



**Connecticut
Alternate
Science
Assessment**

Grade 11 Performance Tasks

Physical Science

Storyline 5: Forces and Motion

Storyline 6: Using Energy Every Day



Connecticut
Alternate
Science
Assessment

Physical Science

Storyline 5: Forces and Motion

Grade 11 Performance Task



Physical Science

Storyline 5: Forces and Motion
Grade 11 Performance Task

Guiding Questions: What factors cause an object to speed up or slow down? How can the force on an object be minimized during a collision to protect it?

| Grade 11 | | | |
|--|--|--|---|
| NGSS Learning Progressions | NGSS Standard Performance Expectations | Connecticut Alternate Science Essence Statements | Core Extensions |
| PS2.A Forces and Motion | HS-PS2-1 Analyze data to support the claim that Newton’s second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration. | CTAS-HS-PS2-1 Use observations and/or data to support a claim that the net force on an object is equal to its mass multiplied by its acceleration. | <ol style="list-style-type: none"> 1. Compare the speed of two objects under different conditions. (CTAS-HS-PS2-1) 2. Compare the acceleration of objects (speeding up or slowing down) under different conditions. (CTAS-HS-PS2-1) 3. Use observation and/or data to support a claim that a greater force will cause an object in motion to speed up faster. (CTAS-HS-PS2-1) 4. Gather data to investigate the force on an object during a collision. (CTAS-HS-PS2-3) 5. Make and support a claim about the modification to a device and its effect on reducing the force during the collision. (CTAS-HS-PS2-3) |
| | HS-PS2-3 Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.* | CTAS-HS-PS2-3 Test a device that minimizes the force on a common object during a collision.* | |
| Appropriate Vocabulary | Acceleration, conditions, force, Newtons, motion, collision, collide, device, cushioning, claim, mass, speed, ramp, steep | | |
| *Indicates a NGSS Standard Performance Expectation or Connecticut Alternate Science Essence Statement that incorporates engineering design. | | | |



Physical Science
Storyline 5: Forces and Motion
Grade 11 Performance Task

General Overview:

This performance task focuses on forces and motion in the context of skateboard ramps and colliding objects. Students will begin by considering the speed, acceleration, and forces in the context of a skateboarder going down a ramp. Students will then conduct a guided, hands-on investigation to test a device that minimizes the force on an object during a collision.

List of Materials Needed:

Teacher-Provided Resources:

ACTIVITY 4

Use the materials and instructions included in Activity 4 Resource 1 to set up the investigation according to the diagram included in Activity 4 Resource 2. **The investigation must be set up prior to the administration of the activity.** Teacher-Provided Resources include:

- Wall
- Scissors
- Masking Tape
- 1 Ping Pong Ball (or Other Type of Ball)
- 1 Roll of Strong Tape (e.g., Duct Tape or Packing Tape)
- 1 Roll of String
- 2 Sheets of Cushioning Material (e.g., Bubble Wrap or Cotton)
- Impact Safety Glasses (1 Each for Teacher and Student[s])
- Measuring Device (Meter Stick, Yard Stick, or Measuring Tape)*

*Best practice is to use metric measuring devices and units.

Instructions for Preparing Materials:

Teachers must collect all relevant materials prior to the administration of each activity. The Card, Sentence Strip, and Strip Resources will need to be cut out. Resources are listed according to the Resource Identifier, which appears on the back of each Resource. The Resources needed for the administration of each activity are listed according to these Resource Identifiers in the Teacher Notes section of each activity.

List of Resources:

- Activity 1 Resource 1: Skateboard Ramp 1 Poster
- Activity 1 Resource 2: Skateboard Ramp 2 Poster
- Activity 1 Resource 3: Card 3a and Card 3b
 - Card 3a – Ramp 1
 - Card 3b – Ramp 2
- Activity 1 Resource 4: Sentence Strips 4a – 4c
 - Sentence Strip 4a – steeper
 - Sentence Strip 4b – shorter
 - Sentence Strip 4c – wider
- Activity 2 Resource 1: Skateboard Half-Pipe Ramp Poster
- Activity 2 Resource 2: Cards 2a – 2c
 - Card 2a – Point A/Point B
 - Card 2b – Point B
 - Card 2c – Point B/Point C
- Activity 3 Resource 1: Skateboard Investigation Poster
- Activity 3 Resource 2: Skateboard Investigation Data Table Poster
- Activity 3 Resource 3: Strips 3a – 3c
 - Strip 3a – Trial 1
 - Strip 3b – Trial 2
 - Strip 3c – same
- Activity 3 Resource 4: Sentence Strips 4a – 4c
 - Sentence Strip 4a – 20N; 3 m/sec
 - Sentence Strip 4b – 10N; 6 m/sec
 - Sentence Strip 4c – 20N; 6 m/sec
- Activity 4 Resource 1: Teacher Directions for Collision Investigation – Collision Investigation Materials
- Activity 4 Resource 2: Teacher Directions for Collision Investigation – Collision Investigation Diagram
- Activity 4 Resource 3: Collision Investigation 1 Observations Data Table
- Activity 4 Resource 4: Sentence Strips 4a – 4c
 - Sentence Strip 4a – reduces force
 - Sentence Strip 4b – increases force
 - Sentence Strip 4c – does not change force
- Activity 5 Resource 1: Collision Investigation 2 Observations Data Table
- Activity 5 Resource 2: Sentence Strips 2a – 2c
 - Sentence Strip 2a – facial tissue
 - Sentence Strip 2b – paper towel
 - Sentence Strip 2c – clear tape

ACTIVITY 1

Essence Statement: CTAS-HS-PS2-1 Use observations and/or data to support a claim that the net force on an object is equal to its mass multiplied by its acceleration.

Core Extension 1: Compare the speed of two objects under different conditions. (CTAS-HS-PS2-1)

Teacher Notes:

Collect the following resources for this activity:

- Activity 1 Resource 1: Skateboard Ramp 1 Poster
- Activity 1 Resource 2: Skateboard Ramp 2 Poster
- Activity 1 Resource 3: Card 3a and Card 3b
 - Card 3a – Ramp 1
 - Card 3b – Ramp 2
- Activity 1 Resource 4: Sentence Strips 4a – 4c
 - Sentence Strip 4a – steeper
 - Sentence Strip 4b – shorter
 - Sentence Strip 4c – wider

Steps to Follow:

1. **SAY** “In this activity, we are going to talk about how a skateboarder will travel at different speeds down two different ramps.”

2. Display Resource 1: Skateboard Ramp 1 Poster for the student.

3. Display Resource 2: Skateboard Ramp 2 Poster for the student.

4. Indicate Resource 1 and Resource 2.

SAY “The same skateboarder is shown at the top of Ramp 1 (*indicate Resource 1*) and Ramp 2 (*indicate Resource 2*). The skateboarder will ride his skateboard down each ramp.”

5. **ASK** “Will the skateboarder travel faster down Ramp 1 or down Ramp 2?”

6. Provide Resource 3: Card 3a and Card 3b to the student. Indicate and read each Card.

a. Indicate Card 3a.

SAY “Ramp 1”

b. Indicate Card 3b.

SAY “Ramp 2”

7. **ASK AGAIN** “Will the skateboarder travel faster down Ramp 1 or down Ramp 2?”

8. Allow student to respond and record response. If no response or if incorrect response, proceed to scaffolding instructions.
9. Indicate Card 3b.
- | | |
|------------|--|
| SAY | “The skateboarder will travel faster down Ramp 2.” |
|------------|--|
10. **ASK** “Why will the skateboarder travel faster down Ramp 2?”
11. Provide Resource 4: Sentence Strips 4a – 4c to the student. Indicate and read each Sentence Strip.
- a. Indicate Sentence Strip 4a.
- | | |
|------------|----------------------|
| SAY | “Ramp 2 is steeper.” |
|------------|----------------------|
- b. Indicate Sentence Strip 4b.
- | | |
|------------|----------------------|
| SAY | “Ramp 2 is shorter.” |
|------------|----------------------|
- c. Indicate Sentence Strip 4c.
- | | |
|------------|--------------------|
| SAY | “Ramp 2 is wider.” |
|------------|--------------------|
12. **ASK AGAIN** “Why will the skateboarder travel faster down Ramp 2?”
13. Allow student to respond and record response.
14. Indicate Sentence Strip 4a.
- | | |
|------------|--|
| SAY | “The skateboarder will travel faster down Ramp 2 because Ramp 2 is steeper.” |
|------------|--|
15. **SAY** “We are now finished with this activity.”

Scoring Guidance and Scaffolding

Scaffolding:

1. After student makes first incorrect attempt, indicate Card 3b.

| | |
|------------|--|
| SAY | “The skateboarder will travel faster down Ramp 2.” |
|------------|--|

2. **ASK** “Why will the skateboarder travel faster down Ramp 2?”

3. Provide Resource 4: Sentence Strips 4a – 4c to the student. Indicate and read each Sentence Strip.

- a. Indicate Sentence Strip 4a.

| | |
|------------|----------------------|
| SAY | “Ramp 2 is steeper.” |
|------------|----------------------|

- b. Indicate Sentence Strip 4b.

| | |
|------------|----------------------|
| SAY | “Ramp 2 is shorter.” |
|------------|----------------------|

- c. Indicate Sentence Strip 4c.

| | |
|------------|--------------------|
| SAY | “Ramp 2 is wider.” |
|------------|--------------------|

4. **ASK AGAIN** “Why will the skateboarder travel faster down Ramp 2?”

