Movement on the Playground

3.1


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Anchoring Phenomenon

Objects move in different ways during physical activities on the playground.

Lesson Concept

Students communicate information about observations of the motion of objects on a playground and what causes the objects to move in order to determine initial criteria for the solution to the problem.

Identified Problem

A school can't reopen the playground until it receives a design for a new playground structure.

Standards

Refer to Appendix 3.1 for NGSS, CCSS—ELA, and California ELD standards.

A project of CA NGSS K–8 Early Implementation Initiative.

Storyline Link

Lesson 1: Movement on the Playground begins with the scenario of a playground that needs to be redesigned. Students discuss why playgrounds are important, make observations of movement on the current playground, and use those observations to determine initial criteria to meet the design challenge of creating a new playground. They also determine initial investigation questions to gather evidence to support their design. Students explore forces and motion.

In Lesson 2: Forces Move Objects, students investigate the strength and direction of forces and resulting motion that happens in the process of a basketball game, specifically looking at what the movement was, how it happened, and how it can be applied to the problem.

Throughout the unit, a flag (▶) denotes formative assessment opportunities where you may change instruction in response to students' level of understanding and making sense of phenomena or solving a problem.

Time

135 minutes

Part I	15 minutes	Engage
Part II	60 minutes	Explore 1/Explain 1
Part III	60 minutes	Explore 2/Explain 2

Materials

Whole Class

- ❑ Chart paper
- ❑ Markers
- ❑ Playground areas (swings, tetherball, basketball hoops, four square, etc.)
- ❑ Playground balls
- ❑ 3.1.R1: Design a Playground
- ❑ 3.1.C1: Basketball
- ❑ 3.1.C2: Soccer
- ❑ 3.1.C3: Tug-of-war

Individual

- ❑ 3.1.H1: Motion Observation
- ❑ Science notebook

Teacher

- ❑ TalkScience resource (http://stemteachingtools.org/assets/landscapes/TalkSciencePrintable.pdf)

Advance Preparation

1. Gather materials.
2. Assess playground(s) for activities (i.e. swings, slides, climbing structures, teeter-totter, horizontal bars, tetherball, playground balls or equipment, etc.) from which students will observe motion.
3. Review TalkScience resource (http://stemteachingtools.org/assets/landscapes/TalkSciencePrintable.pdf) to determine when best to use this resource in student-to-student discourse.
4. Make copies of **3.1.H1: Motion Observation** recording sheet for each student.

Procedure

Part I

Engage (15 minutes)

Obtain and communicate information describing patterns of movement on the playground.

1. Present students with the design problem and the goal. Display **3.1.R1: Design a Playground**. Say, "Suppose we arrived at school today only to find that the playground area was closed because there is a plan to replace the playground with new playground structures and activities. The school cannot rebuild and open the playground until it receives a design for new equipment and games.

   The school wants you, the students, to design new playground structures and activities that use the concepts of force and motion. Your challenge will be to use the engineering process to design and build a model for a new playground structure or activity and write an argument with evidence about why this design is the best."

2. Ask students to turn to their neighbor and discuss why we have a playground. What can we do at recess that we can't do in the classroom? As students share, record their ideas on a classroom chart.

   Leading Questions:

   "Why do we have a playground? I think _____.

   What can we do at recess that we can't do in the classroom?"

   Expected Student Response:

   - *We have playgrounds so that we can move around and not have to sit all day.*
   - *We can run, play games, and move anywhere we want.*

   TEACHER NOTE

   Connect "why" students think recess is necessary to the question about what is their favorite activity in terms of movement.

3. Continue the partner discussion, asking students to name their favorite playground activity, the type of movement they can do, and why they like it. Ask students to record their ideas in their science notebook.

   Leading Question:

   "When on the playground, I like to _____ because _____."

   Expected Student Response:

   - *I like to play soccer because it's fun to run up and down the field.*

- *I like to skip rope because I get to hop and sing with my friends.*
- *I like to play four-square because I get to hit the ball to my friends.*

4. Ask a few to share with the whole group their favorite playground activity, the type of movement they can do, and why they like it. Chart only the activity.

