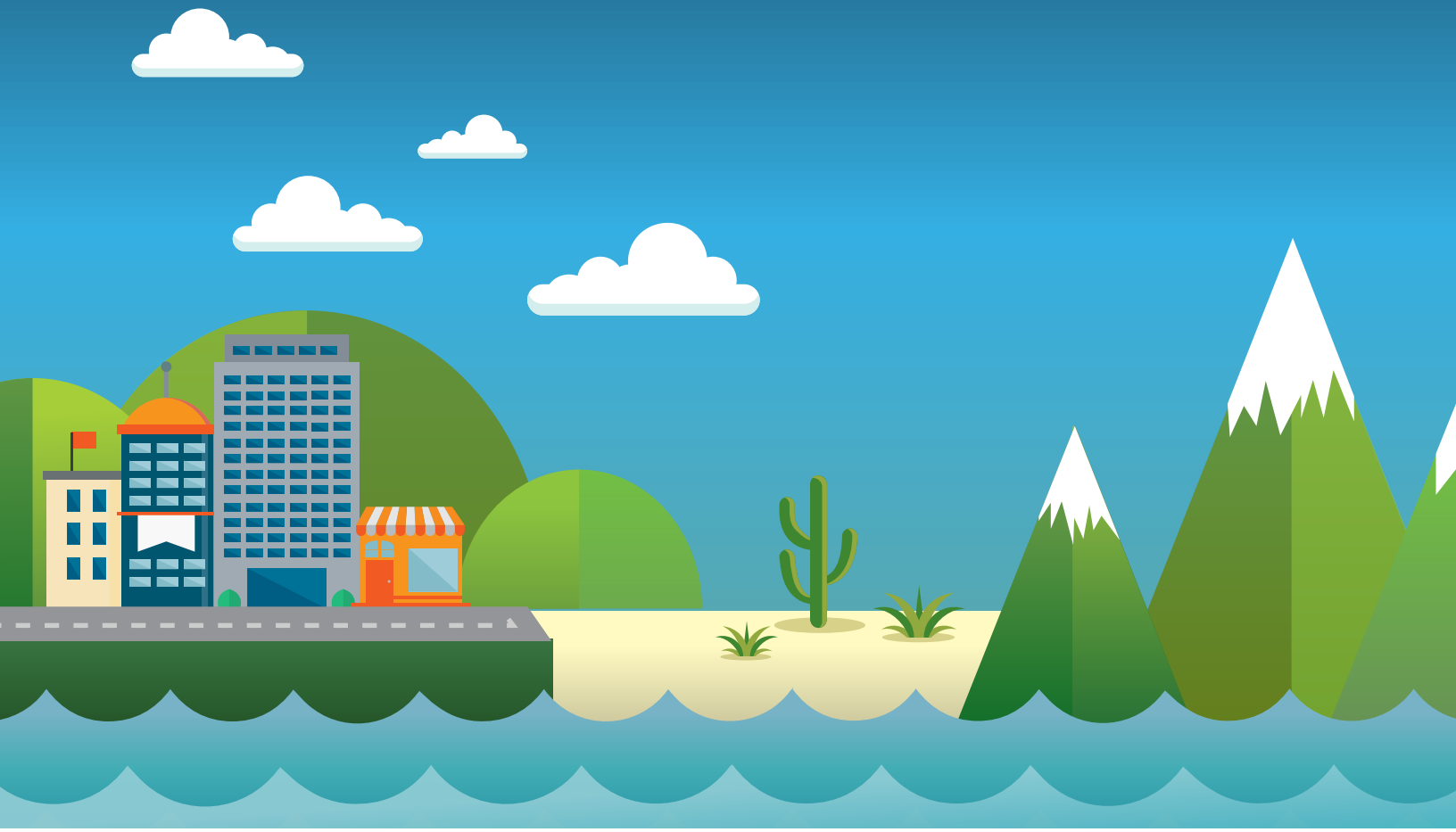
NEEF National Environmental Education Foundation

