

# CAMP INVENTION® DIY ORBOT™ ALIGNED TO COMMON CORE AND NEXT GENERATION SCIENCE STANDARDS

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## KEY CONCEPTS

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- Radio frequencies can be used to remotely or wirelessly control objects and devices.
- Radio waves travel at different frequencies and can move at different speeds.
- Communication is critical to effective teamwork.
- Sketching and designing an idea can help provide clarity in problem solving.
- Modifications can be made to devices to help them meet new and different challenges.
- Iteration is an important part of the design process.
- Building bridges and towers requires careful consideration of quantity and type of materials available.
- Engineering new projects can require comparing multiple possible solutions to best meet the needs of the situation.
- Learning how to use tools safely is an important part of science work.
- Reverse engineering an object can help develop a deep understanding of its components and how it works.
- Gears are an essential component of engines and motors.
- Gears function by working together to form a gear chain to do work.
- Devices can be modified to perform different functions while still keeping the same core components.
- Working as a team is an important part of being productive in a workplace.
- Radio wave energy can be transferred from one object to another that aren't physically touching.
- It's important to be systematic when evaluating design choices to find the best solution.
- Testing a concept can help determine the best ways to solve problems with unknown solutions.
- Another way to evaluate if a design solution is working is to analyze data about the design and/or the options available.
- Planning for a task and evaluating the options available can help inform choices and achieve better outcomes.
- Modifying a prototype based on information learned from testing results in an improved model.
- Design engineering involves the testing of materials and the functionality of objects; sketching and prototyping play a key role in this process.

# OBJECTIVES

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Children will:

- Learn about remote controls by getting instructions from an Instructor acting as a remote control.
- Learn about and discuss the roles of frequency, receivers and remote controls.
- Stand in a circle and create a “wave” like in a frequency.
- Create DIY Orbots and attach them to an RC toy.
- Fill out trading cards about their DIY Orbots features.
- Modify DIY Orbots to play soccer.
- Play a game of Orbot Soccer.
- Begin to take apart the RC toy and its remote and explore its mechanical components.
- Build bridges and tunnels for their DIY Orbots to cross.
- Make modifications to their bots and their bridges or tunnels.
- Learn how to safely use a screwdriver.
- Continue to take turns taking apart the DIY Orbot and its remote and explore its mechanical components.
- Learn about gears and how they help machines work.
- Create a gear train and make observations.
- Investigate gears from disassembled bot.
- Modify DIY Orbots to hold markers.
- Place bots on canvas and work with other students to create a collaborative masterpiece.
- Work as a team to choreograph a bot dance routine.
- Perform Bot Bops dance on Center Stage.
- Continue to take turns reverse engineering the RC toy and its remote to explore its mechanical components.
- Discuss crosstalk, or frequency crossover.
- Learn about how technology was developed to overcome the problem of crosstalk.
- Complete an activity to demonstrate crosstalk and how to overcome it by trying different ways to successfully send a message.
- Build tall towers out of materials.
- Modify DIY Orbots to knock over towers.
- Create a mini-obstacle course out of structures created during the week so far.
- Test DIY Orbots on the course.
- Practice using screwdrivers.
- Continue to reverse engineer RC toys and remotes in small groups.
- Review Ring of Fire points poster and discuss the obstacles in the final task.
- Make final modifications to bots and add a way to display team spirit.
- Practice controlling DIY Orbots.
- Form teams and take turns running the final obstacle course using DIY Orbots.

# DIY ORBOT™ ALIGNED TO NEXT GENERATION SCIENCE STANDARDS K-6

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## K-2-ETS1 ENGINEERING DESIGN

- K-2-ETS1-1. Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.
- K-2-ETS1-2. Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

## 3-5-ETS1 ENGINEERING DESIGN

- 3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
- 3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
- 3-5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

## MS-ETS1 ENGINEERING DESIGN

- MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
- MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem

## KINDERGARTEN

### K-PS2 MOTION AND STABILITY: FORCES AND INTERACTIONS

- K-PS2-1. Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.
- K-PS2-2. Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.

## GRADE TWO

### 2-PS1 MATTER AND ITS INTERACTIONS

- 2-PS1-2. Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.
- 2-PS1-3. Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object.

## GRADE THREE

### 3-PS2 MOTION AND STABILITY: FORCES AND INTERACTIONS

- 3-PS2-1. Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.
- 3-PS2-2. Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.
- 3-PS2-3. Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.

