Potential and Kinetic Energy Lesson 2: "The Make"
Student Handout

The Alleycats are in quite a unique bowling league. In their competition, they can change certain features of their environment: the weight of the ball and even the slope of the alley. They want to make sure they win their upcoming bowling competition. To help, you will design and conduct an investigation that will help you make a recommendation to them so that they can be champions!

Should the Alleycats try to launch their bowling balls from a higher location, or should they get more massive bowling balls, or both?

Your "Make" task today is to:
1. Assemble a marble ruler-ramp to observe:
    a. the effect of mass on a marble's kinetic energy
    b. the effect of speed on a marble's kinetic energy
    c. the effect of kinetic energy on a marble's ability to do work
2. Collect data
3. Draw conclusions

Often times, when scientists can't conduct tests on the specific things they're investigating, they use models to help them draw conclusions. For example, to test how a piece of equipment works in Antarctica, a scientist might test it in the freezer first. Today, since we can't go to a bowling alley, we're going to use items to represent the bowling alley.

Planning Organizer

Object in Model	Represents...
Marbles	
Light Mass Marble	
Heavy Mass Marble	
Ruler with Groove	
Index Cards	

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Brainstorm your Investigation Design
#1:   Marble Mass _____   Number of books: _____ Sketch:
#2:   Marble Mass _____   Number of books: _____ Sketch:
#3:   Marble Mass _____   Number of books: _____ Sketch:
#4:   Marble Mass _____   Number of books: _____ Sketch:

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Make a list of the materials that you will need for your investigations. Have your list approved by your teacher and gather your materials.
1.   2.   3.   4.   5.

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How far from the bottom of the ramp will you place your "bowling pins"? Decide on a distance between 3-5 centimeters. Place the "bowling pins" at this same distance for <u>all</u> trials.
Perform your investigations. Enter the data for the distance the index card moved. Write down any other observations that you notice.

Data #1 Distance card moved: _____ Observations:	**Data #2** Distance card moved: _____ Observations:
Data #3 Distance card moved: _____ Observations:	**Data #4** Distance card moved: _____ Observations:

Calculate mean distance: (_____ + _____ + _____ + _____) / 4 = _____

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Draw conclusions about your observations.

The distance the card moves is an indication of the amount of **kinetic energy** the marble had at the bottom of the ramp. How will these measurements help you make a recommendation to the Alleycats?

Draw the sketch of the investigation design in which the marble had the most kinetic energy causing the card to move the **farthest**. Label how far the card moved.	Draw the sketch of the investigation design in which the marble had the least kinetic energy causing the card to move the **least**. Label how far the card moved.

Should the Alleycats try to launch their bowling balls from a higher location, or should they get more massive bowling balls, or both? Use evidence from your investigations to support your recommendation.

Name: _____   **Date:** _____

Exit Ticket: Connection to the Engineer

1. How did your marble gain potential energy?

2. How did your marble gain kinetic energy?

3. How did **speed** affect the amount of kinetic energy of the marble?

4. How did **mass** affect the amount of kinetic energy of the marble?

5. What will be your recommendation to the Alleycats?

Make Assessment

Use the checklist and cognitive skills rubric to ensure you have addressed all aspects of the "Make" with quality work.

Make Investigation Student Guide Checklist

Your Challenge: Design and conduct an investigation that uses data to help the Alleycats win the bowling tournament!

Project Completeness:
- ❏ Includes at least 4 investigation designs
    - ❏ Marble size indicated
    - ❏ # of books used indicated
    - ❏ sketches are clear, neat and labeled
- ❏ Includes at least 4 sets of data
    - ❏ Measurements indicate for how far card moved
    - ❏ Observations are included
- ❏ Conclusions are included
    - ❏ Both sketches are clear, neat and labeled
    - ❏ Supporting evidence is included
- ❏ Student guide is neat, and in color

DCI Standards Checklist:
- ❏ Investigation of greatest kinetic energy clearly identified, sketched and supported with data and evidence.
- ❏ Investigation of least kinetic energy clearly identified, sketched and supported with data and evidence.
- ❏ Recommendation to Alleycats is supported based on evidence.

Science & Engineering Practices

	Emerging (1)	Developing (2)	Proficient (3)	Advanced (4)
Developing and Using Models	Drawings, diagrams, or visual models include major misconceptions or has missing parts. Explanation of the model is minimal or not present.	Drawings, diagrams, or visual models include minor misconceptions or has missing parts. Explanation of the model is minimal.	Drawings, diagrams, or visual models are complete, but contain a minor misconception. Explanation of the model is complete but lacking complexity.	Drawings, diagrams, or visual models have no misconceptions and contain all details. Explanation of the model is complete and complex.
Constructing Explanations or Arguments From Evidence	Constructs an explanation with no clear sources of evidence.	Uses scientific principles and/or data from at least one source to construct or evaluate an explanation, but explanation contains minor misconceptions.	Uses accurate but incomplete scientific principles and/or data from multiple sources to construct or evaluate an explanation.	Uses accurate and complete scientific principles and/or data from multiple sources to construct or evaluate an explanation.