BERKELEY HEIGHTS PUBLIC SCHOOLS
BERKELEY HEIGHTS, NEW JERSEY

COLUMBIA MIDDLE SCHOOL
TECHNOLOGY EDUCATION

iStem

Curriculum Guide

Date: September 2017
Updated: August 2022

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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 August 11, 2022 .

VISION STATEMENT

STEM is the integrated approach to education in the areas of Science, Technology, Engineering, and Mathematics. Instruction is student centered and driven by an iterative design process, exploratory learning, problem-solving, and engagement in authentic contexts.

Through the process of engaging in authentic, hands-on, open-ended design challenges, students will become familiar with the steps and processes associated with successful problem solving in the context of the engineering design process. Students will gain proficiency in the application of relevant Math, Science, and Technology concepts while expanding their comprehension and understanding of the human-designed world, the nature of technology and engineered systems, and the skills, knowledge, and attitudes necessary to become well-rounded and successful twenty-first century problem solvers and innovators.

MISSION STATEMENT

iStem is a one quarter cycle class designed for 6th grade students at Columbia Middle school that addresses 21st century skills and career ready practices. Students are introduced to the engineering design process and given the opportunity to utilize this process. Throughout the course, students will be engaged in an authentic problem-based learning environment working as a team and serving in different engineering roles. Students will learn to utilize feedback from this process to revise their designs and develop better solutions. This course lays the foundational knowledge needed to solve real world problems across different areas of study and outside the classroom.

COURSE PROFICIENCIES

COURSE OBJECTIVES

The engineering design process is a loop because although the steps are listed in sequential order, you will likely return to previous steps multiple times throughout a project. It is often necessary to revisit stages or steps in order to improve that aspect of a project.

In the engineering design process, engineers…

- Ask (What are we trying to solve?, What are the constraints?, What are the requirements?, What questions do you have about the challenge?)
- Imagine (What are the possible solutions?, Brainstorm ideas, list materials needed, explain the ideas, create a sketch for you ideas)
- Plan (Choose a final solution, sketch a final solution, decide the steps you will take to create your solution, create a technical drawing to explain your design)
- Create (follow your plan and create your design, what changes did you make while creating your design? Why?, Self reflection)
- Improve (What worked well? What could have gone better? What improvements could you make to allow your design to be more successful? Why is the redesign better than the original design?)

STUDENT PROFICIENCIES

Students will understand:

- How to engage in questioning techniques
- The importance of labeled sketches in engineering design
- How to employ various brainstorming techniques
- When to use orthographic drawings (multi-view drawings)
- Various ways to engage in prototyping

METHODS OF EVALUATION

1. Teacher observation/questioning/monitoring
2. Engineering Notebooks/Journals
3. Team evaluation rubrics
4. Self and peer evaluation
5. Performance tasks/assessments
6. Reports and presentations
7. Student created designs and models

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
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- Individual monitoring for understanding/reinforced instruction
- Printed copies of class readings for application of Active Reading Strategies

Diversity, Equity, and Inclusion Curriculum Statement

Berkeley Heights public schools are committed to recognizing diversity and promoting equity, tolerance, and inclusion in our classrooms. We encourage a safe, welcoming, and inclusive environment for all students regardless of race or ethnicity, sexual and gender identities, mental and physical disabilities, and religious beliefs. Our curriculum infuses teaching of these principles and addresses all associated standards and laws. This includes, but is not limited to:

C.18A:35-4.35 - History of disabled and LGBT persons

> *A board of education shall include instruction on the political, economic, and social contributions of persons with disabilities and lesbian, gay, bisexual, and transgender people, in an appropriate place in the curriculum of middle school and high school students as part of the district's implementation of the New Jersey Student Learning Standards.*

18A:35-28. Instruction on Holocaust, genocides required in elementary, secondary school curriculum

> *a. Every board of education shall include instruction on the Holocaust and genocides in an appropriate place in the curriculum of all elementary and secondary school pupils.*
>
> *b. The instruction shall enable pupils to identify and analyze applicable theories concerning human nature and behavior; to understand that genocide is a consequence of prejudice and discrimination; and to understand that issues of moral dilemma and conscience have a profound impact on life. The instruction shall further emphasize the personal responsibility that each citizen bears to fight racism and hatred whenever and wherever it happens.*

Section: 52:16A-88: Responsibilities, duties of Amistad Commission

> *g. to develop, in consultation with the Department of Education, curriculum guidelines for the teaching of information on the African slave trade, slavery in America, the vestiges of slavery in this country, and the contributions of African-Americans to our country. Every board of education shall incorporate the information in an appropriate place in the curriculum of elementary and secondary school students;*

Examples of how these concepts and principles are infused into this curriculum include:

- Students research famous and past African American Inventors as well as from the country of their origin for a Technological invention that significantly impacted society and the world.
- Students Create a Google Slides presentation on the Inventor of their choice and provide the teacher and classmates with information about; who the inventor was, what was his country of origin and their background, what did they invent and how did it make a positive technological contribution to society.

