NGSS Alignment Table

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| **Standards****HS-ESS3 Earth and Human Activity** |
| **Performance Expectation(s)***The chart below outlines how the instruction outlined in this article intertwines science and engineering practices, crosscutting concepts, and disciplinary core ideas from the NGSS and the Framework for K-12 Science Education.*  |
| **Dimension** | **Name and *NGSS* code/citation** | **Specific Connections to Classroom Activity** |
| **Science and Engineering Practices** | **Mathematics and Computational Thinking*** Create and/or revise a computational model or simulation of a phenomenon, designed device, process, or system.
* Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations

**Developing and Using Models*** Evaluate merits and limitations of two different models of the same proposed tool, process, mechanism or system in order to select or revise a model that best fits the evidence or design criteria.
* Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system.
* Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems.
 | Students engage in discretization, parameterization, interpolation, iteration, and rules development to trace contaminated water in both analog cross-section models and computational models of groundwater systems.Students use computational models to support explanations and predictions about the flow of contaminated water through groundwater systems and to make arguments about the best location for wells for pump-and-treat cleanup solutions.Students compare the merits and limitations of concrete physical models, analog cross-section models, and computational models for tracing groundwater contamination and developing clean-up options.Students use physical models, analog cross-section models, and computational models to illustrate the relationships among potential energy, permeability, and groundwater flow pathways. |
| **Disciplinary Core Ideas** | **ESS3.C Human impacts on Earth systems*** Sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources, including the development of technologies.
 | Students learn principles of flow of water through groundwater systems using physical models and apply those principles to using analog cross-section models and computational models to identify the source of groundwater contamination and develop cleanup solutions. |
| **Crosscutting Concept(s)** | **Systems and System Models*** Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.
* Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models.
 | Students use the physical groundwater tank model to understand system boundaries.Students use the physical groundwater tank and the analog cross-section model to identify and describe conditions of groundwater systems (e.g., potential energy, permeability) and the relationships among these parameters and the flow of groundwater.Students propose clean-up solutions based on predictions of the flow of groundwater through aquifer systems, and use computational thinking practice to acknowledge the limitations of their models. |
| **Common Core State Standards Connections:****MP.2** Reason abstractly and quantitatively. (HS-ESS3-6) | Throughout this activity sequence, students reason progressively more abstractly.  |