> **TEACHER NOTE**
>
> Keep this chart for reference in Step 16. Review the chart of the types of activities students like. If students listed basketball, soccer, and tug-of-war, circle them on the chart. If not, add them to the chart, stating that these are the activities they will be investigating during the next few days.

Part II

Explore 1/Explore 1 (60 minutes)

Use observations to describe movement on the playground, noting what causes the movement.

5. Remind students that they are going to design a playground to provide opportunities for movement so they need to observe movement on the current playground.
6. Distribute **3.1.H1: Motion Observation** to each student. Preview **3.1.H1: Motion Observation** with students so they know what to record in each of the boxes. Explain that the class will now go outside to observe movement on the playground in small groups. Their job is to work with their group to observe an object before it moves and then as it moves. Students will record their observations in words and drawings on **3.1.H1: Motion Observation**. Discuss what they will write and draw depending on whether the object is moving or not.
7. Divide the class into groups of 4. Assign each group something on the playground to investigate in terms of movement, making sure one group observes a basketball court (e.g., one to the tetherball, one to jump ropes, four-square, etc.).

> **TEACHER NOTE**
>
> Depending on the situation, several groups could observe the same object.

8. Take students outside and allow them to investigate their assigned object. Remind students to record their observations on **3.1.H1: Motion Observation**. (Later this handout can be taped/glued in their science notebook.) Walk around and observe what students are recording. Pay attention to their prior knowledge of communicating observations related to forces and interactions of objects through cause and effects.

TEACHER NOTE

▶ Look at samples of **3.1.H1: Motion Observation** to formatively assess prior knowledge of students' ability to communicate their observations. Students may be sharing their observations using the kindergarten language of pushes, pulls rather than forces. If so, the term *force* is introduced in Step 11.

9. Return to the classroom. Have students discuss in their small groups their observations and drawings. Ask groups to focus on:

   - "What was the movement of the object?"
   - "What caused the object to move?"

   Have students tape/glue the **3.1.H1: Motion Observation** recording sheet in their science notebook.

10. Conduct a classroom discussion, having each "object" group share the movement of their object and what caused it to move. Record each group's answers on chart paper.

11. Ask students to record their responses to these three questions in their science notebook.

    Leading Question

    "How can you describe the motion of the objects that moved?"

    Expected Student Responses:

    - *Motion changed the position of an object because a force acted on it.*
    - *Motions moves something that was standing still to another place.*

    Leading Question

    "What similarities or patterns did you see in the movement or nonmovement of all of the objects?"

    Expected Student Responses:

    - *All of the moving objects moved from where they were to somewhere new.*
    - *All of the objects that were still didn't move at all.*

    Leading Question

    "What caused the objects to move?"

    Expected Student Response:

    - *Forces (pushes or pulls) caused the object to move.*

TEACHER NOTE

Students may be sharing their observations using the kindergarten language of *pushes* and *pulls*. If so, introduce the term *force* (any action that changes the shape or movement of an object). Explain that from now on they will be using this term to describe movement.

12. Lead students in a discussion of their explanations, noting cause and effect.

TEACHER NOTE

- Reference how when something happens because of something, the thing that makes the change occur is the cause, and the change is the effect.
- Briefly refer to language arts and other content areas where cause and effect is applicable.
- To clarify cause-and-effect relationships, use some of the students' sentences and highlight the cause and effect in each one.
- It is important for students to grasp the concept of events having causes and that these causal relationships sometimes form patterns that are observable and measurable. This will be introduced in Lesson 2: Forces Move Objects.

Part III

Explore 2/Explain 2 (60 minutes)

Identify initial criteria for a problem's solution based on observations of movement and its causes.