## **GRADE FOUR**

### **4-PS3 ENERGY**

- 4-PS3-1. Use evidence to construct an explanation relating the speed of an object to the energy of that object.
- 4-PS3-2. Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.
- 4-PS3-3. Ask questions and predict outcomes about the changes in energy that occur when objects collide.

### **4-PS4 WAVES AND THEIR APPLICATIONS IN TECHNOLOGIES FOR INFORMATION TRANSFER**

- 4-PS4-1. Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.
- 4-PS4-3. Generate and compare multiple solutions that use patterns to transfer information.

## **GRADE SIX**

### **MS-PS2 MOTION AND STABILITY: FORCES AND INTERACTIONS**

- MS-PS2-1. Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.
- MS-PS2-2. Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.
- MS-PS2-3. Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.
- MS-PS2-4. Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.
- MS-PS2-5. Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.

### **MS-PS4 APPLICATIONS IN TECHNOLOGIES FOR INFORMATION TRANSFER**

- MS-PS4-1. Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave. [Clarification Statement: Emphasis is on describing waves with both qualitative and quantitative thinking.] [Assessment Boundary: Assessment does not include electromagnetic waves and is limited to standard repeating waves.]

# DIY ORBOT™ ALIGNED TO COMMON CORE STATE STANDARDS FOR MATHEMATICS K-6

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## KINDERGARTEN

### COUNTING AND CARDINALITY K.CC

Count to tell the number of objects.

- K.CC4. Understand the relationship between numbers and quantities; connect counting to cardinality.
  - a. When counting objects, say the number names in standard order, pairing each object with one and only one number name and each number name with one and only one object.
  - b. Understand that the last number name said tells the number of objects counted. The number of objects is the same regardless of their arrangement or the order in which they were counted.
  - c. Understand that each successive number name refers to a quantity that is one larger.

### NUMBER AND OPERATIONS IN BASE TEN K.NBT

Work with numbers 11-19 to gain foundations for place value.

- K.NBT1. Compose and decompose numbers from 11 to 19 into ten ones and some further ones, e.g., by using objects or drawings, and record each composition or decomposition by a drawing or equation (e.g.,  $18 = 10 + 8$ ); understand that these numbers are composed of ten ones and one, two, three, four, five, six, seven, eight, or nine ones.

### MEASUREMENT AND DATA K.MD

Describe and compare measurable attributes.

- K.MD1. Describe measurable attributes of objects, such as length or weight.

Describe several measurable attributes of a single object.

- K.MD2. Directly compare two objects with a measurable attribute in common, to see which object has “more of”/“less of” the attribute, and describe the difference. For example, directly compare the heights of two children and describe one child as taller/shorter.

### GEOMETRY K.G

Identify and describe shapes (squares, circles, triangles, rectangles, hexagons, cubes, cones, cylinders, and spheres).

- K.G1. Describe objects in the environment using names of shapes, and describe the relative positions of these objects using terms such as above, below, beside, in front of, behind, and next to.
- K.G3. Analyze, compare, create, and compose shapes.
- K.G5. Model shapes in the world by building shapes from components (e.g., sticks and clay balls) and drawing shapes.

## GRADE ONE

### NUMBER AND OPERATIONS IN BASE TEN 1.NBT

Understand place value.

- 1.NBT2. Understand that the two digits of a two-digit number represent amounts of tens and ones. Understand the following as special cases:
  - a. 10 can be thought of as a bundle of ten ones – called a “ten.”

b. The numbers from 11 to 19 are composed of a ten and one, two, three, four, five, six, seven, eight, or nine ones.

c. The numbers 10, 20, 30, 40, 50, 60, 70, 80, 90 refer to one, two, three, four, five, six, seven, eight, or nine tens (and ones).

## MEASUREMENT AND DATA 1.MD

Tell and write time.

- 1.MD3. Tell and write time in hours and half-hours using analog and digital clocks.

Represent and interpret data.

- 1.MD4. Organize, represent, and interpret data with up to three categories; ask and answer questions about the total number of data points, how many in each category, and how many more or less are in one category than in another.

## GEOMETRY 1.G

- 1.G2. Compose two-dimensional shapes (rectangles, squares, trapezoids, triangles, half-circles, and quarter-circles) or three-dimensional shapes (cubes, right rectangular prisms, right circular cones, and right circular cylinders) to create a composite shape, and compose new shapes from the composite shape.

## GRADE TWO

### NUMBER AND OPERATIONS IN BASE TEN 2.NBT

Understand place value.

