TEKS Cluster: Force, Motion, Potential, and Kinetic Energy

6.8 **Force, motion, and energy.** The student knows force and motion are related to potential and kinetic energy.

Potential and Kinetic Energy

Readiness Standards

6.8(A)* compare and contrast potential and kinetic energy

Motion

Readiness Standards

6.8(C)* calculate average speed using distance and time measurements

Supporting Standards

6.8(B) identify and describe the changes in position, direction, and speed of an object when acted upon by unbalanced forces

6.8(D)* measure and graph changes in motion

6.8(E) investigate how inclined planes can be used to change the amount of force to move an object

* Eligible for assessment on Grade 8 STAAR

6.8(A) Readiness

Subcluster: Potential and Kinetic Energy

TEKS Scaffold

TEKS	Student Expectation
P.6(B)	investigate examples of kinetic and potential energy and their transformations (R)
I.5(D)	investigate the law of conservation of energy (R)
I.5(B)	recognize and demonstrate common forms of potential energy, including gravitational, elastic, and chemical, such as a ball on an inclined plane, springs, and batteries (R)
I.5(A)	recognize and demonstrate that objects and substances in motion have kinetic energy such as vibration of atoms, water flowing down a stream moving pebbles, and bowling balls knocking down pins (S)

6.8(A)* **6.8 Force, motion, and energy.** The student knows force and motion are related to potential and kinetic energy. The student is expected to:

(A) compare and contrast potential and kinetic energy

Stimulus

Investigation	Demonstration	Graph	Chart/Table
Diagram	Visual/Image/ Illustration	Web/Cycle/Chain	Model
Informational Text/List	Map	Formula/Equation	

Content Builder

- Potential energy
- Kinetic energy

Major concepts in this standard include:
- Comparing potential and kinetic energy
- Contrasting potential and kinetic energy
- Developing a conceptual understanding of the law of conservation of energy
- Developing a conceptual understanding of energy transformations

Instructional Implications

6.8(A) is tested on Grade 8 STAAR. (Note: Standards designated as "readiness" are essential for success in the current grade. This standard is designated as "supporting" by TEA when assessed on Grade 8 STAAR.)

Understanding how to compare and contrast potential and kinetic energy lays the foundation for further study of balanced/unbalanced forces and motion. Using precise scientific language to describe the energy transformations between kinetic and potential energy will further concept development. Students may struggle with this content because kinetic and potential energy are new concepts and the law of conservation of energy is abstract.

When teaching this concept, remember to:
- Provide opportunities for students to interpret energy as it relates to the law of conservation of energy with kinetic and potential energy.
- Varying the visuals, allow students to interpret energy transformations in potential and kinetic energy in multiple scenarios.
- Compare and contrast kinetic and potential energy: in definition, on visual images, in scenarios, on machines, on movable objects in laboratory investigations, and using charts/tables.

Learning from Mistakes

Students may make the following mistakes:
- Thinking that potential and kinetic energy can be created or destroyed
- Thinking that potential energy does not change as a function of height
- Thinking that kinetic energy is changed by height

Academic Vocabulary

elastic potential energy
energy transformation
gravitational potential energy*
kinetic energy*
law of conservation of energy
potential energy*

6.8(C) Readiness

TEKS Scaffold

TEKS	Student Expectation
P.4(B)	describe and analyze motion in one dimension using equations and graphical vector addition with the concepts of distance, displacement, speed, average velocity, instantaneous velocity, frames of reference, and acceleration (R)
8.6(C)	investigate and describe applications of Newton's three laws of motion such as in vehicle restraints, sports activities, amusement park rides, Earth's tectonic activities, and rocket launches (R)
8.6(A)	demonstrate and calculate how unbalanced forces change the speed or direction of an object's motion (R)
6.8(C)*	**6.8 Force, motion, and energy.** The student knows force and motion are related to potential and kinetic energy. The student is expected to: **(C) calculate average speed using distance and time measurements**
5.6(D)	design a simple experimental investigation that tests the effect of force on an object (S)

Stimulus

Investigation	Demonstration	Graph	Chart/Table
Diagram	Visual/Image/ Illustration	Web/Cycle/Chain	Model
Informational Text/List	Map	Formula/Equation	

Content Builder

- Average speed $= \frac{\text{total distance}}{\text{total time}} = \frac{d}{t}$

Major concepts in this standard include:
- Mathematically calculating the average speed of an object by using distance and time measurements
- Mathematically calculating average speed using varied units for distance and time

Instructional Implications

6.8(C) is tested on Grade 8 STAAR. (Note: Standards designated as "readiness" are essential for success in the current grade. This standard is designated as "supporting" by TEA when assessed on Grade 8 STAAR.)

Understanding how to calculate speed using distance and time lays the foundation for application of balanced/unbalanced forces and Newton's Law's of Motion in Grade 8 and dimensional motion in Physics. Students may struggle with this concept because units and motion in the context of a mathematical equation are new concepts.

When teaching this concept, remember to:
- Provide opportunities for students to calculate average speed from a distance and time graph.
- Create opportunities for students to solve for average speed using data from investigations and word-problem scenarios.
- Investigate solving for time and distance by manipulating the mathematical equation for speed.
- Explore equivalent units for time, distance, and speed.

