# Create – Investigation of Water and its Effects on Earth (NGSS HS-ESS2-5)

Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes. 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.

## Identifying the phenomenon to be investigated

### 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.

## Identifying the evidence to answer the question under investigation

### Students develop an investigation plan and describe the data that will be collected and the evidence to be derived from the data, which may include at least one selection from the following list (Roman numerals):

1. Properties of water, including:
	1. The heat capacity of water;
	2. The density of water in its solid and liquid states; and
	3. The polar nature of the water molecule due to its molecular structure.
2. 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.
3. 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:
	1. Stream transportation and deposition using a stream table, which can be used to infer the ability of water to transport and deposit materials;
	2. 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
	3. The expansion of water as it freezes, which can be used to infer the ability of water to break rocks into smaller pieces.
4. 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:
	1. The solubility of different materials in water, which can be used to infer chemical weathering and recrystallization;
	2. The reaction of iron to rust in water, which can be used to infer the role of water in chemical weathering;
	3. Data illustrating that water lowers the melting temperature of most solids, which can be used to infer melt generation; and
	4. Data illustrating that water decreases the viscosity of melted rock, affecting the movement of magma and volcanic eruptions.

## Designing the Investigation

### 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.

### 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:

1. The role of the heat capacity of water to affect the temperature, movement of air and movement of water at the Earth’s surface;
2. The role of flowing water to pick up, move and deposit sediment;
3. The role of the polarity of water (through cohesion) to prevent or facilitate erosion;
4. The role of the changing density of water (depending on physical state) to facilitate the breakdown of rock;
5. The role of the polarity of water in facilitating the dissolution of Earth materials;
6. Water as a component in chemical reactions that change Earth materials; and
7. The role of the polarity of water in changing the melting temperature and viscosity of rocks.

### In the plan, students state whether the investigation will be conducted individually or collaboratively.

## Collect data

### Students collect and record measurements or indications of the predicted effect of a property of water on Earth’s materials or surface.

## Refine the design

### Students evaluate the accuracy and precision of the collected data.

### Students evaluate whether the data can be used to infer the effect of water on processes in the natural world.

### If necessary, students refine the plan to produce more accurate and precise data.

## Report the Data, Findings and Conclusions

### Students will document their full investigation through a formal presentation or written report. Minimally, the report will include the following sections:

1. Title Page. The title of the investigation and the authors’ names
2. Abstract. A summary of the full report.
3. Introduction and Objective. What the students investigated. (Parts 1 and 2)
4. Research Methods and Materials. How the investigation designed and executed. (Part 3)
5. Results. The data collected in the form of tables, graphs, photographs, etc. describing the output of the investigation. (Part 4)
6. Discussion. Analysis of the results, including specific references to data and observations which are supported by tables and graphs, and a comparison to those results the students may have expected. A discussion may also include failures and redesigns of the investigation. (Parts 4 and 5)
7. Further Study. Recommendations for any further studies other students might take on based on what was discovered.
8. Acknowledgements and References. What help did the students receive or was anyone else’s work used to develop and conduct the investigation.