Additionally, components of this are tagged throughout the curriculum as appropriate (i.e. standards, objectives, activities). Tagging convention is outlined below:

- DEI - Diversity, Equity and Inclusion Learning

- AM - Learning associated with Amistad
- HG - Learning associated with Holocaust and Genocide
- SEL - Social-Emotional Learning
- L+ - Learning associated with LGBTQ+ and Neurodiverse communities

Climate Change Curriculum Statement

With the adoption of the 2020 New Jersey Student Learning Standards (NJSLS), New Jersey became the first state in the nation to include climate change across content areas. These standards are designed to prepare students to understand how and why climate change happens, the impact it has on our local and global communities and to act in informed and sustainable ways.

Districts are encouraged to utilize the NJSLS to develop interdisciplinary units focused on climate change that include authentic learning experiences, integrate a range of perspectives and are action oriented. While the 2016 NJSLS-English Language Arts (ELA) and Mathematics do not have specific climate change standards, districts may want to consider how they can design interdisciplinary climate change units that incorporate relevant ELA and mathematics standards. Likewise, it may be helpful to review the 2020 NJSLS documents to identify other relevant standards that might be incorporated as well as to understand the role of core ideas, performance expectations and practices in curriculum development and lesson planning.

Standards and/or activities addressed in this curriculum includes:

- 8.2.8.ITH.3: Evaluate the impact of sustainability on the development of a designed product or system.
- 8.2.8.ITH.4: Identify technologies that have been designed to reduce the negative consequences of other technologies and explain the change in impact.

Components of this are tagged throughout the curriculum as appropriate: CC - Climate Change.

Career Readiness, Life Literacies, and Key Skills Practices

Career Readiness, Life Literacies, and Key Skills Practices describe the habits of the mind that all educators in all content areas should seek to develop in their students. They are practices that have been linked to increased college, career, and life success. These practices should be taught and reinforced in all content areas with increasingly higher levels of complexity and expectation as a student advances through a program of study.

2020 NJSLS - Career Readiness, Life Literacies, and Key Skills Practices	
CLKS-P1	Act as a responsible and contributing community member and employee.
CLKS-P2	Attend to financial well-being.
CLKS-P3	Consider the environmental, social and economic impacts of decisions
CLKS-P4	Demonstrate creativity and innovation.
CLKS-P5	Utilize critical thinking to make sense of problems and persevere in solving them.
CLKS-P6	Model integrity, ethical leadership and effective management.
CLKS-P7	Plan education and career paths aligned to personal goals.
CLKS-P8	Use technology to enhance productivity, increase collaboration and communicate effectively.
CLKS-P9	Work productively in teams while using cultural/global competence.

Pacing Guide

Unit Number	Unit Title	Suggested Pacing
1	Introduction to iSTEM	5 days
2	Introduction to Skills for Engineering Design	15 days
3	Engineering Design Application	15 days

SCOPE AND SEQUENCE
COURSE OUTLINE/STUDENT OBJECTIVE

Unit 1: Introduction to iSTEM

Duration: 5 days

Overview: Students will examine the engineering design process and begin to investigate how this can be used to solve problems.

Technology: 8.2.8.ED.1-3, 8.2.8.ITH.3-5

21st Century: CLKS-P1-6, CLKS-P8,9

Cross-Curricular Connections: RST.6-8.3; RST.6-8.4; RST.6-8.7; MP1,2,3,4,5

Essential Questions:
- How can the engineering design process be used to approach making changes to the designed world?
- Why is the engineering design process a loop and not linear?

Students Learning Objectives:
Students will know…
The steps of the engineering design process
● *Science principles drive the creation and evolution of technology*

Students will be able to…
- Students will be able to understand the differences and interconnectedness between science and technology
  Students will begin to examine the engineering design process through discussions and real-life examples.
- Students will apply the design process to understand product evolution.
- Students will implement the information about the evolution of technology so far, to predict how the future might look.

