**Unless otherwise specified, "descriptions" referenced in the evidence statements could include but are not limited to written, oral, pictorial, and kinesthetic descriptions.*

HS-ESS2-5

Students who demonstrate understanding can:

HS-ESS2-5. **Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.** [Clarification Statement: Emphasis is on mechanical and chemical investigations with water and a variety of solid materials to provide the evidence for connections between the hydrologic cycle and system interactions commonly known as the rock cycle. Examples of mechanical investigations include stream transportation and deposition using a stream table, erosion using variations in soil moisture content, or frost wedging by the expansion of water as it freezes. Examples of chemical investigations include chemical weathering and recrystallization (by testing the solubility of different materials) or melt generation (by examining how water lowers the melting temperature of most solids).]

The performance expectation above was developed using the following elements from *A Framework for K-12 Science Education*:

Science and Engineering Practices

Planning and Carrying Out Investigations
Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.

- Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.

Disciplinary Core Ideas

ESS2.C: The Roles of Water in Earth's Surface Processes

- The abundance of liquid water on Earth's surface and its unique combination of physical and chemical properties are central to the planet's dynamics. These properties include water's exceptional capacity to absorb, store, and release large amounts of energy, transmit sunlight, expand upon freezing, dissolve and transport materials, and lower the viscosities and melting points of rocks.

Crosscutting Concepts

Structure and Function

- The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials.

Observable features of the student performance by the end of the course:

1	Identifying the phenomenon to be investigated		
	a	Students describe* the phenomenon under investigation, which includes the following idea: a connection between the properties of water and its effects on Earth materials and surface processes.	
2	Identifying the evidence to answer this question		
	a	Students develop an investigation plan and describe* the data that will be collected and the evidence to be derived from the data, including:	
		i.	Properties of water, including:
			a) The heat capacity of water;
			b) The density of water in its solid and liquid states; and
			c) The polar nature of the water molecule due to its molecular structure.
		ii.	The effect of the properties of water on energy transfer that causes the patterns of temperature, the movement of air, and the movement and availability of water at Earth's surface.
		iii.	Mechanical effects of water on Earth materials that can be used to infer the effect of water on Earth's surface processes. Examples can include:
			a) Stream transportation and deposition using a stream table, which can be used to infer the ability of water to transport and deposit materials;

		b) Erosion using variations in soil moisture content, which can be used to infer the ability of water to prevent or facilitate movement of Earth materials; and
		c) The expansion of water as it freezes, which can be used to infer the ability of water to break rocks into smaller pieces.
		iv. Chemical effects of water on Earth materials that can be used to infer the effect of water on Earth's surface processes. Examples can include:
		a) The solubility of different materials in water, which can be used to infer chemical weathering and recrystallization;
		b) The reaction of iron to rust in water, which can be used to infer the role of water in chemical weathering;
		c) Data illustrating that water lowers the melting temperature of most solids, which can be used to infer melt generation; and
		d) Data illustrating that water decreases the viscosity of melted rock, affecting the movement of magma and volcanic eruptions.
	b	In their investigation plan, students describe* how the data collected will be relevant to determining the effect of water on Earth materials and surface processes.
3	Planning for the Investigation	
	a	In their investigation plan, students include a means to indicate or measure the predicted effect of water on Earth's materials or surface processes. Examples include:
		i. The role of the heat capacity of water to affect the temperature, movement of air and movement of water at the Earth's surface;
		ii. The role of flowing water to pick up, move and deposit sediment;
		iii. The role of the polarity of water (through cohesion) to prevent or facilitate erosion;
		iv. The role of the changing density of water (depending on physical state) to facilitate the breakdown of rock;
		v. The role of the polarity of water in facilitating the dissolution of Earth materials;
		vi. Water as a component in chemical reactions that change Earth materials; and
		vii. The role of the polarity of water in changing the melting temperature and viscosity of rocks.
	b	In the plan, students state whether the investigation will be conducted individually or collaboratively.
4	Collecting the data	
	a	Students collect and record measurements or indications of the predicted effect of a property of water on Earth's materials or surface.
5	Refining the design	
	a	Students evaluate the accuracy and precision of the collected data.
	b	Students evaluate whether the data can be used to infer the effect of water on processes in the natural world.
	c	If necessary, students refine the plan to produce more accurate and precise data.