ASSESSMENT SYSTEM OVERVIEW

Each OpenSciEd unit includes an assessment system that offers many opportunities for different types of assessments throughout the lessons, including pre-assessment, formative assessment, summative assessment, and student self-assessment. The table below outlines where key assessments can be found in the unit. Key formative assessments are identified here, but many more opportunities are embedded in each lesson, and guidance for those also appears in the following table.
Each OpenSciEd unit includes an assessment system that offers many opportunities for different types of assessments throughout the lessons, including pre-assessment, formative assessment, summative assessment, and student self assessment. Formative assessments are embedded and called out directly in the lesson plans. Please look for the "Assessment Icon" in the teacher support boxes to identify places for assessments. In addition, the table below outlines where each type of assessment can be found in the unit.

Overall Unit Assessment

When	Assessment and Scoring Guidance	Purpose of Assessment
Lesson 1	Initial Model: Objects During Collisions	**Pre-Assessment** Lesson 1 is an opportunity to uncover students' initial ideas and questions about how damage sometimes happens to objects in collisions. Analyzing student work will allow you to see if students have skills from prior grade bands (what a force is, balanced and unbalanced forces, energy is transferred in collisions, energy can be transferred through forces, and so forth) and if they have some current grade-band understandings (mass and speed as factors related to kinetic energy; net force ideas; and so forth). Use students' initial models of collisions and the Consensus Discussion as a pre-assessment opportunity. In the Consensus Discussion, it is best if you select students who will share a wide variety of ideas. Disagreement among students about what causes damage to objects in a collision will motivate students to find answers throughout the unit. Disagreement will also help students develop a Driving Question Board with questions they will answer throughout the unit.
Lesson 4	Independent, Dependent, and Controlled Variables	**Formative** At the start of Lesson 4, students express their initial ideas about important variables in an investigation. The handout *Independent, Dependent, and Controlled Variables* can be used as a reference for students throughout the unit and throughout 8th grade as they continue to design and carry out investigations.
Lesson 5	Slide S-U and related student investigation plans	**Formative** This is a good opportunity to determine if students can plan investigations in small groups without a lot of scaffolding. Slide S cues students to start planning their investigation with their group. You can assess much of this plan before groups go to carry out the investigation and collect the data from it. Look for • identification of a single independent variable • identification of the dependent variables • identification of important variables to keep constant • a data table with results from at least two conditions tested • peak forces measurements and/or equalities or inequalities noted for both push-pull spring scales for each condition tested • results from repeated trials for each condition (optional) • source(s) of error in the system (optional)

When	Assessment and Scoring Guidance	Purpose of Assessment
Lesson 6	Soccer Assessment Soccer Assessment Key	**Formative and Summative** This is a putting-the-pieces-together lesson. It includes an assessment that provides a transfer task opportunity for students to apply their understanding of peak forces, damage, and kinetic energy on different parts of a system in a collision in a new context. Students also draw free-body diagrams of the parts of a system during a collision. It's critical that students first understand that the forces during a collision are always equal and opposite and that the peak forces experienced by each object are the same before they attempt to make a free-body diagram describing that relationship. However, once students become adept at using the free-body diagram to describe forces and energy transfer as objects interact, they will better be able to use free-body diagrams to predict the changes in motion to objects and changes in kinetic energy in a collision. The lesson includes an opportunity to revisit the Driving Question Board to identify questions that can be answered so far, which provides a meaningful way to review important ideas the class has figured out before asking students to apply these to a new phenomena in the transfer task.
Lesson 12	*Automatic Bike Braking Assessment*. *Automatic Bike Braking Key*.	**Summative** This is a putting-the-pieces-together lesson. It includes a summative midpoint assessment. The goal of the assessment is to determine if students can apply their evidence from lab activities and key science ideas to explain collision-related phenomena in the context of an electronic braking system for bicycles, before shifting to a larger amount of engineering work and computer coding investigations in the remainign lessons of the unit. The lesson includes an opportunity to revisit the Driving Question Board to identify questions that can be answered so far, which provides a meaningful way to review important ideas the class has figured out before asking students to apply these to a new phenomena in the transfer task.
Lesson 14	*Interpreting Blocks of Code* Testing and modifying computer code for different sensors on day 2 and 3 of this lesson	**Formative** This lesson provides multiple opportunities to gauage students' comfortability with interpreting, modifying, and testing computer code. This may be the first time that some students have ever worked with coding.
Lesson 16	Physical prototypes and related code that each group builds, modifies, and tests.	**Formative and Summative** The class criteria for the design solution developed in lesson 15 is intended to help guide iterative rounds of design work related to this assessment opportunity. Feedback and artifacts from these lessons will be particularly critical to help developers understand the types of work students engage in using the existing materials. Encourage and accept all creative work that leverages what students have figured out to this point.
Lesson 17	Final design presentation and feedback Class criteria for the design solution developed in lesson 15	**Summative** This is a putting-the-pieces-together lesson. It provides an opportunity for students to communicate their understanding from the entire unit in the context of their own design ideas. The class criteria for the design solution developed in lesson 15 is intended to serve as 1) a gotta-have-it checklist for producing an artifact for sharing their design solutions with peers and 2) a checklist for helping students evaluate and provide and respond to specific feedback about different design solutions.