5. Allow student to respond and record response.

6. Indicate Sentence Strip 4a.

| | |
|------------|--|
| SAY | “The skateboarder will travel faster down Ramp 2 because Ramp 2 is steeper.” |
|------------|--|

7. **SAY** “We are now finished with this activity.”

Correct answers are as follows:

1. Will the skateboarder travel faster down Ramp 1 or down Ramp 2?
 - a. Card 3b – Ramp 2
2. Why will the skateboarder travel faster down Ramp 2?
 - a. Sentence Strip 4a – Ramp 2 is steeper.

| Content Guidance | Rating | Score |
|--|---|----------|
| <p>Student...</p> <ul style="list-style-type: none"> gives NO response. <p style="text-align: center;">OR</p> <ul style="list-style-type: none"> is unable to identify that the skateboarder will travel faster down Ramp 2 (Card 3b); and is unable to describe that the skateboarder will travel faster on Ramp 2 because Ramp 2 is steeper (Sentence Strip 4a). | <p>The student does not demonstrate understanding.</p> | <p>0</p> |
| <p>Student...</p> <ul style="list-style-type: none"> is able to identify that the skateboarder will travel faster down Ramp 2 (Card 3b); and is unable to describe that the skateboarder will travel faster down Ramp 2 because Ramp 2 is steeper (Sentence Strip 4a). <p style="text-align: center;">OR</p> <ul style="list-style-type: none"> is unable to identify that the skateboarder will travel faster down Ramp 2 (Card 3b); and after scaffolding, is able to describe that the skateboarder will travel faster down Ramp 2 because Ramp 2 is steeper (Sentence Strip 4a). | <p>The student demonstrates limited understanding typically requiring additional support through scaffolding.</p> | <p>1</p> |
| <p>Student...</p> <ul style="list-style-type: none"> is able to identify that the skateboarder will travel faster down Ramp 2 (Card 3b); and is able to describe that the skateboarder will travel faster down Ramp 2 because Ramp 2 is steeper (Sentence Strip 4a). | <p>The student demonstrates understanding independently without scaffolding.</p> | <p>2</p> |

ACTIVITY 2

Essence Statement: CTAS-HS-PS2-1 Use observations and/or data to support a claim that the net force on an object is equal to its mass multiplied by its acceleration.

Core Extension 2: Compare the acceleration of objects (speeding up or slowing down) under different conditions. (CTAS-HS-PS2-1)

Teacher Notes:

Collect the following resources for this activity:

- Activity 2 Resource 1: Skateboard Half-Pipe Ramp Poster
- Activity 2 Resource 2: Cards 2a – 2c
 - Card 2a – Point A/Point B
 - Card 2b – Point B
 - Card 2c – Point B/Point C

Steps to Follow:

1. **SAY** “In this activity, we are going to talk about how, at different points on a half-pipe ramp, a skateboarder travels at different speeds.”

2. Display Resource 1: Skateboard Half-Pipe Ramp Poster for the student.

3. Indicate Resource 1.

SAY “Some ramps are curved (*trace finger along ramp shape*). This curved ramp is called a half-pipe ramp. A skateboarder rolls down a half-pipe ramp and travels across Point A, through Point B, and stops at Point C (*trace route on Resource 1 with finger*). The skateboarder travels across Points A, B, and C (*indicate Points A, B, and C*) at different speeds.”

4. **ASK** “Where on the half-pipe ramp is the skateboarder speeding up?”

5. Provide Resource 2: Cards 2a – 2c to the student. Indicate and read each Card.

a. Indicate Card 2a.

SAY “from Point A to Point B”

b. Indicate Card 2b.

SAY “at Point B”

c. Indicate Card 2c.

SAY “from Point B to Point C”

6. **ASK AGAIN** “Where on the half-pipe ramp is the skateboarder speeding up?”

7. Allow student to respond and record response. If no response or if incorrect response, proceed to scaffolding instructions.
8. Indicate Card 2a.
- | | |
|------------|--|
| SAY | “The skateboarder is speeding up from Point A to Point B.” |
|------------|--|
9. **ASK** “Where on the half-pipe ramp is the skateboarder slowing down?”
10. Provide remaining Resource 2: Card 2b and Card 2c to the student. Indicate and read each remaining Card.
- a. Indicate Card 2b.
- | | |
|------------|--------------|
| SAY | “at Point B” |
|------------|--------------|
- b. Indicate Card 2c.
- | | |
|------------|---------------------------|
| SAY | “from Point B to Point C” |
|------------|---------------------------|
11. **ASK AGAIN** “Where on the half-pipe ramp is the skateboarder slowing down?”
12. Allow student to respond and record response.
13. Indicate Card 2c.
- | | |
|------------|---|
| SAY | “The skateboarder is slowing down from Point B to Point C.” |
|------------|---|
14. **SAY** “We are now finished with this activity.”

Scoring Guidance and Scaffolding

Scaffolding:

1. After student makes first incorrect attempt, indicate Card 2a.

| | |
|------------|--|
| SAY | “The skateboarder is speeding up from Point A to Point B.” |
|------------|--|

2. **ASK** “Where on the half-pipe ramp is the skateboarder slowing down?”

3. Provide remaining Resource 2: Card 2b and Card 2c to the student. Indicate and read each remaining Card.

- a. Indicate Card 2b.

| | |
|------------|--------------|
| SAY | “at Point B” |
|------------|--------------|

- b. Indicate Card 2c.

| | |
|------------|---------------------------|
| SAY | “from Point B to Point C” |
|------------|---------------------------|

4. **ASK AGAIN** “Where on the half-pipe ramp is the skateboarder slowing down?”

5. Allow student to respond and record response.

6. Indicate Card 2c.

| | |
|------------|---|
| SAY | “The skateboarder is slowing down from Point B to Point C.” |
|------------|---|

7. **SAY** “We are now finished with this activity.”

Correct answers are as follows:

1. Where on the half-pipe ramp is the skateboarder speeding up?
 - a. Card 2a – from Point A to Point B
2. Where on the half-pipe ramp is the skateboarder slowing down?
 - a. Card 2c – from Point B to Point C



| Content Guidance | Rating | Score |
|--|---|-------|
| <p>Student...</p> <ul style="list-style-type: none">gives NO response; <p style="text-align: center;">OR</p> <ul style="list-style-type: none">is unable to identify that the skateboarder is speeding up from Point A to Point B on the half-pipe ramp (Card 2a); andis unable to identify that the skateboarder is slowing down from Point B to Point C on the half-pipe ramp (Card 2c). | <p>The student does not demonstrate understanding.</p> | 0 |
| <p>Student...</p> <ul style="list-style-type: none">is able to identify that the skateboarder is speeding up from Point A to Point B on the half-pipe ramp (Card 2a); andis unable to identify that the skateboarder is slowing down from Point B to Point C on the half-pipe ramp (Card 2c). <p style="text-align: center;">OR</p> <ul style="list-style-type: none">is unable to identify that the skateboarder is speeding up from Point A to Point B on the half-pipe ramp (Card 2a); andafter scaffolding, is able to identify that the skateboarder is slowing down from Point B to Point C on the half-pipe ramp (Card 2c). | <p>The student demonstrates limited understanding typically requiring additional support through scaffolding.</p> | 1 |
| <p>Student...</p> <ul style="list-style-type: none">is able to identify that the skateboarder is speeding up from Point A to Point B on the half-pipe ramp (Card 2a); andis able to identify that the skateboarder is slowing down from Point B to Point C on the half-pipe ramp (Card 2c). | <p>The student demonstrates understanding independently without scaffolding.</p> | 2 |

ACTIVITY 3

Essence Statement: CTAS-HS-PS2-1 Use observations and/or data to support a claim that the net force on an object is equal to its mass multiplied by its acceleration.

Core Extension 3: Use observation and/or data to support a claim that a greater force will cause an object in motion to speed up faster. (CTAS-HS-PS2-1)

Teacher Notes:

Collect the following resources for this activity:

- Activity 3 Resource 1: Skateboard Investigation Poster
- Activity 3 Resource 2: Skateboard Investigation Data Table Poster
- Activity 3 Resource 3: Strips 3a – 3c
 - Strip 3a – Trial 1
 - Strip 3b – Trial 2
 - Strip 3c – same
- Activity 3 Resource 4: Sentence Strips 4a – 4c
 - Sentence Strip 4a – 20N; 3 m/sec
 - Sentence Strip 4b – 10N; 6 m/sec
 - Sentence Strip 4c – 20N; 6 m/sec

Steps to Follow:

1. **SAY** “In this activity, we will talk about how a student investigates the relationship between motion and force. The student measured force in a unit called Newtons. The student measured speed in units of meters traveled per second.”

2. Display Resource 1: Skateboard Investigation Poster for the student.

3. Display Resource 2: Skateboard Investigation Data Table Poster for the student.

4. Indicate Resource 1.

SAY “A student investigates how pushing a skateboarder affects his motion at different points along a track. The points are labeled A (*indicate Point A*), B (*indicate Point B*), and C (*indicate Point C*).”

5. Indicate Resource 2.

SAY “The student records their observations in this data table titled ‘**Skateboard Investigation Data Table**’.”

6. Indicate Resource 1 and Resource 2.

SAY “In Trial 1, one student pushes the skateboarder with a small, constant force of 10 Newtons. The skateboarder’s speed is 1 meter per second at Point A, 2 meters per second at Point B, and 3 meters per second at Point C.”

