SPICE | Science Projects Integrating Computing and Engineering

Computational Thinking

Brief

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Computational Thinking Practice Brief

What is computational thinking?

Computational thinking provides a framework for using a computer's programming power to explore scientific phenomena or engineering design problems and solutions. Using computational thinking involves developing or revising computer programs to help answer questions in science and engineering, such as by developing models. To do this there are a set of routines and phrases used in all computer languages for coding the computer to build and execute the model, and help answer the question.

What isn't computational thinking?

Computational thinking is not purely plugging numbers into an existing program to answer a question (e.g. using a calculator), not is it merely following a set of instructions that might resemble a computer program. Computational thinking must in some way have the potential to leverage the computational power of a computer. Computational thinking can, however, be done without a computer, as the routines and phrases of computational thinking can be applied without the use of technology.

How are we using computational thinking in the curriculum?

Computational thinking is used in the curriculum when students are asked to develop the code needed to model the science phenomenon and test engineering design solutions. Computational thinking helps students organize their model code in a systematic and logical way that makes it easier to check if the model is correct. Students will need to combine their experiences with the conceptual models and hands-on activities to develop their computational models for water runoff. The crosscutting concept of systems and matter (conservation) will help them keep track of how they are understanding and using their models: What's going into the system? What's coming out? What interactions are occurring in the system?

How are we supporting students' computational thinking?

We are supporting connections between students' conceptual models representing water flow and their computational models, which make numerical predictions about water flow for specific amounts of rainfall and surface materials. Students articulate the basic water flow relationships in the conceptual models, then specify these relationships in their computational modeling code.

The block-structured language we have created to help students build and understand their models is simple and intuitive. It avoids students have to learn complex syntax (language) to construct their models and helps students leverage everyday language and science concepts.

Before working on building the computational model for the runoff scenario, students have the chance to experience the routines and languages of Computational Thinking in the context of a set dice games. This approach introduces students to computational concepts like conditionals, variables, and expressions in a familiar context, before extending their understanding to a science context.