GREENING STEM: ROOTED IN MATH

EDUCATOR TOOLKIT



Learn more at NEEFusa.org

Mitsubishi Corporation Foundation FOR THE AMERICAS

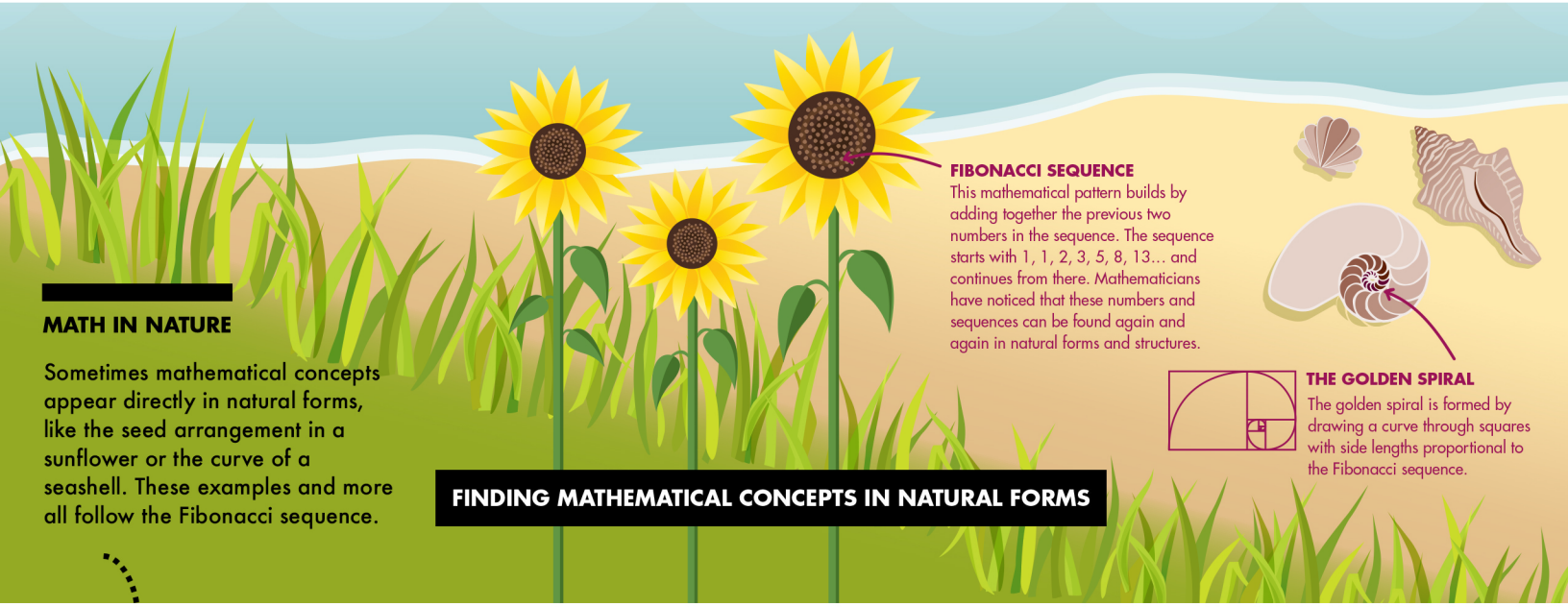
INTRODUCTION

Concepts of math in and of themselves might seem far removed from the natural world, created to explain and evaluate concrete principles in a way that relies on certainties and hard facts, but when you take a closer look at the world, the way we study it, and the way we interact with it, you might be surprised to find out how much of what we know about the environment is *rooted in math*.

Mathematics allows us to analyze current conditions within an environment, make predictions about future trends, and respond in ways that surpass what is possible through simple observation. When looked at in the context of the other STEM subjects (science, technology, and engineering), mathematics becomes a necessary tool in the practice of these fields, enabling the collection and comparison of scientific data that then informs the technology and engineering design of the future.

In this educator toolkit, you'll find lesson plans, activity ideas, and informational resources all freely available to help you continue to bridge the gap between mathematics and the natural world. Use the headings and page numbers below to find the content that most interests you:

MATH IN NATURE



Numbers in Nature **(Grades 9-12)** ***Featured Resource***
Discovery Education
Through this lesson, students learn to recognize the Fibonacci sequence and how it is expressed in nature.