7. Indicate Resource 1 and Resource 2.

| | |
|------------|--|
| SAY | “In Trial 2, the same student pushes the skateboarder with a large, constant force of 20 Newtons. The skateboarder’s speed is 2 meters per second at Point A, 4 meters per second at Point B, and 6 meters per second at Point C.” |
|------------|--|

8. **ASK** “During which trial was the skateboarder speeding up faster?”

9. Provide Resource 3: Strips 3a – 3c to the student. Indicate and read each Strip.

a. Indicate Strip 3a.

| | |
|------------|-----------|
| SAY | “Trial 1” |
|------------|-----------|

b. Indicate Strip 3b.

| | |
|------------|-----------|
| SAY | “Trial 2” |
|------------|-----------|

c. Indicate Strip 3c.

| | |
|------------|-----------------------------|
| SAY | “same speed in both trials” |
|------------|-----------------------------|

10. **ASK AGAIN** “During which trial was the skateboarder speeding up faster?”

11. Allow student to respond and record response. If no response or if incorrect response, proceed to scaffolding instructions.

12. Indicate Strip 3b and Resource 2.

| | |
|------------|---|
| SAY | “Based on the data (<i>indicate Resource 2</i>) we can claim the skateboarder sped up faster during Trial 2 (<i>indicate Strip 3b</i>). In Trial 2, the skateboarder went 6 m/sec at Point C compared to 3 m/s in Trial 1. We can also claim that the faster speed was due to the greater force when pushing the skateboarder.” |
|------------|---|

13. **ASK** “Which statement of data supports the claim that the skateboarder sped up faster **due to a greater force**?”

14. Provide Resource 4: Sentence Strips 4a – 4c to the student. Indicate and read each Sentence Strip.

a. Indicate Sentence Strip 4a.

| | |
|------------|--|
| SAY | “With 20N of force, the speed at Point C was 3 m/sec.” |
|------------|--|

b. Indicate Sentence Strip 4b.

| | |
|------------|--|
| SAY | “With 10N of force, the speed at Point C was 6 m/sec.” |
|------------|--|

c. Indicate Sentence Strip 4c.

| | |
|------------|--|
| SAY | "With 20N of force, the speed at Point C was 6 m/sec." |
|------------|--|

15. **ASK AGAIN** "Which statement of data supports the claim that the skateboarder sped up faster **due to a greater force?**"

16. Allow student to respond and record response.

17. Indicate Sentence Strip 4c.

| | |
|------------|--|
| SAY | "With 20N of force, the speed at Point C was 6 m/sec." |
|------------|--|

18. **SAY** "We are now finished with this activity."

Scoring Guidance and Scaffolding

Scaffolding:

1. After student makes first incorrect attempt, indicate Strip 3b and Resource 2.

| | |
|------------|---|
| SAY | “Based on the data (<i>indicate Resource 2</i>) we can claim the skateboarder sped up faster during Trial 2 (<i>indicate Strip 3b</i>). In Trial 2, the skateboarder went 6 m/sec at Point C compared to 3 m/s in Trial 1. We can also claim that the faster speed was due to the greater force when pushing the skateboarder.” |
|------------|---|

2. **ASK** “Which statement of data supports the claim that the skateboarder sped up faster **due to a greater force**?”

3. Provide Resource 4: Sentence Strips 4a – 4c to the student. Indicate and read each Sentence Strip.

- a. Indicate Sentence Strip 4a.

| | |
|------------|--|
| SAY | “With 20N of force, the speed at Point C was 3 m/sec.” |
|------------|--|

- b. Indicate Sentence Strip 4b.

| | |
|------------|--|
| SAY | “With 10N of force, the speed at Point C was 6 m/sec.” |
|------------|--|

- c. Indicate Sentence Strip 4c.

| | |
|------------|--|
| SAY | “With 20N of force, the speed at Point C was 6 m/sec.” |
|------------|--|

4. **ASK AGAIN** “Which statement of data supports the claim that the skateboarder sped up faster **due to a greater force**?”

5. Allow student to respond and record response.

6. Indicate Sentence Strip 4c.

| | |
|------------|--|
| SAY | “With 20N of force, the speed at Point C was 6 m/sec.” Say, “We are now finished with this activity.” |
|------------|--|

7. **SAY** “We are now finished with this activity.”

Correct answers are as follows:

1. During which trial was the skateboarder speeding up faster?
 - a. Strip 3b – Trial 2
2. Which statement of data supports the claim that the skateboarder sped up faster **due to a greater force**?
 - a. Sentence Strip 4c – With 20N of force, the speed at Point C was 6 m/sec.

| Content Guidance | Rating | Score |
|--|---|----------|
| <p>Student...</p> <ul style="list-style-type: none"> gives NO response. <p style="text-align: center;">OR</p> <ul style="list-style-type: none"> is unable to identify that the skateboarder speeds up faster during Trial 2 (Strip 3b); and is unable to interpret data in the table to support the claim that the skateboarded travels faster when pushed with a greater force (Sentence Strip 4c). | <p>The student does not demonstrate understanding.</p> | <p>0</p> |
| <p>Student...</p> <ul style="list-style-type: none"> is able to identify that the skateboarder speeds up faster during Trial 2 (Strip 3b); and is unable to interpret data in the table to support the claim that the skateboarder travels faster when pushed with a greater force (Sentence Strip 4c). <p style="text-align: center;">OR</p> <ul style="list-style-type: none"> is unable to identify that the skateboarder speeds up faster during Trial 2 (Strip 3b); and after scaffolding, is able to interpret data in the table to support the claim that the skateboarder travels faster when pushed with a greater force (Sentence Strip 4c). | <p>The student demonstrates limited understanding typically requiring additional support through scaffolding.</p> | <p>1</p> |
| <p>Student...</p> <ul style="list-style-type: none"> is able to identify that the skateboarder speeds up faster during Trial 2 (Strip 3b); and is able to interpret data in the table to support the claim that the skateboarder travels faster when pushed with a greater force (Sentence Strip 4c). | <p>The student demonstrates understanding independently without scaffolding.</p> | <p>2</p> |

ACTIVITY 4

Essence Statement: CTAS-HS-PS2-3 Test a device that minimizes the force on a common object during a collision.*

Core Extension 4: Gather data to investigate the force on an object during a collision. (CTAS-HS-PS2-3)

Teacher Notes:

Collect the following resources for this activity:

- Activity 4 Resource 1: Teacher Directions for Collision Investigation – Collision Investigation Materials
- Activity 4 Resource 2: Teacher Directions for Collision Investigation – Collision Investigation Diagram
- Activity 4 Resource 3: Collision Investigation 1 Observations Data Table
- Activity 4 Resource 4: Sentence Strips 4a – 4c
 - Sentence Strip 4a – reduces force
 - Sentence Strip 4b – increases force
 - Sentence Strip 4c – does not change force

Teacher-Provided Resources:

Use the materials and instructions included in Resource 1 to set up the investigation according to the diagram included in Resource 2. **Teacher must set up and test the investigation prior to introducing the investigation to the student.** Teacher-Provided Resources include:

- Wall
- Scissors
- Masking Tape
- 1 Ping Pong Ball (or Other Type of Ball)
- 1 Roll of Strong Tape (e.g., Duct Tape or Packing Tape)
- 1 Roll of String
- 2 Sheets of Cushioning Material (e.g., Bubble Wrap or Cotton)
- Impact Safety Glasses (1 Each for Teacher and Student[s])
- Measuring Device (Meter Stick, Yard Stick, or Measuring Tape)*

*Best practice in science instruction is to use metric measuring devices and units.

Activity 4 and Activity 5 must be completed back-to-back.

Steps to Follow:

1.

| | |
|------------|--|
| SAY | “In this activity, we are going to conduct an investigation to study a collision.” |
|------------|--|
2. Use the materials and instructions included in Resource 1: Teacher Directions for Collision Investigation – Collision Investigation Materials to set up the investigation according to the Resource 2: Teacher Directions for Collision Investigation – Collision Investigation Diagram.
3. Display Resource 3: Collision Investigation 1 Observations Data Table for the student.

4. Indicate Resource 3.

| | |
|------------|--|
| SAY | “In this investigation, we will make observations about what happens to the distance that the ball bounces back from the wall during three different trials. We will record our observations in this data table. During Trial 1 (<i>indicate ‘Trial 1’</i>), we will have no cushioning on the wall (<i>indicate no cushion</i>), and we will measure the distance that the ball bounces back in centimeters (<i>indicate ‘___ centimeters’ row 1</i>). During Trial 2 (<i>indicate ‘Trial 2’</i>), we will have a small amount of cushioning on the wall (<i>indicate ‘Small Amount’</i>), and we will measure the distance that the ball bounces back in centimeters (<i>indicate ‘___ centimeters’ row 2</i>). During Trial 3 (<i>indicate ‘Trial 3’</i>), we will have a large amount of cushioning on the wall (<i>indicate ‘Large Amount’</i>), and we will measure the distance that the ball bounces back in centimeters (<i>indicate ‘___ centimeters’ row 3</i>).” |
|------------|--|

5. **SAY** “We are ready to begin our investigation. Let’s begin Trial 1.”

6. Demonstrate Trial 1 for the student.

7. **ASK** “How far did the ball bounce back from the wall during Trial 1 when there was no cushioning on the wall?”

8. Allow student to record response in Resource 3: Collision Investigation 1 Observations Data Table.
Teacher may assist student if necessary.

9. **SAY** “Let’s begin Trial 2.”

10. Demonstrate Trial 2 for the student.

11. **ASK** “How far did the ball bounce back from the wall during Trial 2 when there was a small amount of cushioning on the wall?”

