guided note-taking
- Study Guides
- Modified homework
- Differentiated pre-typed class notes and example problems
- Use of the special education teacher to re-instruct in flexible small groups for the struggling learner
- Manipulatives
- Flipped Instruction
- Word banks
- Reduced choice on assessments
- Preferential seating
- Choice activities
- Modified time requirements
- Modified notes
- Modified lesson, assessment and study guide format
- Provide an enriched curriculum and activities
- Independent projects
- Contracts/behavior support plans
- Open-ended responses
- Project-based learning
- Group activities
- Guided Notes
- Functional learning incorporated into each lesson
- Exploration Activities
- Assessment read aloud
- Small group assessments
- Organizational Support

- Oral questioning assessments to supplement written response
- Pre-writing Structural Supports for extended writing tasks
- Ongoing teacher feedback as part of the writing process
- Interactive Study Guides
- Multi-sensory approach to instruction
- Written and spoken step-by-step directions
- Content-focused assessment (not grading for spelling/grammar)
- Graphic organizers
- Non-verbal cues to begin task/remain on task/refocus
- Individual monitoring for understanding/reinforced instruction
- Printed copies of class readings for application of Active Reading Strategies

Gifted & Talented

- Provide one-to-one teacher support
- Curriculum Compacting
- Advanced problems to extend the critical thinking skills of the advanced learner
- Supplemental reading material for independent study
- Elevated questioning techniques using Webb's Depth of Knowledge matrix
- Curriculum Compacting
- Flexible grouping
- Tiered assignments
- Topic selection by interest
- Manipulatives
- Tiered Lessons
- Flipped Instruction
- Multimedia Presentations
- Open-ended responses
- Project-based learning
- Group activities
- Guided Notes
- Conclusions and analysis of exploratory activities
- Career based learning incorporated into each lesson
- Exploration Activities
- Student choice

ELLs

- Exemplars of varied performance levels
- Multimedia presentations
- Sheltered instruction
- Consultation with ESL teachers
- Manipulatives
- Tiered/Scaffolded Lessons
- Mnemonic devices
- Visual aids
- Modeling

- Guided note-taking
- Study Guides
- Modified homework
- Differentiated pre-typed class notes and example problems
- Individualized instruction plans
- Manipulatives
- Flipped Instruction
- Words banks
- Reduced choice on assessments
- Preferential seating
- Choice activities
- Modified time requirements
- Modified notes
- Modify lesson, assessment and study guide format
- Provide an enriched curriculum and activities
- Contracts/management plans
- Open-ended responses
- Project-based learning
- Group activities
- Guided Notes
- Exploration Activities
- Assessment read aloud
- Small group assessments
- Oral questioning assessments to supplement written response
- Pre-writing Structural Supports for extended writing tasks
- Ongoing teacher feedback as part of the writing process
- Interactive Study Guides
- Multi-sensory approach to instruction
- Written and spoken step-by-step directions
- Graphic organizers
- Non-verbal cues to begin task/remain on task/refocus
- Individual monitoring for understanding/reinforced instruction
- Printed copies of class readings for application of Active Reading Strategies

504s

- Exemplars of varied performance levels
- Multimedia presentations
- Sheltered instruction
- Tiered/Scaffolded Lessons
- Mnemonic devices
- Visual aids
- Modeling
- Guided note-taking
- Study Guides
- Differentiated pre-typed class notes and example problems

- Manipulatives
- Words banks
- Reduced choice on assessments
- Preferential seating
- Modified time requirements
- Modified notes
- Modify lesson, assessment and study guide format
- Modified homework
- Independent projects
- Contracts/management plans
- Open-ended responses
- Project-based learning
- Group activities
- Guided Notes
- Exploration Activities
- Assessment read aloud
- Small group assessments
- Organizational Support
- Oral questioning assessments to supplement written response
- Pre-writing Structural Supports for extended writing tasks
- Ongoing teacher feedback as part of the writing process
- Interactive Study Guides
- Multi-sensory approach to instruction
- Written and spoken step-by-step directions
- Content-focused assessment (not grading for spelling/grammar)
- Graphic organizers
- Non-verbal cues to begin task/remain on task/refocus
- Individual monitoring for understanding/reinforced instruction
- Printed copies of class readings for application of Active Reading Strategies

Students at Risk of Failure

- Exemplars of varied performance levels
- Multimedia presentations
- Tiered/Scaffolded Lessons
- Modeling
- Guided note-taking
- Study Guides
- Differentiated pre-typed class notes and example problems
- Individualized instruction plans
- Words banks
- Reduced choice on assessments
- Preferential seating
- Choice activities
- Modified time requirements
- Modified notes