When	Assessment and Scoring Guidance	Purpose of Assessment
After each lesson	Lesson Performance Expectation Assessment Guidance	**Formative Assessment** Use this document to see which parts of lessons or student activity sheets can be used as embedded formative assessments.
Occurs in most lessons	Progress Tracker	**Formative and Student Self-Assessment** The Progress Tracker is a thinking tool that was designed to help students keep track of important discoveries that the class makes while investigating phenomena and figure out how to prioritize and use those discoveries to develop a model to explain phenomena. It is important that what the students write in the Progress Tracker reflects their own thinking at that particular moment in time. In this way, the Progress Tracker can be used to formatively assess individual student progress or for students to assess their own understanding throughout the unit. Because the Progress Tracker is meant to be a thinking tool for students, we strongly suggest it is not collected for a summative "grade" other than for completion.
Anytime after a discussion	Student Self-Assessment Discussion Rubric	**Student Self-Assessment** The student self-assessment discussion rubric can be used anytime after a discussion to help students reflect on their participation in the class that day. Choose to use this at least once a week or once every other week. Initially, you might give students ideas for what they can try next time to improve, such as sentence starters for discussions. As students gain practice and proficiency with discussions, ask for their ideas about how the classroom and small-group discussions can be more productive.
After students complete substantial, meaningful work	Peer Feedback Facilitation: A Guide	**Peer Feedback** There will be times in your classroom when facilitating students to give each other feedback will be very valuable for their three-dimensional learning and for learning to give and receive feedback from others. We suggest that peer review happens at least two times per unt. This document is designed to give you options for how to support this in your classroom. It also includes student-facing materials to support giving and receiving feedback along with self-assessment rubrics where students can reflect on their experience with the process. Peer feedback is most useful when there are complex and diverse ideas visible in student work, and not all work is the same. Student models or explanations are good times to use a peer feedback protocol. They do not need to be final pieces of student work, rather, peer feedback will be more valuable to students if they have time to revise after receiving the peer feedback. It should be a formative, not summative, type of assessment. It is also necessary for students to have experience with past investigations, observations, and activities where they can use these experiences as evidence for their feedback.

For more information about the OpenSciEd approach to assessment and general program rubrics, visit the OpenSciEd Teacher Handbook.

Lesson-by-Lesson Assessment Opportunities

Every OpenSciEd lesson includes one or more lesson-level performance expectations (LLPEs). The structure of every LLPE is designed to be a three-dimensional learning, combining elements of science and engineering practices, disciplinary core ideas and cross cutting concepts. The font used in the LLPE indicates the source/alignment of each piece of the text used in the statement as it relates to the NGSS dimensions: alignment to Science and Engineering Practice(s), alignment to Cross-Cutting Concept(s), and alignment to the Disciplinary Core Ideas.

The table below summarizes opportunities in each lesson for assessing every lesson-level performance expectation (LLPE). Examples of these opportunities include student handouts, home learning assignments, progress trackers, or student discussions. Most LLPEs are recommended as potential formative assessments. Assessing every LLPE listed can be logistically difficult. Strategically picking which LLPEs to assess and how to provide timely and informative feedback to students on their progress toward meeting these is left to the teacher's discretion.