12. Allow student to record response in Resource 3: Collision Investigation 1 Observations Data Table.
Teacher may assist student if necessary.

13. **SAY** “Let’s begin Trial 3.”

14. Demonstrate Trial 3 for the student.

15. **ASK** “How far did the ball bounce back from the wall during Trial 3 when there was a large amount of cushioning on the wall?”

16. Allow student to record response in Resource 3.
Teacher may assist student if necessary.
17. **ASK** “Why does the ball not bounce back as far from the wall as when there is a large amount of cushioning on the wall?”
18. Provide Resource 4: Sentence Strips 4a – 4c to the student. Indicate and read each Sentence Strip.
- a. Indicate Sentence Strip 4a.
- SAY** “The cushioning reduces the force on the ball.”
- b. Indicate Sentence Strip 4b.
- SAY** “The cushioning increases the force on the ball.”
- c. Indicate Sentence Strip 4c.
- SAY** “The cushioning does not change the force on the ball.”
19. **ASK AGAIN** “Why does the ball not bounce back as far from the wall as when there is a large amount of cushioning on the wall?”
20. Allow student to respond and record response. If no response or if incorrect response, proceed to scaffolding instructions.
21. Indicate Sentence Strip 4a.
- SAY** “The cushioning reduces the force on the ball.”
22. **SAY** “We are now finished with this activity.”

Scoring Guidance and Scaffolding

Scaffolding:

1. After student makes first incorrect attempt, remove the incorrect Sentence Strip chosen by the student.

| | |
|------------|---|
| SAY | "[Insert description of incorrect Sentence Strip chosen by the student] is not the correct answer." |
|------------|---|

2.

| | |
|------------|---|
| ASK | "Why does the ball not bounce back as far from the wall as when there is a large amount of cushioning on the wall?" |
|------------|---|

3. Provide remaining Resource 4: Sentence Strips 4a – 4c to the student. Indicate and read each remaining Sentence Strip.

- a. Indicate Sentence Strip 4a.

| | |
|------------|---|
| SAY | "The cushioning reduces the force on the ball." |
|------------|---|

- b. Indicate Sentence Strip 4b.

| | |
|------------|---|
| SAY | "The cushioning increases the force on the ball." |
|------------|---|

- c. Indicate Sentence Strip 4c.

| | |
|------------|---|
| SAY | "The cushioning does not change the force on the ball." |
|------------|---|

4.

| | |
|------------------|---|
| ASK AGAIN | "Why does the ball not bounce back as far from the wall as when there is a large amount of cushioning on the wall?" |
|------------------|---|

5. Allow student to respond and record response.

6. Indicate Sentence Strip 4a.

| | |
|------------|---|
| SAY | "The cushioning reduces the force on the ball." |
|------------|---|

7.

| | |
|------------|---|
| SAY | "We are now finished with this activity." |
|------------|---|

The correct answer is as follows:

1. Why does the ball not bounce back as far from the wall as when there is a large amount of cushioning on the wall?
 - a. Sentence Strip 4a – The cushioning reduces the force on the ball.



| Content Guidance | Rating | Score |
|---|--|-------|
| Student... <ul style="list-style-type: none">gives NO response. <p style="text-align: center;">OR</p> <ul style="list-style-type: none">is unable to identify that cushioning reduces the force on the ball (Sentence Strip 4a). | The student does not demonstrate understanding. | 0 |
| Student... <ul style="list-style-type: none">after scaffolding, is able to identify that cushioning reduces the force on the ball (Sentence Strip 4a). | The student demonstrates limited understanding typically requiring additional support through scaffolding. | 1 |
| Student... <ul style="list-style-type: none">is able to identify that cushioning reduces the force on the ball (Sentence Strip 4a). | The student demonstrates understanding independently without scaffolding. | 2 |

ACTIVITY 5

Essence Statement: CTAS-HS-PS2-3 Test a device that minimizes the force on a common object during a collision.*

Core Extension 5: Make and support a claim about the modification to a device and its effect on reducing the force during the collision. (CTAS-HS-PS2-3)

Teacher Notes:

Collect the following resources for this activity:

- Activity 5 Resource 1: Collision Investigation 2 Observations Data Table
- Activity 5 Resource 2: Sentence Strips 2a – 2c
 - Sentence Strip 2a – facial tissue
 - Sentence Strip 2b – paper towel
 - Sentence Strip 2c – clear tape

Steps to Follow:

1.

| | |
|------------|---|
| SAY | “In this activity, we are going to talk about the results of an investigation. In this investigation, students conducted the same investigation that you just saw, where the students measured how far a ball bounced back after hitting a wall. This time, the students tried out different materials on the wall, and measured how far the ball bounced back with each material.” |
|------------|---|

2. Display Resource 1: Collisions Investigation 2 Observations Data Table for the student.
3. Indicate Resource 1.

| | |
|------------|--|
| SAY | “A student tested the distance that a ball bounced back from the wall using three different materials as cushion on the wall. During Trial 1 (<i>indicate ‘Trial 1’</i>), there was facial tissue as cushion on the wall (<i>indicate ‘Facial Tissue’</i>), and the ball bounced back 15 centimeters (<i>indicate ‘15 centimeters’ in row 1</i>). During Trial 2 (<i>indicate ‘Trial 2’</i>), there was paper towel as cushion on the wall (<i>indicate ‘Paper Towel’</i>), and the ball bounced back 5 centimeters (<i>indicate ‘5 centimeters’ in row 2</i>). During Trial 3 (<i>indicate ‘Trial 3’</i>), there was clear tape as cushion on the wall (<i>indicate ‘Clear Tape’</i>), and the ball bounced back 25 centimeters (<i>indicate ‘25 centimeters’ in row 3</i>).” |
|------------|--|

4.

| | |
|------------|--|
| ASK | “Which claim can be supported by the data in this data table?” |
|------------|--|

5. Provide Resource 2: Sentence Strips 2a – 2c to the student. Indicate and read each Sentence Strip.

- a. Indicate Sentence Strip 2a.

| | |
|------------|--|
| SAY | “The facial tissue cushioned the impact of the ball the best.” |
|------------|--|

- b. Indicate Sentence Strip 2b.

| | |
|------------|--|
| SAY | “The paper towel cushioned the impact of the ball the best.” |
|------------|--|

c. Indicate Strip 2c.

| | |
|------------|---|
| SAY | “The clear tape cushioned the impact of the ball the best.” |
|------------|---|

6. **ASK** “Which claim can be supported by the data in this data table?”

AGAIN

7. Allow student to respond and record response. If no response or if incorrect response, proceed to scaffolding instructions.

8. Indicate Sentence Strip 2b.

| | |
|------------|--|
| SAY | “The paper towel cushioned the impact of the ball the best.” |
|------------|--|

9. **SAY** “We are now finished with this activity.”

Scoring Guidance and Scaffolding

Scaffolding:

1. After student makes first incorrect attempt, remove the incorrect Strip chosen by the student.

| | |
|------------|--|
| SAY | "[Insert description of incorrect Strip chosen by the student] is not the correct answer." |
|------------|--|

2.

| | |
|------------|--|
| ASK | "Which claim can be supported by the data in this data table?" |
|------------|--|

3. Provide remaining Resource 2: Sentence Strips 2a – 2c to the student. Indicate and read each remaining Sentence Strip.

- a. Indicate Sentence Strip 2a.

| | |
|------------|--|
| SAY | "The facial tissue cushioned the impact of the ball the best." |
|------------|--|

- b. Indicate Sentence Strip 2b.

| | |
|------------|--|
| SAY | "The paper towel cushioned the impact of the ball the best." |
|------------|--|

- c. Indicate Strip 2c.

| | |
|------------|---|
| SAY | "The clear tape cushioned the impact of the ball the best." |
|------------|---|

4.

| | |
|----------------------|--|
| ASK AGAIN | "Which claim can be supported by the data in this data table?" |
|----------------------|--|

5. Allow student to respond and record response.

6. Indicate Sentence Strip 2b.

| | |
|------------|--|
| SAY | "The paper towel cushioned the impact of the ball the best." |
|------------|--|

7.

| | |
|------------|---|
| SAY | "We are now finished with this activity." |
|------------|---|

The correct answer is as follows:

1. Which claim can be supported by the data in this data table?
 - a. Sentence Strip 2b – The paper towel cushioned the impact of the ball the best.



| Content Guidance | Rating | Score |
|---|--|-------|
| Student... <ul style="list-style-type: none">gives NO response. <p style="text-align: center;">OR</p> <ul style="list-style-type: none">is unable to identify the claim that is supported by the data in the data table (Sentence Strip 2b). | The student does not demonstrate understanding. | 0 |
| Student... <ul style="list-style-type: none">after scaffolding, is able to identify the claim that is supported by the data in the data table (Sentence Strip 2b). | The student demonstrates limited understanding typically requiring additional support through scaffolding. | 1 |
| Student... <ul style="list-style-type: none">is able to identify the claim that is supported by the data in the data table (Sentence Strip 2b). | The student demonstrates understanding independently without scaffolding. | 2 |



Connecticut
Alternate
Science
Assessment

Physical Science

Storyline 6: Using Energy Every Day

Grade 11 Performance Task



Physical Science

**Storyline 6: Using Energy Every Day
Grade 11 Performance Task**

Guiding Questions: What types of energy do we use every day? How do devices we use every day transfer energy? How does heat energy transfer in a system?