13. Remind students that they will design the new playground. How will the school administration decide which design to choose to build the playground? Explain that engineering design must meet certain criteria for the final product.
14. Ask students to identify the science information they learned in today's lesson regarding forces and motion that they will use as foundational to their design. Have them respond to these questions in their science notebook:
    - What was the movement?
    - What caused it to move?
    - How does it apply to our problem?

TEACHER NOTE

Lesson 2: Forces Move Objects, Lesson 3: Patterns of Motion, and Lesson 4: Balanced and Unbalanced Forces are built on answers to these 3 questions, and rubrics are found in Lesson 2: Forces Move Objects and Lesson 3: Patterns of Motion to formatively measure student understanding about force and motion.

15. Conduct a brainstorm of this question: "How can you use what you know about force and motion to create the criteria for the playground design?" Chart the list of criteria, which will be added to during each lesson.

TEACHER NOTE

Students should suggest the following for criteria: motion, motion changes direction and strength, pattern of predictability, and forces. The idea of balance and unbalanced forces will most likely not be mentioned in the list yet. They will learn more about this in Lesson 2: Forces Move Objects. It can be added to the criteria list then.

16. Connect the criteria list to the types of movement that students need to investigate to gather evidence to support their playground design. Review the chart with the types of movement on the playground. Ask: "Which activities could you investigate to gather evidence that will explain the science behind the criteria in your design? Why do you think this would be a good activity to investigate?" If students listed basketball, soccer, and/or tug-of-war, circle them as an affirmation that they already had thought about these activities. If not, explain that the school has requested a basketball court, a soccer field, and an area for games like tug-of-war. Tell students, "We will investigate basketball, soccer, and tug-of-war over the next several lessons. As you investigate basketball, soccer and tug-of-war, you will make designs for these three playground areas. Then you will put those designs together with designs for other playground equipment for their final playground design at the end of the unit."

17. As a class, create three charts. Use **3.1.C1: Basketball**, **3.1.C2: Soccer** and **3.1.C3: Tug-of-war** as models. For each activity, have the class brainstorm the questions that can be investigated about movement and the evidence that can be gathered that will support a playground design. Record student ideas on the charts.

18. Review the three charts. Ask students if they have any other questions or wonderings to add to the charts.

TEACHER NOTE

Save each chart and add new learnings and wonderings to it after each lesson activity.

References

STEM Teaching Tools. (n.d.). Talk Science Printable. Retrieved from http://stemteachingtools.org/assets/landscapes/TalkSciencePrintable.pdf

Toolbox Table of Contents

Basketball

What Questions Can We Investigate About Movement?	What Evidence Can We Gather That Will Support Our Design?

Soccer

What Questions Can We Investigate About Movement?	What Evidence Can We Gather That Will Support Our Design?

Tug-of-war

What Questions Can We Investigate About Movement?	What Evidence Can We Gather That Will Support Our Design?

Motion Observation

Draw and label a model of the playground object when it is not moving:	Draw and label a model of the playground object when it is moving:
What do you notice about how the object doesn't move?	What do you notice about how the object moves?
What do you think caused the object to not move?	What do you think caused the object to move?
What questions do you have about the movement of the object?	

Design a Playground

A demolition crew removed the playground structure and activity areas. The school wants the students to design a new playground structure and activity area that uses the concepts of force and motion.