- Modified lesson, assessment and study guide format
- Modified homework
- Provide an enriched curriculum and activities
- Contracts/management plans
- Open-ended responses
- Project-based learning
- Group activities
- Guided Notes
- Exploration Activities
- Assessment read aloud
- Small group assessments
- Oral questioning assessments to supplement written response
- Pre-writing Structural Supports for extended writing tasks
- Ongoing teacher feedback as part of the writing process
- Interactive Study Guides
- Multi-sensory approach to instruction
- Written and spoken step-by-step directions
- Graphic organizers
- Non-verbal cues to begin task/remain on task/refocus
- Individual monitoring for understanding/reinforced instruction
- Printed copies of class readings for application of Active Reading Strategies

SCOPE AND SEQUENCE
COURSE OUTLINE/STUDENT OBJECTIVE

Unit 1: What is a fair test? How are fair tests designed? How are results of a fair test analyzed?

Duration: 10 days

Overview: Students analyze video clips from *Mythbusters* TV series to identify key elements of fair scientific tests. Students discuss the characteristics of a testable question. Students identify the need for clearly defined independent and dependent variables, constants, and a control for comparison when possible. Students will engage as a whole class in the design and implementation of small scale experiments to answer testable questions. Students will evaluate evidence to support or disprove a claim.

Standards: AID6-8; PaCI6-8; AQDP6-8

Technology: 8.1.8.A.1; 8.1.8.A.3; 8.1.8.A.4; 8.2.8.A.3; 8.2.8.A.2; 8.2.8.C.4; 8.2.8.C.5

21st Century: CRP2; CRP4; CRP8; 9.3.ST.2; 9.3.ST-ET.2; 9.3.ST-ET.3; 9.3.ST-SM.1; 9.3.ST-SM.2

Cross Curricular: RST.6-8.1; RST.6-8.3; RST.6-8.7; RST.6-8.9; SL.8.5; 8.EE.A.3, MP.2, MP.4

Essential Questions:

- What is a fair test?
- How are fair tests designed?
- How are results of a fair test analyzed?

Student Learning Objectives:

Students will know and be able to

- Distinguish between a fair and a biased test
- Engage in a scientific argument about the validity of a test.
- Write a testable question for which an experiment can be designed to gather evidence.
- Distinguish between independent and dependent variables
- Identify a single independent and dependent variable in a fair test
- Identify constants in a fair test
- Justify the need for all variables besides independent variable to remain constant in a fair test
- Identify a control in a fair test.
- Use the results of a control to determine if the independent variable has an impact on the dependent variable
- Use evidence to give make a claim that answers a testable question
- Evaluate the value of evidence towards providing an answer to the testable question.
- Use modeling to gather data and develop a claim based up on evidence and reasoning

Possible Activities:

- Watch clips from Mythbusters in order to identify certain aspects of designing a fair test
- Write testable questions based on topics that are presented in Mythbusters clips
- Identify independent and dependent variables, constants and controls from tests done on Mythbusters
- Design and implement an experiment to answer the question, "Is it possible to fold a piece of paper in half seven times?" Use evidence to support a claim.
- Design and implement an experiment to answer the question, "Is it possible for balloons to lift up a house (like in the movie *Up*)?" Use evidence to support a claim.
- Design and implement an experiment to answer the question, "Is reading emotion through people's eyes possible?" Use evidence to support a claim.
- Evaluate/rank evidence in terms of value when supporting a claim.
- Engage in a scientific argument about the validity of a claim using evidence.
- Introduce final project. Students develop teams and do research on a myth they'd like to test.
- Student teams choose two possible myths to test. Write a proposal for each myth identifying the testable question, a brief synopsis of the experiment that will be used to test the myth, and what evidence will be collected and analyzed.

<u>Unit 2</u>: MythBusting as a class: How can we design a fair test? How can we collect data from a test? How do we analyze the results? How can we share our findings?

Duration: 10 days

Overview: Students engage in the experimental design process in small groups to test teacher provided myths related to a central theme. Students engage in the process of designing and implementing an experiment as a group by gathering background information, writing a testable question, determining how to use teacher provided materials to design a test, executing a test and analyzing results. Students share their findings to the class via an oral presentation.

Standards: PACI6-8; CEDS6-8; OECI6-8

Technology: 8.1.8.A.1; 8.1.8.A.3; 8.1.8.A.4; 8.2.8.A.3; 8.2.8.A.2; 8.2.8.C.4; 8.2.8.C.5

21st Century: CRP2; CRP4; CRP8; 9.3.ST.2; 9.3.ST-ET.2; 9.3.ST-ET.3; 9.3.ST-SM.1; 9.3.ST-SM.2

Cross Curricular: RST.6-8.1; RST.6-8.3; RST.6-8.7; RST.6-8.9; SL.8.5; 8.EE.A.3, MP.2, MP.4

Essential Questions:

- What elements must exist in a testable question?
- How can a testable question be used to design an experiment?
- How can the results of an experiment be used to answer a testable question?
- What information is necessary to include when sharing results of an experiment?