- 2.NBT1. Understand that the three digits of a three-digit number represent amounts of hundreds, tens, and ones; e.g., 706 equals 7 hundreds, 0 tens, and 6 ones. Understand the following as special cases:
  - a. 100 can be thought of as a bundle of ten tens - called a “hundred”.
  - b. The numbers 100, 200, 300, 400, 500, 600, 700, 800, 900 refer to one, two, three, four, five, six, seven, eight, or nine hundreds (and 0 tens and 0 ones).

Use place value understanding and properties of operations to add and subtract.

- 2.NBT5. Fluently add and subtract within 100 using strategies based on place value, properties of operations, and/or the relationship between addition and subtraction.
- 2.NBT8. Mentally add 10 or 100 to a given number 100–900, and mentally subtract 10 or 100 from a given number 100–900.

### MEASUREMENT AND DATA 2.MD

Work with time and money.

- 2.MD7. Tell and write time from analog and digital clocks to the nearest five minutes, using a.m. and p.m.

## GRADE THREE

### NUMBER AND OPERATIONS IN BASE TEN 3.NBT

Use place value understanding and properties of operations to perform multi-digit arithmetic.

- 3.NBT2. Fluently add and subtract within 1000 using strategies and algorithms based on place value, properties of operations, and/or the relationship between addition and subtraction.

## GRADE FOUR

### NUMBER AND OPERATIONS IN BASE TEN 4.NBT

Use place value understanding and properties of operations to perform multi-digit arithmetic.

- 4.NBT4. Fluently add and subtract multi-digit whole numbers using the standard algorithm.

# DIY ORBOT™ ALIGNED TO COMMON CORE STATE STANDARDS FOR ENGLISH LANGUAGE ARTS K-6

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## LANGUAGE STANDARDS L

### KINDERGARTEN

- L4. Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on kindergarten reading and content.

### GRADE ONE

- L4. Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grade 1 reading and content, choosing flexibly from an array of strategies.

### GRADE TWO

- L4. Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grade 2 reading and content, choosing flexibly from an array of strategies.

### GRADE THREE

- L4. Determine or clarify the meaning of unknown and multiple-meaning word and phrases based on grade 3 reading and content, choosing flexibly from a range of strategies.
  - b. Identify real-life connections between words and their use (e.g., describe people who are friendly or helpful).

### GRADE FOUR

- L4. Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grade 4 reading and content, choosing flexibly from a range of strategies.

### GRADE FIVE

- L4. Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grade 5 reading and content, choosing flexibly from a range of strategies.

### GRADE SIX

- L4. Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grade 6 reading and content, choosing flexibly from a range of strategies.

## READING STANDARDS FOR LITERATURE RL

### KINDERGARTEN

- RL7. With prompting and support, describe the relationship between illustrations and the story in which they appear (e.g., what moment in a story an illustration depicts).

### GRADE TWO

- RL7. Use information gained from the illustrations and words in a print or digital text to demonstrate understanding of its characters, setting, or plot.

### GRADE FOUR

- RL7. Make connections between the text of a story or drama and a visual or oral presentation of the text, identifying where each version reflects specific descriptions and directions in the text.

## READING STANDARDS FOR INFORMATIONAL RI

### GRADE ONE

- RI5. Know and use various text features (e.g., headings, tables of contents, glossaries, electronic menus, icons) to locate key facts or information in a text.

- RI.6. Distinguish between information provided by pictures or other illustrations and information provided by the words in a text.

## **GRADE TWO**

- RI.3. Describe the connection between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text.
- RI.5. Know and use various text features (e.g., captions, bold print, subheadings, glossaries, indexes, electronic menus, icons) to locate key facts or information in a text efficiently.
- RI.7. Explain how specific images (e.g., a diagram showing how a machine works) contribute to and clarify a text.

## **GRADE THREE**

- RI.7. Use information gained from illustrations (e.g., maps, photographs) and the words in a text to demonstrate understanding of the text (e.g., where, when, why, and how key events occur).

## **GRADE FOUR**

- RI.7. Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears.

## **GRADE FIVE**

- RI.7. Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently.

## **GRADE SIX**

- RI.7. Integrate information presented in different media or formats (e.g., visually, quantitatively) as well as in words to develop a coherent understanding of a topic or issue.

## **WRITING STANDARDS W**

### **KINDERGARTEN**

- W.8. With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question.

### **GRADE ONE**

- W.8. With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question.

### **GRADE TWO**

- W.8. Recall information from experiences or gather information from provided sources to answer a question.