Image via iStock.com/PhilAugustavo

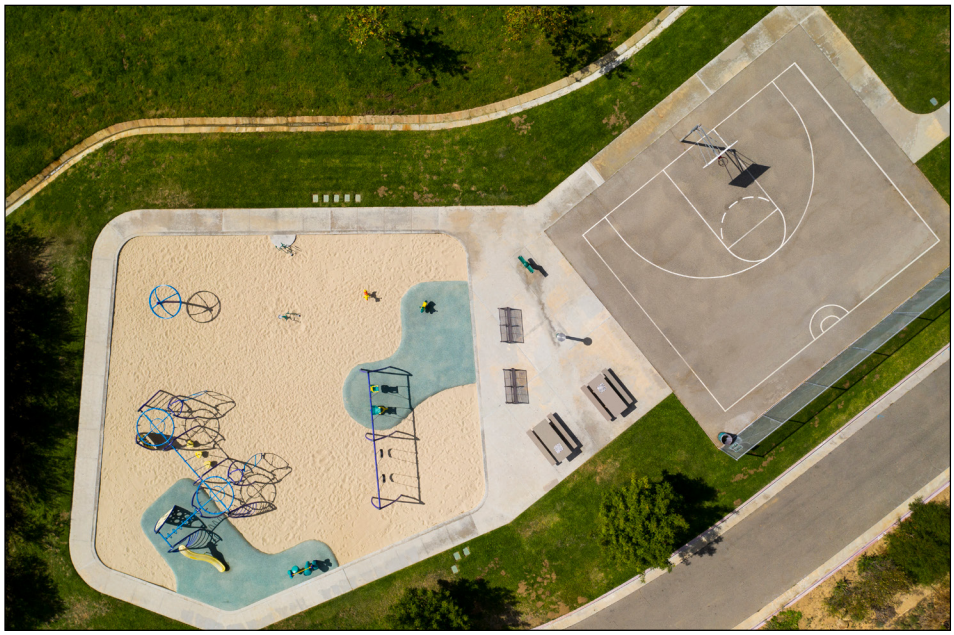

Image via iStock.com/Spiderplay

Appendix 3.1

Movement on the Playground

Next Generation Science Standards (NGSS)

This lesson is building toward:

PERFORMANCE EXPECTATIONS (PE)	
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. [Clarification Statement: Examples could include an unbalanced force on one side of a ball can make it start moving; and, balanced forces pushing on a box from both sides will not produce any motion at all.] [*Assessment Boundary: Assessment is limited to one variable at a time: number, size, or direction of forces. Assessment does not include quantitative force size, only qualitative and relative. Assessment is limited to gravity being addressed as a force that pulls objects down.*]

NGSS Lead States. 2013. Next Generation Science Standards: For States, By States. Washington, DC: The National Academies Press.

SCIENCE AND ENGINEERING PRACTICES (SEP)

Asking Questions and Defining Problems

- Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships.
- Define (Given) a simple design problem that can be solved through the development of an object, tool, process, or system and includes (identify) several criteria for success.

DISCIPLINARY CORE IDEAS (DCI)

PS2.A: Forces and Motion

- Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion.

PS2.B: Types of Interaction

- Objects in contact exert forces on each other.

ETS1.A: Defining and Delimiting Engineering Problems

- Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.

Appendix 3.1

CROSSCUTTING CONCEPTS (CCC)
Cause and Effect
• Students routinely identify and test causal relationships and use these relationships to explain change. They understand events that occur together with regularity might or might not signify a cause and effect relationship.

Common Core State Standards (CCSS)

CCSS ELA READING
CCSS.ELA-LITERACY.RI.3.3
Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect.
CCSS ELA SPEAKING & LISTENING
CCSS.ELA-LITERACY.SL.3.1
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.
CCSS.ELA-LITERACY.SL.3.4
Report on a topic or text, or recount an experience with appropriate facts and relevant, descriptive details, speaking clearly at an understandable level.

California English Language Development (ELD) Standards

CA ELD		
Part 1.3.1 Exchanging information and ideas.		
EMERGING	EXPANDING	BRIDGING
Contribute to conversations and express ideas by asking and answering *yes-no* and *wh-* questions and responding using short phrases.	Contribute to class, group, and partner discussions, including sustained dialogue, by following turn-taking rules, asking relevant questions, affirming others, and adding relevant information.	Contribute to class, group, and partner discussions, including sustained dialogue, by following turn-taking rules, asking relevant questions, affirming others, adding relevant information, building on responses, and providing useful feedback.
In addition to the standard above, you may find that you also touch on the following standard in this lesson as well: **P1.3.9** Plan and deliver brief oral presentations on a variety of topics and content areas.		