| Grade 11 | | | |
|--|--|--|---|
| NGSS Learning Progressions | NGSS Standard Performance Expectations | Connecticut Alternate Science Essence Statements | Core Extensions |
| PS3.A Definitions of Energy | HS-PS3-3 Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.* | CTAS-HS-PS3-3 Test a device that converts one form of energy into another form of energy.* | 1. Identify two ways that different forms of energy (e.g., heat, motion, light, sound, electrical, mechanical, wind, kinetic) are used in everyday life. (CTAS-HS-PS3-3) |
| PS3.D Energy in Chemical Processes and Everyday Life | HS-PS3-4 Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics). | CTAS-HS-PS3-4 Use the results of an investigation as evidence that when objects at different temperatures are brought together in a system, they will eventually reach equilibrium (the same temperature). | 2. Given examples of energy transformation, label the energy change from one form to another. (CTAS-HS-PS3-3) 3. Use the results of a test to show that energy is transferred using a device. (CTAS-HS-PS3-3) 4. Measure the temperature of water at two different temperatures. (CTAS-HS-PS3-4) 5. Use the results of an investigation to show that temperature equilibrium will be reached by combining water at two different temperatures. (CTAS-HS-PS3-4) |
| Appropriate Vocabulary | Energy, motion, mechanical energy, kinetic energy, electrical energy, heat energy, light energy, sound energy, charge, transfer (move from one place to another), temperature, thermometer, equilibrium (a state in which opposing forces or influences are balanced) | | |

*** Indicates a NGSS Standard Performance Expectation or Connecticut Alternate Science Essence Statement that incorporates engineering design.**



Physical Science
Storyline 6: Using Energy Every Day
Grade 11 Performance Task

General Overview:

Students will complete a series of activities focusing on exploring ways that forms of energy are used in everyday life. Students will examine how energy can change from one form of energy to another, recognizing that energy transformation has occurred. Students will also use temperatures of samples of water to demonstrate temperature equilibrium.

List of Materials Needed:

Teacher-Provided Resources:

ACTIVITY 1

- 1 Piece of Paper
- 1 Pair of Scissors

ACTIVITY 4

Label the first cup with ‘**Sample 1**’ and the second cup with ‘**Sample 2**.’ Fill **Sample 1** with cold water. Fill **Sample 2** with hot water. These cups should be filled with two significantly different temperatures of water—there should be *at least* a 20-degree temperature difference between the two cups. **The investigation must be set up prior to the administration of the activity.** Teacher-Provided Resources include:

- Thermometer
- 2 Cups of the Same Type (e.g. 2 Paper Cups)
- Hot Water
- Cold Water

ACTIVITY 5

Label the first cup with ‘**Sample 1**,’ the second cup with ‘**Sample 2**,’ and the third cup with ‘**Sample 3**.’ Fill **Sample 1** one third of the way with cold water. Fill **Sample 2** one third of the way with hot water. These cups should be filled with two significantly different temperatures of water—there should *be at least* a 20-degree temperature difference between the two cups. You will combine the water in **Sample 1** and the water in **Sample 2** by pouring the contents of each into the cup labeled **Sample 3**.

The investigation must be set up prior to the administration of the activity. Teacher-Provided Resources include:

- Thermometer
- 3 Cups of the Same Type (e.g. 3 Paper Cups)
- Hot Water
- Cold Water

Instructions for Preparing Materials:

Teachers must collect all relevant materials prior to the administration of each activity. The Card, Sentence Strip, and Strip Resources will need to be cut out. Resources are listed according to the Resource Identifier, which appears on the back of each Resource. The Resources needed for the administration of each activity are listed according to these Resource Identifiers in the Teacher Notes section of each activity.

List of Resources:

- Activity 1 Resource 1: Cards 1a – 1c
 - Card 1a – Sound Energy
 - Card 1b – Electrical Energy
 - Card 1c – Mechanical Energy
- Activity 1 Resource 2: Toy Car Poster
- Activity 1 Resource 3: Cards 3a – 3c
 - Card 3a – Kinetic Energy
 - Card 3b – Light Energy
 - Card 3c – Heat Energy
- Activity 2 Resource 1: Table Lamp Poster
- Activity Resource 2: Cards 2a – 2c
 - Card 2a – Light Energy
 - Card 2b – Mechanical Energy
 - Card 2c – Sound Energy
- Activity 2 Resource 3: Electrical Energy to Radio Poster
- Activity 3 Resource 1a: Cell Phone 1 Charging Poster
- Activity 3 Resource 1b: Cell Phone 2 Charging Poster
- Activity 3 Resource 2: Sentence Strips 2a – 2c
 - Sentence Strip 2a – Cell Phone 1
 - Sentence Strip 2b – Cell Phone 2
 - Sentence Strip 2c – Both Cell Phones
- Activity 3 Resource 3: Strips 3a – 3c
 - Strip 3a – Heat/Electrical
 - Strip 3b – Mechanical/Light
 - Strip 3c – Electrical/Battery
- Activity 4 Resource 1: Water Temperature Investigation 1 Data Table Poster
- Activity 5 Resource 1: Water Temperature Investigation 2 Data Table Poster
- Activity 5 Resource 2: Sentence Strips 2a – 2c
 - Sentence Strip 2a – Higher
 - Sentence Strip 2b – Lower
 - Sentence Strip 2c – Same

- Activity 5 Resource 3: Sentence Strips 3a – 3c
 - Sentence Strip 3a – Higher
 - Sentence Strip 3b – Lower
 - Sentence Strip 3c – Same
- Activity 5 Resource 4: Cards 4a – 4c
 - Card 4a – Sample 1
 - Card 4b – Sample 2
 - Card 4c – Sample 3

ACTIVITY 1

Essence Statement: CTAS-HS-PS3-3 Test a device that converts one form of energy into another form of energy.*

Core Extension 1: Identify two ways that different forms of energy (e.g., heat, motion, light, sound, electrical, mechanical, wind, kinetic) are used in everyday life. (CTAS-HS-PS3-3)

Teacher Notes:

Collect the following resources for this activity:

- Activity 1 Resource 1: Cards 1a – 1c
 - Card 1a – Sound Energy
 - Card 1b – Electrical Energy
 - Card 1c – Mechanical Energy
- Activity 1 Resource 2: Toy Car Poster
- Activity 1 Resource 3: Cards 3a – 3c
 - Card 3a – Kinetic Energy
 - Card 3b – Light Energy
 - Card 3c – Heat Energy

Teacher-Provided Resources:

- 1 Piece of Paper
- 1 Pair of Scissors

Steps to Follow:

1.

| | |
|------------|---|
| SAY | “In this activity, we are going to talk about how we use different forms of energy in everyday life. There are many forms of energy that we use every day. The forms of energy that we use include heat, light, sound, electrical, mechanical, and kinetic energy.” |
|------------|---|

2.

| | |
|------------|---|
| SAY | “We are going to cut a piece of paper with scissors.” |
|------------|---|

3.

| | |
|------------|---|
| SAY | “Let’s cut the piece of paper with the scissors.” |
|------------|---|

4. *If the student is unable to use scissors, the teacher may demonstrate cutting a piece of paper with scissors for the student.*

5.

| | |
|------------|--|
| ASK | “What is one form of energy that the scissors use to cut the paper?” |
|------------|--|

6. Provide Resource 1: Cards 1a – 1c to the student. Indicate and read each Card.
 - a. Indicate Card 1a.

| | |
|------------|----------------|
| SAY | “Sound Energy” |
|------------|----------------|

 - b. Indicate Card 1b.

| | |
|------------|---------------------|
| SAY | “Electrical Energy” |
|------------|---------------------|

c. Indicate Card 1c.

| | |
|------------|---------------------|
| SAY | “Mechanical Energy” |
|------------|---------------------|

7. **ASK AGAIN** “What is one form of energy that the scissors use to cut the paper?”

8. Allow student to respond and record response. If no response or if incorrect response, proceed to scaffolding instructions.

9. Indicate Card 1c.

| | |
|------------|--|
| SAY | “The scissors use mechanical energy to cut the paper.” |
|------------|--|

10. Display Resource 2: Toy Car Poster for the student.

11. Indicate Resource 2.

| | |
|------------|--|
| SAY | “This is a picture of a toy car. This toy car runs on a battery. The toy car is moving up a ramp.” |
|------------|--|

12. **ASK** “What is one form of energy that the toy car uses when it moves up the ramp?”

13. Provide Resource 3: Cards 3a – 3c to the student. Indicate and read each Card.

a. Indicate Card 3a.

| | |
|------------|------------------|
| SAY | “Kinetic Energy” |
|------------|------------------|

b. Indicate Card 3b.

| | |
|------------|----------------|
| SAY | “Light Energy” |
|------------|----------------|

c. Indicate Card 3c.

| | |
|------------|---------------|
| SAY | “Heat Energy” |
|------------|---------------|

14. **ASK AGAIN** “What is one form of energy that the toy car uses when it moves up the ramp?”

15. Allow student to respond and record response.

16. Indicate Card 3a.

| | |
|------------|---|
| SAY | “The car uses kinetic energy because the car is in motion when it moves up a ramp.” |
|------------|---|

17. **SAY** “We are now finished with this activity.”

Scoring Guidance and Scaffolding

Scaffolding:

1. After student makes first incorrect attempt, indicate Card 1c.

| | |
|------------|--|
| SAY | “The scissors use mechanical energy to cut the paper.” |
|------------|--|

2. Display Resource 2: Toy Car Poster for the student.

3. Indicate Resource 2.

| | |
|------------|--|
| SAY | “This is a picture of a toy car. This toy car runs on a battery. The toy car is moving up a ramp.” |
|------------|--|

4. **ASK** “What is one form of energy that the toy car uses when it moves up the ramp?”