Lesson	Lesson-Level Performance Expectation(s)	Assessment Guidance

Lesson	Lesson-Level Performance Expectation(s)	Assessment Guidance
Lesson 1	**1.A** Develop a model to describe interactions between two objects as they collide and show the changes that occur in the structure of both objects when one object is damaged as a result and also when neither object is damaged as a result. **1.B** Ask questions that arise from observations of collisions between two objects in order to seek additional information about factors (causes) that might affect the outcome of such collisions.	**1.A Developing and Using Models; Stability and Change; Systems and System Models** **When to check for understanding:** Collect students' initial models on *Initial Collision Model* and explanations on *Interactions During Collisions* at the end of day 1 to pre-assess their fluency in developing a model. **What to look for/listen for:** Prompts in this task ask students to engage in two elements of the modeling practice related to representing descriptive aspects of the phenomenon as well as unobservable mechanisms. These will provide an opportunity for students to use related DCIs from prior grades; grade 4 (energy transfer in collisions) and grade 2 (objects push each other when they collide). There are phrases in the prompts that ask students to consider related elements of CCCs, particularly systems and system models and stability and change. You may also see some students developing particle-level representations for changes happening in the matter in the system, based on their extensive work in developing such models in prior OpenSciEd units. See the related *Assessment* callout box for additional guidance. **1.B Asking Questions and Defining Problems; Cause and Effect** **When to check for understanding:** Since students will put their initials on the backs of these sticky notes, you will have a few opportunities to take stock of the kinds of questions students ask in this initial lesson after they are posted on the DQB as well as when they first write them. When students share these questions for the DQB, they will likely have time to share only one. Collect the remaining questions that don't get posted after the development of the DQB is complete. This record of questions they form today will help you formatively assess their fluency in the practice of asking questions at the start of this year. Collect and look through student notebooks to see their individual ideas for future investigations to pursue as well. **What to look for/listen for:** See the related *Assessment* callout box for additional guidance.
Lesson 2	**2.A** Collect data on changes in the motion and shape of colliding objects that serve as the basis for evidence that energy transfer occurs during the collision and that there are forces between colliding objects. **2.B** Construct an argument supported by empirical evidence and scientific reasoning to support a model showing that changes in motion of colliding objects (connected to subsystems) results from energy transfer between them (cause) and changes in the shape of those objects results from force(s) between them (cause).	**2.A Planning and Carrying Out Investigations; Stability and Change** **When to check for understanding:** Students carry out two investigations to explore what happens in collisions on day 1 of the lesson. In the first, the *Dropping and Breaking Lab*, they explore what happens to objects during a collision by dropping rigid objects on other objects. Students encounter challenges in understanding what's happening at the moment of contact in collisions and help identify a plan for the *Exploring Horizontal Collisions Lab* to improve their ability to make observations. **What to look/listen for:** Listen for students to suggest ways to control the collisions they observe. For example, students will likely suggest the use of slow-motion video or zoomed-in images of the moment of collision. They are likely to suggest that they want to see how the materials themselves are changing during the time the objects are in contact with each other. They may also suggest ways to control the motion and speed of objects in collisions, such as a way to target or line up the objects to ensure that they will collide after one or both are put into motion. **2.B Engaging in Argument from Evidence; Stability and Change; Cause and Effect; System and System Models** **When to check for understanding** 1. Students develop cause-and-effect statements to account for mechanisms responsible for the changes in motion and shape during collisions in day 2 of the lesson. 2. Students also update their Progress Trackers at the end of day 2 with what they figure out related to their lesson question. This provides a second opportunity to formatively assess student understanding. **What to look/listen for** 1. Students making arguments that leverage prior knowledge about changes in kinetic energy, energy transfer, and/or forces in the initial cause-and-effect statements they make 2. Students making claims that refer to how energy transfer can help account for changes in motion and for how forces can account for changes in shape (students may also mention that forces can account for changes in motion as well)