Learning from Mistakes

Students may make the following mistakes:
- Misunderstanding how to manipulate the formula for speed
- Misunderstanding the units used in the problem or not converting units when needed
- Misunderstanding how to interpret a speed graph

Academic Vocabulary

average speed*
distance
speed*
time*

6.8(B) **6.8 Force, motion, and energy.** The student knows force and motion are related to potential and kinetic energy. The student is expected to:

(B) identify and describe the changes in position, direction, and speed of an object when acted upon by unbalanced forces

Stimulus

Investigation	Demonstration	Graph	Chart/Table
Diagram	Visual/Image/ Illustration	Web/Cycle/Chain	Model
Informational Text/List	Map	Formula/Equation	

Academic Vocabulary

acceleration
balanced forces
displacement
direction
force
motion
position
speed
unbalanced forces

Role in Concept Development

Supports

- 6.8(C) calculate average speed using distance and time measurements
- 8.6(A) demonstrate and calculate how unbalanced forces change the speed or direction of an object's motion

Connection/ Relevance

This standard provides the foundation for understanding how balanced and unbalanced forces directly affect motion, position, direction, and speed of objects.

When to Teach

After 6.8(C)

Instructional Implications

Instruction should include opportunities for students to interact with balanced and unbalanced forces. Students should interpret how balanced and unbalanced forces can change position (displacement), direction, and speed.

When teaching this concept, remember to:

- Provide opportunities for students to use a spring scale to measure the amount of force on an object using newtons (N).
- Interpret net force diagrams and determine the net force on an object and the direction that object will travel.
- Provide opportunities to investigate how acceleration, an unbalanced force, is related to objects starting/stopping, speeding up/slowing down, or changing direction.
- Create opportunities for students to analyze scenarios for balanced and unbalanced forces.
- Calculate and interpret speed in the context of acceleration in lab investigations and word problems.

Learning from Mistakes

Students may make the following mistakes:

- Misunderstanding that unbalanced forces can change more than just the speed of an object
- Thinking acceleration always means that an object is speeding up
- Misunderstanding that a balanced force can be in motion, such as constant speed, where there is no acceleration

6.8(D)* **6.8 Force, motion, and energy.** The student knows force and motion are related to potential and kinetic energy. The student is expected to:

(D) measure and graph changes in motion

Stimulus

Investigation	Demonstration	Graph	Chart/Table
Diagram	Visual/Image/ Illustration	Web/Cycle/Chain	Model
Informational Text/List	Map	Formula/Equation	

Academic Vocabulary

average speed*
constant speed*
distance
motion*
speed*

Role in Concept Development

Supports
6.8(C) calculate average speed using distance and time measurements

Connection/ Relevance
This standard requires students to graphically represent changes in motion, further deepening content knowledge surrounding balanced and unbalanced forces.

6.6(A) is tested on Grade 8 STAAR.

When to Teach
After 6.8(B) and 6.8(C)

Instructional Implications
Instruction should include opportunities for students to graph and interpret motion on distance-time graphs and speed-time graphs. Students should interpret and compare lines that represent constant speed, increased speed, decreased speed, and at rest as well as if the line indicated balanced or unbalanced forces. Students may struggle with this concept because this is the first time students have graphed changes in motion.

When teaching this concept, remember to:
- Create opportunities for students to write about the motion of an object from a graph.
- Explore scenarios that require students to identify acceleration when provided a graph.
- Provide opportunities for students to construct graphs directly related to laboratory data and/or data provided from text descriptions of objects in motion.

Learning from Mistakes
Students may make the following mistakes:
- Misinterpreting which axis should be labeled with which variable
- Misunderstanding how to relate the changes in motion on a graph to the mathematics the graph represents
- Misinterpreting acceleration on a graph
- Misinterpreting a line with a slope of zero to be at rest on a speed-time graph

6.8(E) **6.8 Force, motion, and energy.** The student knows force and motion are related to potential and kinetic energy. The student is expected to:

(E) investigate how inclined planes can be used to change the amount of force to move an object

Stimulus

Investigation	Demonstration	Graph	Chart/Table
Diagram	Visual/Image/ Illustration	Web/Cycle/Chain	Model
Informational Text/List	Map	Formula/Equation	

Academic Vocabulary

force
inclined plane
motion
spring scale

Role in Concept Development

Supports
8.6(A) demonstrate and calculate how unbalanced forces change the speed or direction of an object's motion

Connection/ Relevance
Investigating how inclined planes can be used to change the amount of force on an object deepens content understanding of how balanced and unbalanced forces change the motion of an object. In Grade 8, students will calculate and demonstrate balanced and unbalanced forces.

When to Teach
After 6.8(B)

Instructional Implications
Instruction should include investigations using an inclined plane to move an object. Students should also move the same object without an inclined plane. Spring scales should be used to measure the amount of force needed to move the object. Students may struggle with this content because spring scale accuracy is dependent on the student's measurement skills.

When teaching this concept, remember to:
- Provide opportunities for students to measure force using inclined planes with various slopes.
- Provide opportunities for students to investigate force using spring scales.
- Provide opportunities for students to compare how the height of the inclined plane affected the amount of force needed to move the object.

Learning from Mistakes
Students may make the following mistakes:
- Misunderstanding how to read a spring scale accurately
- Misinterpreting how balanced and unbalanced forces act on an object that is on an inclined plane
- Misunderstanding how height of an inclined plane can change the amount of force needed to move an object