5. Provide Resource 3: Cards 3a – 3c to the student. Indicate and read each Card.

- a. Indicate Card 3a.

| | |
|------------|------------------|
| SAY | “Kinetic Energy” |
|------------|------------------|

- b. Indicate Card 3b.

| | |
|------------|----------------|
| SAY | “Light Energy” |
|------------|----------------|

- c. Indicate Card 3c.

| | |
|------------|---------------|
| SAY | “Heat Energy” |
|------------|---------------|

6. **ASK AGAIN** “What is one form of energy that the toy car uses when it moves up the ramp?”

7. Allow student to respond and record response.

8. Indicate Card 3a.

| | |
|------------|---|
| SAY | “The car uses kinetic energy because the car is in motion when it moves up a ramp.” |
|------------|---|

9. **SAY** “We are now finished with this activity.”

Correct answers are as follows:

1. What is one form of energy that the scissors use to cut the paper?
 - a. Card 1c – Mechanical Energy
2. What is one form of energy that the toy car uses when it moves up the ramp?
 - a. Card 3a – Kinetic Energy

| Content Guidance | Rating | Score |
|---|--|-------|
| Student... <ul style="list-style-type: none"> • gives NO response. <p style="text-align: center;">OR</p> <ul style="list-style-type: none"> • is unable to identify that mechanical energy is the form of energy that the scissors use (Card 1c); and • is unable to identify that kinetic energy is the form of energy that the toy car uses (Card 3a). | The student does not demonstrate understanding. | 0 |
| Student... <ul style="list-style-type: none"> • is able to identify that mechanical energy is the form of energy that the scissors use (Card 1c); and • is unable to identify that kinetic energy is the form of energy that the toy car uses (Card 3a). <p style="text-align: center;">OR</p> <ul style="list-style-type: none"> • is unable to identify that mechanical energy is the form of energy that the scissors use (Card 1c); and • after scaffolding, is able to identify that kinetic energy is the form of energy that the toy car uses (Card 3a). | The student demonstrates limited understanding typically requiring additional support through scaffolding. | 1 |
| Student... <ul style="list-style-type: none"> • is able to identify that mechanical energy is the form of energy that the scissors use (Card 1c); and • is able to identify that kinetic energy is the form of energy that the toy car uses (Card 3a). | The student demonstrates understanding independently without scaffolding. | 2 |

ACTIVITY 2

Essence Statement: CTAS-HS-PS3-3 Test a device that converts one form of energy into another form of energy.*

Core Extension 2: Given examples of energy transformation, label the energy change from one form to another. (CTAS-HS-PS3-3)

Teacher Notes:

Collect the following resources for this activity:

- Activity 2 Resource 1: Table Lamp Poster
- Activity Resource 2: Cards 2a – 2c
 - Card 2a – Light Energy
 - Card 2b – Mechanical Energy
 - Card 2c – Sound Energy
- Activity 2 Resource 3: Electrical Energy to Radio Poster

Steps to Follow:

1. **SAY** “In this activity, we are going to talk about how energy can change from one form to another. Energy changes forms all around us.”

2. Display Resource 1: Table Lamp Poster for the student.

3. Indicate Resource 1.

SAY “Here is a table lamp that is plugged into an electrical outlet in the wall. The lamp is turned on. There are two boxes below the table lamp with an arrow that leads from the first box to the second box (*indicate the blank box in Resource 1*). The first box says ‘**Electrical Energy**.’ The second box is blank. Let’s place an energy card in the blank box with the form of energy that the lamp produces when it is turned on.”

4. **ASK** “When the table lamp is turned on, what form of energy does the table lamp produce?”

5. Provide Resource 2: Cards 2a – 2c to the student. Indicate and read each Card.

a. Indicate Card 2a.

SAY “Light Energy”

b. Indicate Card 2b.

SAY “Mechanical Energy”

c. Indicate Card 2c.

SAY “Sound Energy”

6. **ASK AGAIN** “When the table lamp is turned on, what form of energy does the table lamp produce?”

7. Allow student to respond and record response. If no response or if incorrect response, proceed to scaffolding instructions.
8. Indicate Card 2a.
- | | |
|------------|--|
| SAY | “Electrical energy is changed into light energy when the table lamp is turned on.” |
|------------|--|
9. Display Resource 3: Electrical Energy to Radio Poster for the student.
10. Indicate Resource 3.
- | | |
|------------|--|
| SAY | “Here is a picture of a cord from a radio plugged into an electrical outlet in the wall. There are two boxes below the cord with an arrow that leads from the first box to the second box (<i>indicate the blank box in Resource 3</i>). The first box says ‘ Electrical Energy. ’ The second box is blank. Let’s place an energy card in the blank box with the form of energy that the radio produces.” |
|------------|--|
11. **ASK** “What form of energy does the radio produce?”
12. Provide remaining Resource 2: Card 2b and Card 2c to the student. Indicate and read each remaining Card.
- a. Indicate Card 2b.
- | | |
|------------|---------------------|
| SAY | “Mechanical Energy” |
|------------|---------------------|
- b. Indicate Card 2c.
- | | |
|------------|----------------|
| SAY | “Sound Energy” |
|------------|----------------|
13. **ASK AGAIN** “What form of energy does the radio produce?”
14. Allow student to respond and record response.
15. Indicate Card 2c.
- | | |
|------------|--|
| SAY | “Electrical energy is changed into sound energy when you turn the radio on.” |
|------------|--|
16. **SAY** “We are now finished with this activity.”

Scoring Guidance and Scaffolding

Scaffolding:

1. After student makes first incorrect attempt, indicate Card 2a.

| | |
|------------|--|
| SAY | “Electrical energy is changed into light energy when the table lamp is turned on.” |
|------------|--|

2. Display Resource 3: Electrical Energy to Radio Poster for the student.

3. Indicate Resource 3.

| | |
|------------|--|
| SAY | “Here is a picture of a cord from a radio plugged into an electrical outlet in the wall. There are two boxes below the cord with an arrow that leads from the first box to the second box (<i>indicate the blank box in Resource 3</i>). The first box says ‘ Electrical Energy. ’ The second box is blank. Let’s place an energy card in the blank box with the form of energy that the radio produces.” |
|------------|--|

4.

| | |
|------------|---|
| ASK | “What form of energy does the radio produce?” |
|------------|---|

5. Provide remaining Resource 2: Card 2b and Card 2c to the student. Indicate and read each remaining Card.

- a. Indicate Card 2b.

| | |
|------------|---------------------|
| SAY | “Mechanical Energy” |
|------------|---------------------|

- b. Indicate Card 2c.

| | |
|------------|----------------|
| SAY | “Sound Energy” |
|------------|----------------|

6.

| | |
|------------------|---|
| ASK AGAIN | “What form of energy does the radio produce?” |
|------------------|---|

7. Allow student to respond and record response.

8. Indicate Card 2c.

| | |
|------------|--|
| SAY | “Electrical energy is changed into sound energy when you turn the radio on.” |
|------------|--|

9.

| | |
|------------|---|
| SAY | “We are now finished with this activity.” |
|------------|---|

Correct answers are as follows:

1. When the table lamp is turned on, what form of energy does the table lamp produce?
 - a. Card 2a – Light Energy
2. What form of energy does the radio produce?
 - a. Card 2c – Sound Energy



| Content Guidance | Rating | Score |
|--|---|----------|
| <p>Student...</p> <ul style="list-style-type: none">• gives NO response. <p style="text-align: center;">OR</p> <ul style="list-style-type: none">• is unable to identify that light energy is the form of energy that the lamp produces (Card 2a); and• is unable to identify that sound energy is the form of energy that the radio produces (Card 2c). | <p>The student does not demonstrate understanding.</p> | <p>0</p> |
| <p>Student...</p> <ul style="list-style-type: none">• is able to identify that light energy is the form of energy that the lamp produces (Card 2a); and• is unable to identify that sound energy is the form of energy that the radio produces (Card 2c). <p style="text-align: center;">OR</p> <ul style="list-style-type: none">• is unable to identify that light energy is the form of energy that the lamp produces (Card 2a); and• after scaffolding, is able to identify that sound energy is the form of energy that the radio produces (Card 2c). | <p>The student demonstrates limited understanding typically requiring additional support through scaffolding.</p> | <p>1</p> |
| <p>Student...</p> <ul style="list-style-type: none">• is able to identify that light energy is the form of energy that the lamp produces (Card 2a); and• is able to identify that sound energy is the form of energy that the radio produces (Card 2c). | <p>The student demonstrates understanding independently without scaffolding.</p> | <p>2</p> |

ACTIVITY 3

Essence Statements: CTAS-HS-PS3-3 Test a device that converts one form of energy into another form of energy.*

Core Extension 3: Use the results of a test to show that energy is transferred using a device. (CTAS-HS-PS3-3)

Teacher Notes:

Collect the following resources for this activity:

- Activity 3 Resource 1a: Cell Phone 1 Charging Poster
- Activity 3 Resource 1b: Cell Phone 2 Charging Poster
- Activity 3 Resource 2: Sentence Strips 2a – 2c
 - Sentence Strip 2a – Cell Phone 1
 - Sentence Strip 2b – Cell Phone 2
 - Sentence Strip 2c – Both Cell Phones
- Activity 3 Resource 3: Strips 3a – 3c
 - Strip 3a – Heat/Electrical
 - Strip 3b – Mechanical/Light
 - Strip 3c – Electrical/Battery

Prior to the administration of this activity, teacher may cut apart Resource 1a and Resource 1b.