Lesson	Lesson-Level Performance Expectation(s)	Assessment Guidance
Lesson 3	**3.A** Construct and revise a written argument using evidence from various sources of data (slow-motion videos, photos, and firsthand investigations) to support or refute the claim that all objects do bend or change shape when pushed in a collision.	**3.A Engaging in argument from evidence; stability and change** **When to check for understanding:** Check for student progress in their responses they write for their initial claim in their notebooks. **What to look/listen for:** Students should identify that the evidence supports the claim that all objects bend or change shape when pushed in a collision.
Lesson 4	**4.A** Plan an investigation, identifying controls to keep constant, and carry out the investigation to produce data to serve as the basis for evidence to develop a mathematical model for the relationship (pattern) between the amount of force applied to an object and the amount it deforms. **4.B** Analyze and interpret graphical data (patterns) from tests of compression force vs. amount and type of deformation (temporary vs. permanent) to provide evidence that supports an argument that all objects behave elastically up to a specific limit beyond which permanent damage occurs (stability and change).	**4.A Planning and Carrying out Investigations; Patterns, Cause & Effect, Stability & Change** **When to check for understanding:** Completion of *Types of Variables* will provide a useful reference text for future investigations that students will plan in small groups in later lessons and future OpenSciEd units in 8th grade. **What to look/listen for:** Look for students to do the following in the planning of the investigation: • identify the independent variable as the amount of force applied to an object, • identify the dependent variable as the amount of deformation in the object, and • identify controls including where the force is applied and how much of the object overlaps the two supports (bricks) in each test. **4.B Analyzing and Interpreting Data; Patterns, Cause & Effect** **When to check for understanding** Students construct graphical displays of data from compression force vs. deformation tests to help identify a linear relationship that describes the elastic behavior of all objects in graphs they make at the end of day 1 on *Deformation Results* **What to look/listen for** • the *x*-axis labeled as the force applied to the object (in N) • the *y*-axis labeled as the amount of deformation in the object (in cm) • stretching out the intervals to maximize the use of the graph paper while still capturing the highest *x* value and highest *y* value • equal intervals identified on each axis • a straight line of best fit through the data that are represented with points drawn as open circles (anywhere the beam returned to its original shape after the weight was removed)

<table>
<tr><th>Lesson</th><th>Lesson-Level Performance Expectation(s)</th><th>Assessment Guidance</th></tr>
<tr><td>Lesson 5</td><td>5.A Plan and carry out an investigation and identify patterns in the data collected from the investigation to provide evidence that when peak contact forces on each object during the collision are equal in strength, the strength of those forces increases when the mass or the speed of the object that was moving before the collision increases.

5.B Develop and use subsystem models (free body diagrams) to represent how the relative strength of 1) the contact forces acting on a motionless object compare and 2) the peak contact forces on two different objects compare in a collision and how these are related to corresponding changes in the kinetic energy of a moving object before it collides due to an change in its mass or the speed.</td><td>5.A Plan and Carry out Investigations; Patterns, Systems and System Models
When to check for understanding: Slide T cues students to start planning their investigation with their group. You can assess much of this plan before groups go to carry out the investigation and collect the data from it.

What to look/listen for
Identification of a single independent variable: mass or speed
Identification of the following dependent variables: the peak force measured on the push-pull spring scale on cart subsystem A and the peak force measured on the push-pull spring scale on cart subsystem B
Identification of important variables to keep constant: If students identified mass as the independent variable then they should identify speed as an important variable to try to keep constant. If students identified speed as the independent variable then they should identify mass as an important variable to try to keep constant.
A data table with results from at least two conditions tested (e.g., no additional mass vs. added mass or slower speed vs. faster)
Peak forces measurements and/or equalities or inequalities noted for both push-pull spring scales for each condition tested
Results from repeated trials for each condition (optional)
Source(s) of error in the system (optional)
5.B Develop and Use Models; Systems and Systems Models
When to check for understanding:
Students individual responses to the two prompts on Slide L.
Collect student exit tickets at the end of day 3 of this lesson (Slide W).
What to look/listen for:
Predicting a force of 2.5N and explaining that the strength of this force added to the strength of the other force on the right of the cart (1.5N) adds up to the sum of the strengths of the two forces on the left side of the car (1N + 3N).
Transferring the representations of the ideas developed in the class consensus model to a new context to explain a different phenomenon. The following ideas should be show up in students' responses:
A: Students identify one or both objects.
B: The forces on both would be equal in strength.
C: The kinetic energy would be less.
D: The contact forces in the collision would be weaker but still equal in strength.</td></tr>
<tr><td>Lesson 6</td><td>6.A Apply science ideas and use evidence to construct an explanation for how the amounts of peak force and energy transfer (cause) in soccer collisions result in instability in the brain (concussions, effect) due to sudden changes at the cellular level.</td><td>6.A Constructing Explanations and Designing Solutions; Cause and Effect; Stability and Change
When to check for understanding: Students use science ideas from Lessons 1-5 in Soccer Assessment to determine how peak forces and energy transfer affect different soccer collision scenarios.

