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 12/5/19.
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

Robotics is a one quarter cycle class designed for 7th and 8th 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 program robots to solve tasks. 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.
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. Students will use this process in the application of basic robotic models and programming.

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?)

Career Ready Practices

CRP1. Act as a responsible and contributing citizen and employee.
CRP2. Apply appropriate academic and technical skills.
CRP4. Communicate clearly and effectively and with reason.
CRP5. Consider the environmental, social and economic impacts of decisions.
CRP6. Demonstrate creativity and innovation.
CRP7. Employ valid and reliable research strategies.
CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.
CRP9. Model integrity, ethical leadership and effective management.
CRP11. Use technology to enhance productivity.
CRP12. Work productively in teams while using cultural global competence.
STUDENT PROFICIENCIES

Students will understand:

● How to create programs to accomplish tasks
● How sensors can be used to provide input to the programing decisions
● The importance of labeled sketches in engineering design
● How to employ various brainstorming techniques
● 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
• 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
Unit 1: Robotic Components – Hardware

Duration: 5 days

Overview: Students will examine the robotics parts and conduct basic tests to understand the operation and use of each part.

Technology: 8.1.8.A.1-2; 8.2.8.D.13

21st Century: CRP1,2,4,5,6,7,8,9,11,12

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

Essential Questions:
  - How does robotic technology present itself in our day-to-day life and decision-making processes?
  - What are robots used for in everyday life and what kinds of tasks do they help accomplish?
  - How can we use brainstorming to develop and organize ideas and thoughts?
  - What are the basic components needed to build a functioning robot?

Students Learning Objectives:

*Students will know...*
  - The steps of the engineering design process
  - The parts of the EV3 kits and their basic function

*Students will be able to...*
  - Assemble basic robotic parts and verify operation

Possible Activities:
  - EV3 getting started tutorial
  - Part hunt using lego diagrams
  - Assembly of basic robot
Unit 2: Programming and Sensors

Duration: 15 days

Overview: Students will program basic robots and use sensors to extend the abilities of the basic robot.

Technology: 8.1.8.A.1-2; 8.2.8.D.13; 8.2.8.E.2-3

21st Century: CRP1,2,4,5,6,7,8,9,11,12

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

Essential Questions:
- What are the fundamental components associated with all robots and autonomous robotic technology?
- What is a robot, and how do robots impact humankind’s capacity for solving problems and changing their world?
- How do robots know what is happening around them?

Students Learning Objectives:

Students will know...
- The basic sensor types
- The basic actuator types

Students will be able to...
- Use a basic actuators to complete simple tasks
- Extend a robot with sensors to perform more complex actions
- Wire a basic robot
- Combine the movement of actuators to create different types of movement
- 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.

Possible Activities:
- EV3 motion unit
- EV3 sensor unit
- Robot obstacle design course
Unit 3: Programming Robotic Design Challenges

Duration: 15 days

Overview: Student will use the information on programing, sensors, and actuators to design and build a robot to complete a complex series of challenges.

Technology: 8.1.8.A.1-2; 8.2.8.A.2; 8.2.8.C.1-5,5a,6,8; 8.2.8.D.13; 8.2.8.E.2-3

21st Century: CRP1,2,4,5,6,7,8,9,11,12

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

Essential Questions:
● How do we complete complex actions using simple components?

Students Learning Objectives:
Students will know...
● How to identify the needs of their design.
● How to use brainstorming techniques to think outside of the box.

Students will be able to...
● Apply their knowledge of the Engineering Design Process, and robotics parts and programing by completing the design challenges.

Possible Activities:
● FLL game board and challenge
SUGGESTED AUDIO VISUAL/COMPUTER AIDS

1. Graphing Calculator
2. iPad apps and peripherals
3. Discovery Channel’s Mythbusters
5. EV3 Robots
SUGGESTED MATERIALS

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

Resources for Teacher
http://education.rec.ri.cmu.edu/previews/ev3_products/ev3_curriculum/