Steps to Follow:

1. **SAY** “In this activity, we are going to talk about how energy is transferred to a cell phone when it is charged.”

2. Display Resource 1a: Cell Phone 1 Charging Poster for the student.

3. Display Resource 1b: Cell Phone 2 Charging Poster for the student.

4. Indicate Resource 1a and Resource 1b.

SAY “This picture shows two cell phones charging. Cell Phone 1 has been charging for 10 minutes (*indicate Resource 1a*). Cell Phone 2 has been charging for 40 minutes (*indicate Resource 1b*).”

5. **ASK** “Which cell phone has more energy?”

6. Provide Resource 2: Sentence Strips 2a – 2c to the student. Indicate and read each Sentence Strip.

a. Indicate Sentence Strip 2a.

SAY “Cell phone 1 has more energy.”

b. Indicate Sentence Strip 2b.

SAY “Cell phone 2 has more energy.”

c. Indicate Sentence Strip 2c.

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| SAY | “Both cell phones have the same amount of energy.” |
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7. **ASK** “Which cell phone has more energy?”

| | |
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| AGAIN | |
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8. Allow student to respond and record response. If no response or if incorrect response, proceed to scaffolding instructions.

9. Indicate Sentence Strip 2b.

| | |
|------------|---------------------------------|
| SAY | “Cell phone 2 has more energy.” |
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10. Indicate Resource 1a and Resource 1b.

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| SAY | “The charging cord for each cell phone is plugged into a wall outlet. This is a form of energy transfer.” |
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11. **ASK** “What form of energy transfer is taking place when the cell phone is charging?”

12. Provide Resource 3: Strips 3a – 3c to the student. Indicate and read each Strip.

a. Indicate Strip 3a.

| | |
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| SAY | “heat energy to electrical energy” |
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b. Indicate Strip 3b.

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| SAY | “mechanical energy to light energy” |
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c. Indicate Strip 3c.

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| SAY | “electrical energy to battery energy” |
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13. **ASK** “What form of energy transfer is taking place when the cell phone is charging?”

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| AGAIN | |
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14. Allow student to respond and record response.

15. Indicate Strip 3c.

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| SAY | “The energy transfer that takes place when the cell phone is charging is electrical energy to battery energy.” |
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16. **SAY** “We are now finished with this activity.”

Scoring Guidance and Scaffolding

Scaffolding:

1. After student makes first incorrect attempt, indicate Sentence Strip 2b.

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|------------|---------------------------------|
| SAY | “Cell phone 2 has more energy.” |
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2. Indicate Resource 1a and Resource 1b.

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| SAY | “The charging cord for each cell phone is plugged into a wall outlet. This is a form of energy transfer.” |
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3. **ASK** “What form of energy transfer is taking place when the cell phone is charging?”

4. Provide Resource 3: Strips 3a – 3c to the student. Indicate and read each Strip.

- a. Indicate Strip 3a.

| | |
|------------|------------------------------------|
| SAY | “heat energy to electrical energy” |
|------------|------------------------------------|

- b. Indicate Strip 3b.

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|------------|-------------------------------------|
| SAY | “mechanical energy to light energy” |
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- c. Indicate Strip 3c.

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|------------|---------------------------------------|
| SAY | “electrical energy to battery energy” |
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5. **ASK AGAIN** “What form of energy transfer is taking place when the cell phone is charging?”

6. Allow student to respond and record response.

7. Indicate Strip 3c.

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| SAY | “The energy transfer that takes place when the cell phone is charging is electrical energy to battery energy.” |
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8. **SAY** “We are now finished with this activity.”

Correct answers are as follows:

1. Which cell phone has more energy?
 - a. Sentence Strip 2b – Cell phone 2 has more energy.
2. What form of energy transfer is taking place when the cell phone is charging?
 - a. Strip 3c – electrical energy to battery energy



| Content Guidance | Rating | Score |
|---|--|-------|
| Student... <ul style="list-style-type: none">gives NO response. <p style="text-align: center;">OR</p> <ul style="list-style-type: none">is unable to identify that cell phone 2 has more energy (Sentence Strip 2b); andis unable to identify that the transfer of energy is from electrical energy to battery energy (Strip 3c). | The student does not demonstrate understanding. | 0 |
| Student... <ul style="list-style-type: none">is able to identify that cell phone 2 has more energy (Sentence Strip 2b); andis unable to identify that the transfer of energy is from electrical energy to battery energy (Strip 3c). <p style="text-align: center;">OR</p> <ul style="list-style-type: none">is unable to identify that cell phone 2 has more energy (Sentence Strip 2b); andafter scaffolding, is able to identify that the transfer of energy is from electrical energy to battery energy (Strip 3c). | The student demonstrates limited understanding typically requiring additional support through scaffolding. | 1 |
| Student... <ul style="list-style-type: none">is able to identify that cell phone 2 has more energy (Sentence Strip 2b); andis able to identify that the transfer of energy is from electrical energy to battery energy (Strip 3c). | The student demonstrates understanding independently without scaffolding. | 2 |

ACTIVITY 4

Essence Statement: CTAS-HS-PS3-4 Use the results of an investigation as evidence that when objects at different temperatures are brought together in a system, they will eventually reach equilibrium (the same temperature).

Core Extension 4: Measure the temperature of water at two different temperatures. (CTAS-HS-PS3-4)

Teacher Notes:

Collect the following resources for this activity:

- Activity 4 Resource 1: Water Temperature Investigation 1 Data Table Poster

Teacher-Provided Resources:

Label the first cup with '**Sample 1**' and the second cup with '**Sample 2.**' Fill **Sample 1** with cold water. Fill **Sample 2** with hot water. These cups should be filled with two significantly different temperatures of water—there should be *at least* a 20-degree temperature difference between the two cups.

The investigation must be set up prior to the administration of the activity. Teacher-Provided Resources include:

- Thermometer
- 2 Cups of the Same Type (e.g. 2 Paper Cups)
- Hot Water
- Cold Water

Steps to Follow:

1.

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| SAY | “In this activity, we are going to investigate the temperature of two different samples of water.” |
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2. Place **Sample 1** and **Sample 2** on the table.

3. Place the thermometer on the table.

4.

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| SAY | “First, we will use the thermometer to measure the temperature of Sample 1 . Then, we will use the thermometer to measure the temperature of Sample 2. ” |
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5. Display Resource 1: Water Temperature Investigation 1 Data Table Poster for the student.

6. Indicate Resource 1.

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| SAY | “We will use this data table to record our measurements. For each ' Water Sample ', we will record the temperature measurement in the ' Temperature ' column.” |
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7. Indicate the thermometer and Sample 1.

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| SAY | “Let’s use this thermometer (<i>indicate thermometer</i>) to measure the temperature of Sample 1.” |
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8. Allow student to measure the temperature of Sample 1 and record observation in the data table (*teacher may assist the student if necessary*). If no response or if incorrect response, proceed to scaffolding instructions.
9. Indicate the thermometer and Sample 2.
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|------------|---|
| SAY | “Let’s use this thermometer (indicate thermometer) to measure the temperature of Sample 2.” |
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10. Allow student to measure the temperature of Sample 2 and record observation in the data table (*teacher may assist the student if necessary*).
11. **SAY** “We are now finished with this activity.”

Scoring Guidance and Scaffolding

Scaffolding:

- After student makes first incorrect attempt, demonstrate how to measure the temperature of Sample 1.
 - Indicate the thermometer and Sample 2.
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|------------|---|
| SAY | “Let’s use this thermometer (indicate thermometer) to measure the temperature of Sample 2.” |
|------------|---|
- Allow student to measure the temperature of Sample 2 and record observation in the data table (*teacher may assist the student if necessary*).
 - SAY** “We are now finished with this activity.”



| Content Guidance | Rating | Score |
|---|--|-------|
| Student... <ul style="list-style-type: none">gives NO response. <p style="text-align: center;">OR</p> <ul style="list-style-type: none">is unable to measure the temperature of Sample 1 or Sample 2. | The student does not demonstrate understanding. | 0 |
| Student... <ul style="list-style-type: none">is able to measure the temperature of Sample 1; andis unable to measure the temperature of Sample 2. <p style="text-align: center;">OR</p> <ul style="list-style-type: none">is unable to measure the temperature of Sample 1; andafter scaffolding, is able to measure the temperature of Sample 2. | The student demonstrates limited understanding typically requiring additional support through scaffolding. | 1 |
| Student... <ul style="list-style-type: none">is able to measure the temperature of Sample 1 and Sample 2. | The student demonstrates understanding independently without scaffolding. | 2 |

ACTIVITY 5

Essence Statement: CTAS-HS-PS3-4 Use the results of an investigation as evidence that when objects at different temperatures are brought together in a system, they will eventually reach equilibrium (the same temperature).