What to look/listen for: See Soccer Assessment Key.</td></tr>
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Lesson	Lesson-Level Performance Expectation(s)	Assessment Guidance

Lesson 7	**7.A** Develop a model to describe structure/function relationships of the parts in two digital spring scales with different force measurement ranges and they develop a model to represent the inputs and the processes that occur within those systems to produce outputs we can interpret as measurements
	
	7.B Ask questions that arise from analyzing the dissection of two digital spring scales with different force measurement ranges to seek additional information about how electronic sensors work, what the microcontroller (e.g. a micro:bit) does, and how information flows within systems.
		7.A Develop and Use a Model; Structure and Function, Systems and System Models
		When to check for understanding:
		1. On day 1 of the lesson when students complete their structure/function mapping for the parts that make up two different digital scales (**slide M**). Collect these students' initial models to assess their fluency in developing a different type of model.
		2. On day 2 when students complete their input/output model for the digital scale system (**slide P**).
		What to look for/listen for:
		• Parts common to both systems (Beam, Wires, batteries, a light up display, Microprocessor/microchip/circuit board,Tiny square shaped zig-zag structure glued to the beam.)
		• Functions identified for three of the parts:
		  ◦ The beam functions like a spring (or it is elastically deformed and its thickness affects the ratio/rate at which it does this).
		  ◦ The light up display provides output we can interpret/see (or it displays numbers/text or it provides us information/measures).
		  ◦ The wires carry electrical current (or something related to energy transfer, signals, data or information transfer).
		• Input/output and changes common to both systems:
		  ◦ **Input(s):** A force. The top plate is where this is detected.
		  ◦ **Change(s) within the system:** One change that happens in the system is the beam elastically bends/deforms a certain amount. *Optional: This bend is somehow converted by the microprocessor into some other type of information to produce a measure in the form of numbers.*
		  ◦ **Output:** The numbers displayed on the lit up screen.
		
		7.B: Asking Questions and Defining Problems, Systems and System Models
		When to check for understanding: In the questions students record on their sticky notes on day 2 (**slide Q**).
		What to look for/listen for: See the related assessment guidance box.

Lesson 8	**8.A** Design a device that responds when a certain amount of force has been applied to a system, showing which structures change motion, shape, or position and describe how this produces a change in input by repurposing a particular type of digital sensor.	**8.A Constructing Explanations and Designing Solutions, Using Mathematics and Computational Thinking; Systems and System Models, Structure and Function** **When to check for understanding:** On day 1 of the lesson when students document their ideas for the design of their device (**slide O**) and describe how parts in the system shown on **slide P** could help us to turn the light sensor into a speed sensor. **What to look/listen for:** • A description/representation of an application for their design. • A sketch of a design that included a sensor from the lab and additional parts needed for the selected application. • Showing where a force would be applied (input) to a part in the system that would result in a change in its position/shape/motion. • A description of how this is related to where the sensor is located in the system and what it can detect. • Optional: an output signal or action that the device produces under certain input conditions.

Lesson	Lesson-Level Performance Expectation(s)	Assessment Guidance
Lesson 9	**9.A** Plan the data to be collected from different investigations, collect, analyze, and interpret it to identify patterns, including that the kinetic energy of a moving object is proportional to its mass and kinetic energy of a moving object grows with the square of its speed. **9.B** Construct an explanation based on quantitative relationships that predicts why increasing the speed of a rock by a factor of 5 would produce a bigger effect (scale) on the peak forces produced in a collision between it and a stationary object and why this would cause greater damage, than increasing the mass of the rock by a factor of 10.	**9.A Plan and Carry Out an Investigation, Analyze and Interpret Data; Patterns** **When to check for understanding:** 1. On day 1 as groups plan and carry out their Box Slide Investigations using *Investigation Data* (**slide I**). 2. On day 2 when students pair up to complete the Analyzing and Interpreting Results questions on *Investigation Data* (**slide J**). 3. On day 2 when students work with a partner to plan an investigation and collect data on *Investigation Data* (**slides P-R**). 4. On day 2 when students discuss the results from their investigation on *Investigation Data* (**slides S-U**). 5. Optional: When students individually complete questions 5-7 on *Predicting & Explaining Damage* (**slide W**). **What to look for/listen for:** 1. Students have used the *Lab Procedure Flowchart* to consider the number of trials for the control condition (Part B) and experimental condition (Parts C or D). Students correctly identify which variable they are controlling for, either speed (as controlled by how far the spring scale was pulled back) or mass (as controlled by the mass of the cart). 2. See the associated Assessment Opportunity box. 3. The value of each independent and dependent variable and the variable they held constant are recorded in both data tables. 4. See the associated Assessment Opportunity box. 5. See responses for questions 5-9 on *Predicting & Explaining Damage Key*. **9.B Constructing explanations and designing solutions; scale, cause and effect** **When to check for understanding:** When students individually complete questions 1-4 on *Predicting & Explaining Damage* (**slide V**). **What to look for/listen for:** See responses for questions 1-4 on *Predicting & Explaining Damage Key*.
Lesson 10	**10.A** Develop and use a model to identify other parts of the system the cart and box are making contact with or colliding into that could be producing contact forces on these subsystems, causing energy to be transferred to or from them as the box and cart travel down the track.	**10.A Developing and Using Models; Cause and Effect, Systems and System Models, Energy and Matter** **When to check for understanding:** As students complete *Modeling other force interactions in the launcher, cart, box, and track system* at the end of the lesson (**slide F**). **What to look for:** See *Key for modeling force interactions in the launcher, cart, box, and track system*.