Possible Activities:
Identify and explain the steps of the engineering design process.
- Compare and contrast Science and Technology

What is technology? - Class Discussion
- Science vs. Technology - Identify the science behind different technologies
- Understanding the steps of the Engineering Design Process and how it works as a loop through analyzing real world problems
- Compare present-day technology to the technology of the past to determine how the engineering design process affects the evolution of technology.

Unit 2: Introduction to Skills for Engineering Design

Duration: 15 days

Overview: Students will learn skills and tools that can be used to better communicate ideas and solutions to engineering design challenges such as developing orthographic drawings and 3D models which can be used to clearly communicate design intent.

Technology: 8.2.8.ED.1-7;

21st Century: CLKS-P1-6, CLKS-P8,9

Cross-Curricular Connections: RST.6-8.3; RST.6-8.4; RST.6-8.7; MP1,2,3,4,5

Essential Questions:
- How can engineers communicate their ideas?
- How are skills utilized to meet the goals of the design process?

Students Learning Objectives:
Students will know...
- How to research information that will guide their development of ideas.
  How to use brainstorming techniques to think outside of the box.
- How to apply the skill of technical drawing to interpret 3D blocks from the front, side, and top.

Students will be able to…
- Think outside the box while brainstorming
- Apply their knowledge of the Engineering Design Process to complete a design challenge.
- Represent their ideas using technical drawing skills.
- Follow safety rules while working with tools.
- Understand how an object is displayed and represented in an orthographic drawing.

Possible Activities:
- Practice and utilize a variety of different types of strategies and approaches for sketching and drawing.
- Engage in brainstorming activities to generate multiple solutions to problems.
- Communicate multiple design solutions for a unit-specific design challenge.
- Demonstrate proper safety procedures when using tools to assist in design.
- Students will use the steps of the Engineering Design Process to complete design challenges (examples of design challenges are helicopters, water lenses, hoverboards, etc.).
- Students will demonstrate how to use science (apply scientific principles) to design technology (engage in engineering).

Unit 3: Engineering Design Application

Duration: 15 days

Overview: Students will leverage research and data collection to support and modify their design. Based on scientific concepts and validated research students will be able to support their design decisions and create modifications to the design model before construction of a prototype.

Technology: 8.2.8.ED.1-7, 8.2.8.EC.1, 8.2.8.ITH.3-5

21st Century: CLKS-P1-6, CLKS-P8,9

Cross-Curricular Connections: RST.6-8.3; RST.6-8.4; RST.6-8.7; MP1,2,3,4,5

Essential Questions:

- How can the Engineering Design Process be used to approach solving real world problems?

Students Learning Objectives:

Students will know...

- How to research information that will guide their development of ideas.
- How to use brainstorming techniques to think outside of the box.
- How to apply the skill of technical drawing to interpret 3D objects from the front, side, and top.

Students will be able to…

- Students will apply their knowledge of the Engineering Design Process by completing design challenges.

Possible Activities:

- Identify the science necessary to develop a solution to a problem.
- Engage in brainstorming activities to generate multiple solutions to problems.
- Identify the most appropriate way to communicate your most innovative idea.
- Reflect on the final product to improve a design.
- Demonstrate proper safety procedures when using tools to assist in design.
- Students will use the steps of the Engineering Design Process to complete design challenges (examples of design challenges are bridge design, aid drops, etc.)
- Students will demonstrate how to use science (apply scientific principles) to design technology (engage in engineering).

SUGGESTED AUDIO VISUAL/COMPUTER AIDS

1. Graphing Calculator
2. iPad apps and peripherals
3. Discovery Channel's *Mythbusters*
4. http://video.mit.edu/
5. 3D Printer
6. Computer Interface probes
7. Force, Pressure and temperature sensors

SUGGESTED MATERIALS

Resources for Students

- Lego kits
- Glue Guns, Glue
- Balsa wood
- Paper
- 3D Printed Parts
- Tape/Duck Tape
- Balloons
- Straws
- Paper Clips
- Wood skewers
- CD's
- Rubber Bands
- String, Thread
- Screws
- Sketch design tools on iPad
- OneNote

Resources for Teacher

https://insidetheclassroomoutsidethebox.wordpress.com/2014/07/13/design-thinking-and-challenges/

https://dschool-old.stanford.edu/groups/k12/wiki/956b6/Design_Thinking_Projects_and_Challenges.html

https://designthinkingforeducators.com/

https://www.pinterest.com/pin/308355905708355267/

http://pbskids.org/designsquad/parentseducators/resources/index.html?type=activity

http://centerforstem.tcnj.edu/istem-home/resources/

*Or other literature, video, or digital materials of equal academic worth