## **SPEAKING AND LISTENING STANDARDS SL**

### **KINDERGARTEN**

- SL.1. Participate in collaborative conversations with diverse partners about kindergarten topics and texts with peers and adults in small and larger groups.
  - a. Follow agreed-upon rules for discussions (e.g., listening to others and taking turns speaking about the topics and texts under discussion).
  - b. Continue a conversation through multiple exchanges.
- SL.2. Confirm understanding of a text read aloud or information presented orally or through other media by asking and answering questions about key details and requesting clarification if something is not understood.
- SL.3. Recount or describe key ideas or details from a text read aloud or information presented orally or through

other media.

- SL4. Ask and answer questions in order to seek help, get information, or clarify something that is not understood.
- SL5. Add drawings or other visual displays to descriptions as desired to provide additional detail.

## **GRADE ONE**

- SL1. Participate in collaborative conversations with diverse partners about grade 1 topics and texts with peers and adults in small and larger groups.
  - a. Follow agreed-upon rules for discussions (e.g., listening to others with care, speaking one at a time about the topics and texts under discussion).
  - b. Build on others' talk in conversations by responding to the comments of others through multiple exchanges.
  - c. Ask questions to clear up any confusion about the topics and texts under discussion.
- SL2. Ask and answer questions about key details in a text read aloud or information presented orally or through other media.
- SL3. Ask and answer questions about what a speaker says in order to gather additional information or clarify something that is not understood.
- SL5. Add drawings or other visual displays to descriptions when appropriate to clarify ideas, thoughts, and feelings.

## **GRADE TWO**

- SL1. Participate in collaborative conversations with diverse partners about grade 2 topics and texts with peers and adults in small and larger groups.
  - a. Follow agreed-upon rules for discussions (e.g., gaining the floor in respectful ways, listening to others with care, speaking one at a time about the topics and texts under discussion).
  - b. Build on others' talk in conversations by linking their comments to the remarks of others.
  - c. Ask for clarification and further explanation as needed about the topics and texts under discussion.
- SL3. Ask and answer questions about what a speaker says in order to clarify comprehension, gather additional information, or deepen understanding of a topic or issue.

## **GRADE THREE**

- SL1. Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher led) with diverse partners on grade 3 topics and texts, building on others' ideas and expressing their own clearly.
  - b. Follow agreed-upon rules for discussions (e.g., gaining the floor in respectful ways, listening to others with care, speaking one at a time about the topics and texts under discussion).
  - c. Ask questions to check understanding of information presented, stay on topic, and link their comments to the remarks of others.
  - d. Explain their own ideas and understanding in light of the discussion.
- SL2. Determine the main ideas and supporting details of a text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally.
- SL3. Ask and answer questions about information from a speaker, offering appropriate elaboration and detail.

## **GRADE FOUR**

- SL1. Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher led) with diverse partners on grade 4 topics and texts, building on others' ideas and expressing their own clearly.

- b. Follow agreed-upon rules for discussions and carry out assigned roles.
  - c. Pose and respond to specific questions to clarify or follow up on information, and make comments that contribute to the discussion and link to the remarks of others.
  - d. Review the key ideas expressed and explain their own ideas and understanding in light of the discussion.
- SL5. Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes.

## **GRADE FIVE**

- SL1. Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher led) with diverse partners on grade 5 topics and texts, building on others' ideas and expressing their own clearly.
  - b. Follow agreed-upon rules for discussions and carry out assigned roles.
  - c. Pose and respond to specific questions by making comments that contribute to the discussion and elaborate on the remarks of others.
  - d. Review the key ideas expressed and draw conclusions in light of information and knowledge gained from the discussions.

## **GRADE SIX**

- SL1. Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly.
  - c. Pose and respond to specific questions with elaboration and detail by making comments that contribute to the topic, text, or issue under discussion.
- SL2. Interpret information presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how it contributes to a topic, text, or issue under study.

## **LITERACY IN SCIENCE AND TECHNICAL SUBJECTS RST**

### **GRADE SIX**

- RST3. Follow precisely a multi-step procedure when carrying out experiments, taking measurements, or performing technical tasks.

### **READING IN SCIENCE AND TECHNICAL SUBJECTS (RST)**

- 6-8.R.ST Cite specific textual evidence to support analysis of science and technical texts.
- 6-8.R.ST.3 Key Ideas and Details: Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
- 6-8.R.ST.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6–8 texts and topics.