Lesson	Lesson-Level Performance Expectation(s)	Assessment Guidance
Lesson 11	**11.A** Apply scientific ideas and evidence to construct an explanation for the causes of motion and kinetic energy changes that happen before and after collisions and how these affect the outcome of a collision. **11.B** Respectively provide and receive critiques about claims to identify relevant evidence to support an explanation for how energy transfers through the cart-launcher system before and right after a collision. **10.A** Develop and revise a model to identify other parts of the system the cart and box are making contact with or colliding into that are producing contact forces on these subsystems, causing energy to be transferred to or from them as the box and cart travel down the track.	**11.A Planning and Carrying Out Investigations; Cause and Effect** **When to check for understanding:** On day 1 of this lesson, students carry out investigations and examine data at four stations to build understanding of forces due to friction and air resistance and how these affect motion and kinetic energy (KE) of subsystems in the collision system model (**slide D**). **What to look for:** Students should use the patterns they notice to develop cause-effect relationships between observable changes at the macroscopic scale and the particle nature of interactions at the microscopic scale. Students should attribute slowing down or losing energy to particle interactions due to air resistance and friction between surfaces that slide past each other. **11.B Engaging in Argument from Evidence; Energy and Matter** **When to check for understanding:** 1. After students collect evidence and analyze data on day 1 of this lesson, they write claims about the cause-effect relationships between changes in motion and in kinetic energy and particle nature of interactions due to friction and air resistance. (**slides E-F**) 2. They will present and defend their claims on day 2 and engage in discussion to deepen their thinking. **What to look for:** Listen for students to share similarities and differences in the evidence and reasoning they cite to support their claims. Students should be describing the relationship between the particle nature of air and the surfaces of objects sliding past each other. **10.A Developing and Using Models, Systems and System Models, Energy and Matter** **When to check for understanding:** As students revise *Modeling other force interactions in the launcher, cart, box, and track system* at the end of the lesson (**slide P**). **What to look for:** See *Key for modeling force interactions in the launcher, cart, box, and track system* from Lesson 10.
Lesson 12	**12.A** Apply scientific ideas to predict and explain the change in motion and collision-related outcomes for an electronic bike braking system under different conditions and the effect on the kinetic energy, energy transfers, and peak forces. **12.B (Optional)** Apply scientific ideas to explain multiple baseball phenomena, including the effects of air density and wind on ball speed (changes to the stability of the system and its effect on kinetic energy changes due to air resistance), bat mass vs. bat speed (interpreting patterns in graphical and tabular data to determine the linear and nonlinear effects on increases of kinetic energy within the system), and bat type (the effect deformation has on peak forces in the system and kinetic energy) on how the game is played.	**12.A Constructing Explanations and Designing Solutions; Cause and Effect** **When to check for understanding:** As students complete *Automatic Bike Braking Assessment*. **What to look/listen for:** See *Automatic Bike Braking Key*. **12.B (Optional) Constructing Explanations and Designing Solutions; Energy and Matter; Systems and System Models** **When to check for understanding:** As students complete (optional) *Baseball Assessment*. **What to look/listen for:** See *Baseball Assessment Key*.