Student Learning Objectives:

Students will know and be able to

- Gather background information through videos/written sources to gain essential prior knowledge about a research topic.
- Write a testable question from a scientific myth.
- Collaborate with peers to design a fair test to determine an answer to a testable question.
- Engage in scientific testing to isolate one independent variable and control other variables. In order to gather evidence.
- Engage in the engineering process to develop a device that will be used to collect data.
- Develop a model, where applicable, to collect data and predict future events.
- Collect and organize qualitative and quantitative data.
- Evaluate the value of qualitative and quantitative data to answer a testable question.
- Write a claim based on evidence that answers the testable question.
- Present and explain outcomes of their scientific experiment to peers via an oral presentation.

Possible Activities:

- Student groups will:
    - Watch a video clip/read an article to get background information
    - Write a testable question
    - Use teacher supplied materials to design a test
    - Run a scientific test
    - Collect qualitative and/or quantitative data
    - Analyze and create graphic/visual displays for result
    - Share findings with peers

Teacher will choose a general topic for the myths and provide student groups with myths that fall under that topic.
Possible topics/myths to include:

"Natural Phenomena"
1. Will a tongue stick to a freezing pole?
2. Does a clothed snowman melt slower than a naked one?
3. Does a person stay dryer in the rain by running than walking?
4. Do metal body piercings attract lightning?

"Food"
1. Is the 5 second rule real?
2. Can you use Coca-Cola to clean a toilet?
3. Is double dipping really so bad?
4. Is toast more likely to land butter side down?

"Human Behavior"
1. Is yawning contagious?
2. Can color impact mood?
3. Is the stroop effect real?
4. Can smelling one thing while tasting another impact a person's ability to detect what the food really is?

"Movie/TV Myths"
1. A car in free fall will not stay upright?
2. Can quicksand really suck a person down into it?
3. Can you really make a submarine by walking with a rowboat upside down over your head?
4. Can an awning really break a person's fall from a tall building?

<u>Unit 3</u>: Investigation of Chosen Myth

Duration: 10 days

Overview: Students engage in the experimental design process to test chosen myth from Unit 1. Students use their proposal as a starting point to gather materials, design a test, execute, test and analyze results. Student groups choose from options (i.e. video, podcast, lab report, poster) to share findings with the class.

Standards: EAE6-8; OECI6-8; PACI6-8; AID6-8

Technology: 8.1.8.A.1; 8.1.8.A.3; 8.1.8.A.4; 8.2.8.A.3; 8.2.8.A.2; 8.2.8.C.4; 8.2.8.C.5

21st Century: CRP2; CRP4; CRP8; 9.3.ST.2; 9.3.ST-ET.2; 9.3.ST-ET.3; 9.3.ST-SM.1; 9.3.ST-SM.2

Cross Curricular: RST.6-8.1; RST.6-8.3; RST.6-8.7; RST.6-8.9; SL.8.5; 8.EE.A.3, MP.2, MP.4

Essential Questions:

- What materials can be used to execute an investigation to answer a testable question?
- How can an experiment be designed to investigate an answer to a testable question?
- How can the results of a test be shared in a way that is accessible to peers?

Student Learning Objectives:

Students will know and be able to

- Choose and gather materials to implement a fair test to determine an answer to a testable question.
- Collaborate with peers to design a fair test to determine an answer to a testable question.
- Engage in scientific testing to isolate one independent variable and control other variables. In order to gather evidence.
- Use the engineering, where applicable, practices to develop a device to be used for data collection.
- Develop a model, where applicable, to collect data and predict future events.
- Collect and organize qualitative and quantitative data.
- Evaluate the value of qualitative and quantitative data to answer a testable question.
- Write a claim based on evidence and reasoning that answers the testable question.
- Design a presentation to share outcomes of their scientific experiment to peers via a video, podcast, written lab report, or poster presentation.

Possible Activities:

- Student groups will:
    - Use an initial proposal to revise and refine an experiment designed to answer the testable question.
    - Determine and gather materials to run the test

- Run a scientific test
- Collect qualitative and/or quantitative data
- Analyze and create graphic/visual displays for result
- Design presentation to share findings with peers

SUGGESTED MATERIALS AND RESOURCES

http://www.dcidaho.org/wp-content/uploads/2017/10/Myth-Busters-Education-Packet.pdf

https://mythresults.com/

https://go.discovery.com/tv-shows/mythbusters/

https://thebestschools.org/magazine/25-popular-science-myths-debunked/

https://www.nature.com/news/the-science-myths-that-will-not-die-1.19022

https://www.wired.com/video/series/mythbusting