Core Extension 5: Use the results of an investigation to show that temperature equilibrium will be reached by combining water at two different temperatures. (CTAS-HS-PS3-4)

Teacher Notes:

Collect the following resources for this activity:

- Activity 5 Resource 1: Water Temperature Investigation 2 Data Table Poster
- Activity 5 Resource 2: Sentence Strips 2a – 2c
 - Sentence Strip 2a – Higher
 - Sentence Strip 2b – Lower
 - Sentence Strip 2c – Same
- Activity 5 Resource 3: Sentence Strips 3a – 3c
 - Sentence Strip 3a – Higher
 - Sentence Strip 3b – Lower
 - Sentence Strip 3c – Same
- Activity 5 Resource 4: Cards 4a – 4c
 - Card 4a – Sample 1
 - Card 4b – Sample 2
 - Card 4c – Sample 3

Teacher-Provided Resources:

Label the first cup with ‘**Sample 1,**’ the second cup with ‘**Sample 2,**’ and the third cup with ‘**Sample 3.**’ Fill **Sample 1** one third of the way with cold water. Fill **Sample 2** one third of the way with hot water. These cups should be filled with two significantly different temperatures of water—there should *be at least* a 20-degree temperature difference between the two cups. You will combine the water in **Sample 1** and the water in **Sample 2** by pouring the contents of each into the cup labeled **Sample 3.**

The investigation must be set up prior to the administration of the activity. Teacher-Provided Resources include:

- Thermometer
- 3 Cups of the Same Type (e.g. 3 Paper Cups)
- Hot Water
- Cold Water

Steps to Follow:

1.

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| SAY | “In this activity, we are going to investigate the temperature of three different samples of water.” |
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2. Place **Sample 1** cup filled with cold water and **Sample 2** cup filled with hot water on the table.
3. Place the thermometer on the table.

4. **SAY** “Here is a cup labeled **‘Sample 1.’** This cup holds cold water (*indicate Sample 1 cup*). Here is a cup labeled **‘Sample 2.’** This cup holds hot water (*indicate Sample 2 cup*). Let’s measure the water temperature in each of these cups.”

5. Display Resource 1: Water Temperature Investigation 2 Data Table Poster for the student.

6. Indicate Resource 1.

SAY “For each **‘Water Sample,’** we will record the temperature measurement in the **‘Temperature’** column.”

7. Indicate the thermometer and **Sample 1.**

SAY “Let’s use this thermometer (*indicate thermometer*) to measure the temperature of Sample 1.”

8. Allow student to measure the temperature of Sample 1 and record observation in the data table (*teacher may assist the student if necessary*).

9. Indicate the thermometer and **Sample 2.**

SAY “Let’s use this thermometer (*indicate thermometer*) to measure the temperature of Sample 2.”

10. Allow student to measure the temperature of Sample 2 and record observation in the data table (*teacher may assist the student if necessary*).

11. Place empty cup labeled **Sample 3** on the table.

12. **SAY** “Now we are going to observe what happens to the temperature when the cold water in **Sample 1** is combined with the hot water in **Sample 2**. We will pour the cold water and the hot water into the cup labeled **‘Sample 3’** (*indicate Sample 3 cup*).”

13. Pour **Sample 1** and **Sample 2** in cup labeled **Sample 3.**

14. Indicate the thermometer and Sample 3.

SAY “Let’s use this thermometer (*indicate thermometer*) to measure the temperature of Sample 3.”

15. Allow student to measure the temperature of Sample 3 and record observation in the data table (*teacher may assist the student if necessary*).

16. **ASK** “How does the water temperature in Sample 3 compare to the hot water temperature in Sample 2?”
17. Provide Resource 2: Sentence Strips 2a – 2c to the student. Indicate and read each Sentence Strip.
- a. Indicate Sentence Strip 2a.
- SAY** “The temperature in Sample 3 is higher than the temperature in Sample 2.”
- b. Indicate Sentence Strip 2b.
- SAY** “The temperature in Sample 3 is lower than the temperature in Sample 2.”
- c. Indicate Sentence Strip 2c.
- SAY** “The temperature in Sample 3 is the same as the temperature in Sample 2.”
18. **ASK AGAIN** “How does the water temperature in Sample 3 compare to the hot water temperature in Sample 2?”
19. Allow student to respond and record response. If no response or if incorrect response, proceed to scaffolding instructions.
20. Indicate Sentence Strip 2b.
- SAY** “The temperature in Sample 3 is lower than the temperature in Sample 2.”
21. **ASK** “How does the water temperature in Sample 3 compare to the cold water temperature in Sample 1?”
22. Provide Resource 3: Sentence Strips 3a – 3c to the student. Indicate and read each Sentence Strip.
- a. Indicate Sentence Strip 3a.
- SAY** “The temperature in Sample 3 is higher than the temperature in Sample 1.”
- b. Indicate Sentence Strip 3b.
- SAY** “The temperature in Sample 3 is lower than the temperature in Sample 1.”
- c. Indicate Sentence Strip 3c.
- SAY** “The temperature in Sample 3 is the same as the temperature in Sample 1.”
23. **ASK AGAIN** “How does the water temperature in Sample 3 compare to the cold water temperature in Sample 1?”

24. Allow student to respond and record response.
25. Indicate Sentence Strip 3a.
- | | |
|------------|---|
| SAY | “The temperature in Sample 3 is higher than the temperature in Sample 1.” |
|------------|---|
26. **ASK** “Which water sample reached temperature equilibrium: Sample 1, Sample 2, or Sample 3?”
27. Provide Resource 4: Cards 4a – 4c to the student. Indicate and read each Card.
- a. Indicate Card 4a.
- | | |
|------------|------------|
| SAY | “Sample 1” |
|------------|------------|
- b. Indicate Card 4b.
- | | |
|------------|------------|
| SAY | “Sample 2” |
|------------|------------|
- c. Indicate Card 4c.
- | | |
|------------|------------|
| SAY | “Sample 3” |
|------------|------------|
28. **ASK AGAIN** “Which water sample reached temperature equilibrium: Sample 1, Sample 2, or Sample 3?”
29. Allow student to respond and record response.
30. Indicate Card 4c.
- | | |
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| SAY | “Sample 3 reached temperature equilibrium.” |
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31. **SAY** “We are now finished with this activity.”

Scoring Guidance and Scaffolding

Scaffolding:

Note: Optionally, you may ask the student the third question, “Which sample reached temperature equilibrium: Sample 1, Sample 2, or Sample 3?” if the scaffold is applied. However, if you choose to ask the third question and the student answers the third question correctly, the student will still receive one point.

1. Indicate Sentence Strip 2b.

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| SAY | “The temperature in Sample 3 is lower than the temperature in Sample 2.” |
|------------|--|

2.

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| ASK | “How does the water temperature in Sample 3 compare to the cold water temperature in Sample 1?” |
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3. Provide Resource 3: Sentence Strips 3a – 3c to the student. Indicate and read each Sentence Strip.

- a. Indicate Sentence Strip 3a.

| | |
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| SAY | “The temperature in Sample 3 is higher than the temperature in Sample 1.” |
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- b. Indicate Sentence Strip 3b.

| | |
|------------|--|
| SAY | “The temperature in Sample 3 is lower than the temperature in Sample 1.” |
|------------|--|

- c. Indicate Sentence Strip 3c.

| | |
|------------|---|
| SAY | “The temperature in Sample 3 is the same as the temperature in Sample 1.” |
|------------|---|

4.

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|----------------------|---|
| ASK AGAIN | “How does the water temperature in Sample 3 compare to the cold water temperature in Sample 1?” |
|----------------------|---|

5. Allow student to respond and record response.

6.

| | |
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| SAY | “We are now finished with this activity.” |
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Correct answers are as follows:

1. How does the water temperature in Sample 3 compare to the hot water temperature in Sample 2?
 - a. Sentence Strip 2b – The temperature in Sample 3 is lower than the temperature in Sample 2.
2. How does the water temperature in Sample 3 compare to the cold-water temperature in Sample 1?
 - a. Sentence Strip 3a – The temperature in Sample 3 is higher than the temperature in Sample 1.
3. Which water sample reached temperature equilibrium: Sample 1, Sample 2, or Sample 3?
 - a. Card 4c – Sample 3



| Content Guidance | Rating | Score |
|--|---|-------|
| <p>Student...</p> <ul style="list-style-type: none">gives NO response. <p style="text-align: center;">OR</p> <ul style="list-style-type: none">is unable to identify that the temperature in Sample 3 is lower than the temperature in Sample 2 (Sentence Strip 2b); andis unable to identify that the temperature in Sample 3 is higher than the temperature in Sample 1 (Sentence Strip 3a); andis unable to identify that Sample 3 reached temperature equilibrium (Card 4c). | <p>The student does not demonstrate understanding.</p> | 0 |
| <p>Student...</p> <ul style="list-style-type: none">is able to identify that the temperature in Sample 3 is lower than the temperature in Sample 2 (Sentence Strip 2b); oris able to identify that the temperature in Sample 3 is higher than the temperature in Sample 1 (Sentence Strip 3a); andis unable to identify that Sample 3 reached temperature equilibrium (Card 4c). <p style="text-align: center;">OR</p> <ul style="list-style-type: none">is unable to identify that the temperature in Sample 3 is lower than the temperature in Sample 2 (Sentence Strip 2b); orafter scaffolding, is able to identify that the temperature in Sample 3 is higher than the temperature in Sample 1 (Sentence Strip 3a). | <p>The student demonstrates limited understanding typically requiring additional support through scaffolding.</p> | 1 |
| <p>Student...</p> <ul style="list-style-type: none">is able to identify that the temperature in Sample 3 is lower than the temperature in Sample 2 (Sentence Strip 2b); oris able to identify that the temperature in Sample 3 is higher than the temperature in Sample 1 (Sentence Strip 3a); andis able to identify that Sample 3 reached temperature equilibrium (Card 4c). | <p>The student demonstrates understanding independently without scaffolding.</p> | 2 |