Lesson	Lesson-Level Performance Expectation(s)	Assessment Guidance
Lesson 13	**13.A** Design a device that repurposes a type of digital sensor that also includes a) structures that enable it to be robust/reliable in hurricane weather conditions, b) structures that adjusts its response to a higher range of speeds or forces, and c) outlines information relationships that the software should process/produce, as if... input(s), then... output(s).	**13.A Constructing Explanations and Designing Solutions, Using Mathematics and Computational Thinking; Systems and System Models, Structure and Function** **When to check for understanding:** As students individually brainstorm, then work with a partner to consider how to use another sensor to design a new solution (**slides K-L**). **What to look/listen for:** • Students should begin to think about novel ways to use other sensors. At this point, it is okay for a wide variety of ideas to emerge. • Students use similar notations when completing a version of the Outputs and Conditionals poster with a partner. Their "if... then... statements" relate structures in the sensors to the types of outputs produced.
Lesson 14	**14.A** Test and compare different solutions (code) to a variety of design problems, including producing different outputs in response to different values/ranges of inputs and performing different mathematical operations (such as inequalities, absolute values, differences, quotients). **14.B** Define a design problem that responds to changes in force applied to part of the system (differences in input) that can be solved through the development of a measurement tool and series of computational processes/algorithms that produces different outputs under specific conditions.	**14.A Planning and Carrying out an Investigation, Using Mathematics and Computational Thinking; Patterns, Cause and Effect** **When to check for understanding:** 1. On day 1 as students complete and discuss their responses to part 2 on *Interpreting Blocks of Code* (**slides E-F**). 2. On day 2 when students work with a partner to examine and then discuss the program of two sensors using *Flex & Pressure Sensor Programs* (**slides S-T**). **What to look for/listen for:** 1. See the associated Assessment Opportunity box. 2. See the associated Assessment Opportunity box. **14.B Constructing explanations and Designing solutions; Cause and Effect, Energy and Matter: Flows, Cycles, and Conservation.** **When to check for understanding:** When students record their responses to questions 1-4 on notebook paper from **slide KK**. **What to look for/listen for:** See the related assessment callout box.
Lesson 15	**15.A** Determine a design goal that can be solved with the development of a device to alert and protect people and structures from damage from high force winds (peak forces) by identifying and considering multiple criteria and constraints along with specific materials, shapes, and designs of devices that reflect our science and computer science ideas of how the integration of hardware and software affect the function of a design.	**15.A Asking Questions and Defining Problems; Structure and Function** **When to check for understanding:** 1. As the class identifies constraints to add to the Constraints poster. (**slide D**) 2. As the class identifies criteria for each subproblem on the Criteria poster. (**slides E-H**) **What to look for/listen for:** • Students should identify constraints based on their prior experiences working with micro:bit programming code and sensors, as well as the overall design goal. Look for relevant and specific constraints. • Students should identify generalistic criteria and ways to represent or communicate them which can be used to determine success of designs and inform feedback for revisions. In the first round of criteria development, students should focus on the available hardware and materials. In the second round of criteria development, students should focus on the available software and library suite of code.
Lesson 16	**16.A** Engage in the design cycle for building and testing a prototype of the interactions between the physical parts and/or (pseudo)code parts of a sensor system that measures and responds to changes in force in a selected application (chosen by the student).	**16.A Planning and Carrying Out Investigations, Constructing Explanations and Designing Solution; Systems and System Models, Structure and Function** The class criteria for the design solution is intended to help guide interative rounds of design work related to this assessment opportunity. Feedback and artifacts from these lessons will be particularly critical to help developers understand the types of work students engage in using the existing materials. Encourage and accept all creative work that leverages what students have figured out to this point.

Lesson	Lesson-Level Performance Expectation(s)	Assessment Guidance
Lesson 17	**17.A** Communicate how the hardware and software structures of a prototype of the group's design solution transform changes in force (input) to provide specific outputs (function) to address the class' design goal. **17.B** Evaluate how well parts of groups' design solutions meet the identified class constraints and criteria; consider how to address the feedback from peers provided to the group that can still address the class' design goal.	**17.A Obtaining, Evaluating, and Communicating Information; Systems and System Models, Structure and Function** The class criteria for the design solution is intended to serve as a gotta-have-it checklist for producing an artifact for sharing their design solutions with peers. **17.B Engaging in Argument from Evidence, Obtaining, Evaluating, and Communicating Information; Systems and System Models, Structure and Function** The class criteria for the design solution is intended to serve as a checklist for helping students evaluate and provide and respond to specific feedback about different design solutions.
Lesson 18	Lesson-level performance expectation(s) is under development.	Assessment guidance for this lesson is still under development.