IGNITE MY FUTURE

CURRICULUM CONNECTOR | SCIENCE

Computational thinking helps students explore the world

Computational thinking teaches students to apply strategies that computers use to solve real-world problems. The seven computational thinking strategies equip students with valuable problem-solving skills such as analyzing data in order to make inferences and breaking a problem down into manageable pieces. As a science educator, you know that these skills overlap with the practices of scientists and engineers. These engaging and fun standards-aligned resources give you the tools to integrate computational thinking into your science classroom.

Computational thinking strategies:

Collecting data—in order to solve a problem, you need to find the right information

Wired Pier: San Francisco Bay Exploratorium

Collecting data starts with understanding the question or the problem to be solved and determining what data will be relevant and needed to answer the question or solve the problem. The Exploratorium in the San Francisco Bay hosts an experiment known as the "Wired Pier" which collects data about the conditions of the bay. Scientists want to know if rising and falling tides affect the surface currents, water conditions, and ecosystems in San Francisco Bay. And if the weather changes the air quality in San Francisco, among hundreds of other questions that could be answered using their data gathering instruments. The initiative's home page provides explanations about why we collect data, educational activities for students on collecting data, and more information on the data collected about the bay. The website also offers a beta version of their app that allows users to design their own graph to compare data sets. Students can select and display different sets of data and change the graph controls to gain different views of collected data over a selected period of time. Several other sites are available to collect live data using marine instruments:

- Great Lakes
- National River Forecasts and Flood Risks
- Chesapeake Bay Marine Data

Connect to: Earth systems, ecosystems, earth and human activity

Analyze data—interpret data to find relationships, identify trends and predict outcomes

Understand Science: UC Berkeley Museums of Paleontology

Data analysis is a foundational skill. Computers analyze data by building models, constructing visual representations and testing hypotheses. The "Understanding Science" website was created by the Museum of Paleontology of the University of California at Berkeley. Links direct users to the testing and analysis phase of the Scientific Method as well as to explanations and charts of the Scientific Method. A website search with the term "charts" leads to resources that prompt students to chart information, and to experiments to test hypotheses and analyze results, such as "Exploring Bouncing Balls."

Connect to: Dependent and independent variables, motion and stability

Find more easy-to-implement resources to integrate computational thinking practices into your classroom by visiting **ignitemyfutureinschool.org**

Decompose—solve a complicated problem by breaking it into smaller pieces

Journey to Mars: Pioneering Next Steps in Space Exploration: NASA

Sometimes a problem is so big that it's hard to know where to start. The press release "Journey to Mars: Pioneering Next Steps in Space Exploration" demonstrates how NASA is breaking down enormous challenges and tackling the multiple smaller problems involved with traveling to Mars. Students can identify many, many ways that NASA decomposes this problem as they read the text. Explore more details of the plan's subtasks via a link at the beginning of the press release. A link near the end of the press release to the "Journey to Mars" homepage allows access to a variety of other links including activities which could be used to practice decomposing a problem, such as how to design a wheel for Mars terrain (Engineering Design Challenge: Gaining Traction on Mars).

Connect to: Earth's place in the universe, engineering design

Find Patterns—identify themes and connections in order to simplify problems

Predicting Seasonal Weather: The National Science Foundation

Finding patterns allows us to make predictions and forecasts. The National Science Foundation special report "Predicting Seasonal Weather" is a web page dedicated to demonstrating how forecast models are developed and used. The page describes how global patterns are analyzed to make predictions about temperature and related weather in order to solve or prevent problems for society. It also explores the challenges of turning patterns into rules for accurate prediction, and the resulting ongoing changes to forecast models. Students can analyze patterns in weather data in their region in order to predict weather events such as blizzards or droughts. A link in the left menu leads to additional classroom resources.

Connect to: Earth systems, ecosystems, earth and human activity

Abstract—remove details to see the big picture

The Lemelson Center for the Study of Invention and Innovation: The Smithsonian Institution

The computational skill of abstraction teaches students how to reduce complexity in order to make one solution applicable to many different problems. The Lemelson Center for the Study of Invention and Innovation seeks to preserve and catalog stories and information about inventions in order to encourage this kind of thinking. Inventing new solutions requires abstraction to reduce complexity or to apply ideas in a new context. Links reveal many innovative global and societal solutions to real world problems. The broader web site offers invention stories, places of invention, a blog, as well as audio and video excerpts about invention. Students can research how abstractions have been used to take basic things like wheels, gears and pistons and make a wide variety of inventions.

Connect to: Energy, wave transfer, engineering design

Build models—test, experiment and simulate to fix errors

PhET Interactive Simulations (University of Colorado Boulder)

Visualizations and simulations of mathematical models allow student to experiment, find and fix errors, and simulate real-life events using mathematics. The PhET Interactive Simulations website offers interactive models for math concepts and applications such as estimation, equations and their graphs, area, fractions and proportions, least-squares regression, and much more. Students can manipulate parts of the models and observe resulting quantitative and qualitative data that help to demonstrate principles of the modeled concept. Engage students in data-driven modeling by using simulations that support concept knowledge exploration and understanding.

Connect to: Modeling, engineering design

Develop algorithms—step-by-step instructions on how to perform a task

Computer Science Unplugged

Students might not realize it, but they rely on algorithms every day. Algorithms form the basis of video games, GPS navigation, search engines and more. Computer Science Unplugged offers a wide variety of interactive resources that engage students with different types of algorithms. Teach your students about algorithms by adding these searching, sorting and routing activities to your lesson plans.

Connect to: Engineering design, algorithms