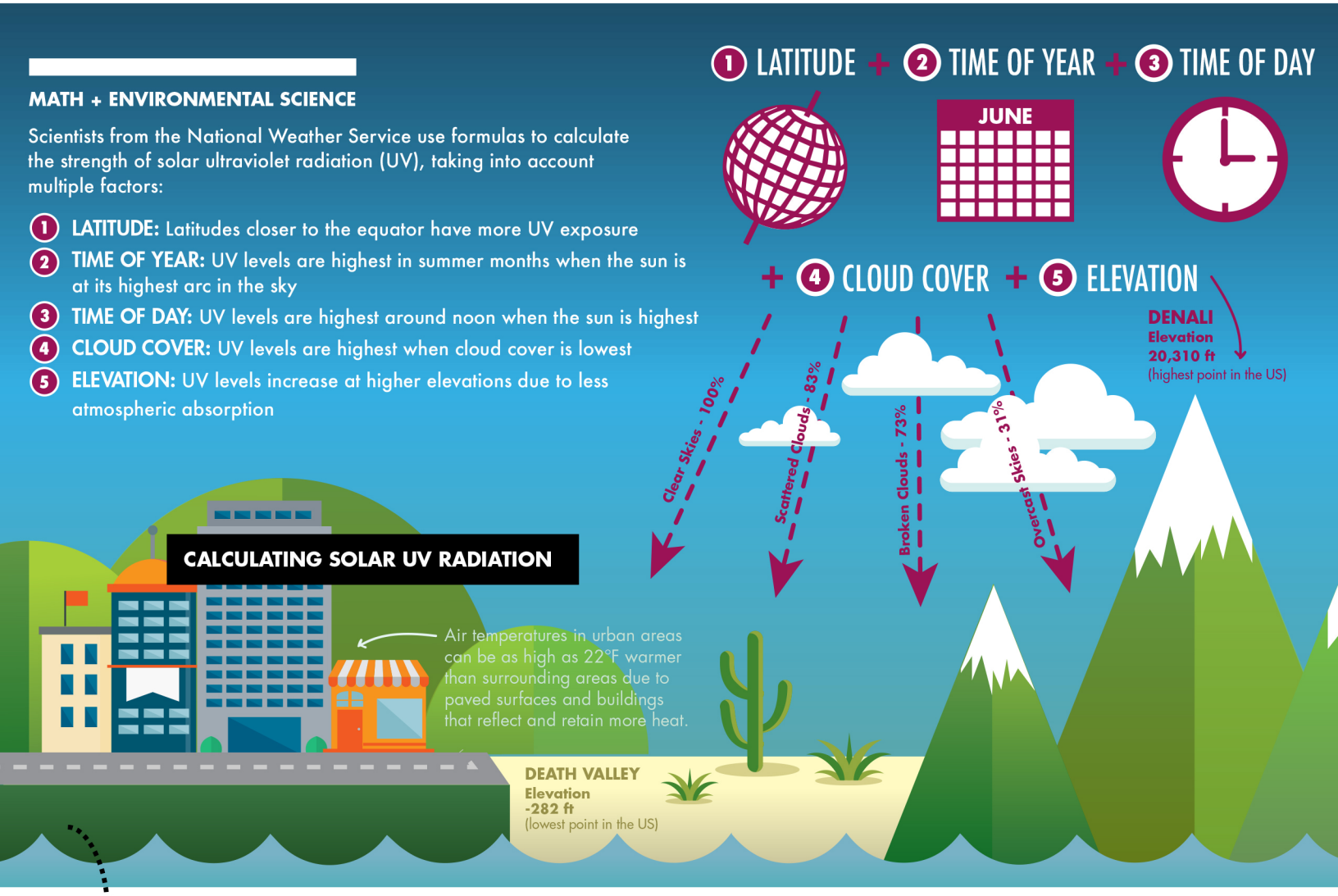
Snowflake Symmetry (Grades K-4)
Scholastic
Snowflakes lend themselves easily to the study of math concepts, particularly geometry. Using images of real snowflakes, have students explore various lines of symmetry and geometric shapes identifiable in each of the snowflake images. Also included: snowball fight simulation to learn about, graph, and track data.

Extreme Weather: A Math Hunt Activity (Grades 3-8)
Scholastic
Students go on an online fact-finding mission to answer five multiple-choice, math-related questions about severe weather, including earthquakes, tornadoes, and hurricanes.

Endangered Animals: A Math Hunt Activity (Grades 3-8)
Scholastic
Students meet grizzlies, rhinos, cougars, and more incredible endangered animals while solving math word problems about them.

Pi & the Fibonacci Sequence (Grades 6-12)
PBS LearningMedia
Students discover the intriguing appearances of pi and the Fibonacci sequence in nature, whether it be in the number of petals on flowers or the number of spirals of a pinecone. Students also discover how pi is used to calculate the length of a meandering river. Discussion questions allow for more opportunity to apply these mathematical concepts.

MATH + ENVIRONMENTAL SCIENCE



SunWise (Grades K-8) ***Featured Resource***
NEEF & US EPA
The goal of the SunWise program is to educate children and the adults who care for them about health risks associated with UV radiation and how to protect against excessive UV exposure. By registering for SunWise, educators receive a SunWise toolkit to teach children in grades K-8 about stratospheric ozone, ultraviolet (UV) radiation, and the health effects of overexposure to UV radiation.

How Big is a tree (Grades K-4)
US Forest Service
In this activity, students develop a data base which can be upgraded each year by measuring and calculating the height and circumference of selected trees. More related lessons can be found here.

Winter Tree Math (Grades K-4)
US Fish and Wildlife Service
(This activity was created by the Minnesota Valley National Wildlife Refuge to be used in part in the classroom and part at the Refuge, but could be replicated anywhere)
Students use a variety of methods and measuring tools to determine the size of trees on the refuge. By comparing their measurements among teams and with the Minnesota State Champion Trees, students begin to understand the importance of protocols in data collection.

River Math Word Problems using the Hudson River (Grades K-5)
New York State Department of Environmental Conservation
These lessons use Hudson River data to construct word problems that require mathematics skills for their solution. A number of the lessons require students to interpret information in tables or bar graphs. Several also build geography skills through use of Hudson River Miles, a system which uses mile numbers to locate points on the river.

Sizing up the Clouds (Grades 5-8)
NASA Wavelength
In this activity, the teacher sets up three simulated clouds representing three different cloud types. Students use different methods to estimate precipitation contents of each cloud type. Each method is roughly analogous to methods actually used for weather forecasting. Finally, the precipitation from each cloud is released and students compare their estimates to what is actually experienced on the "ground."

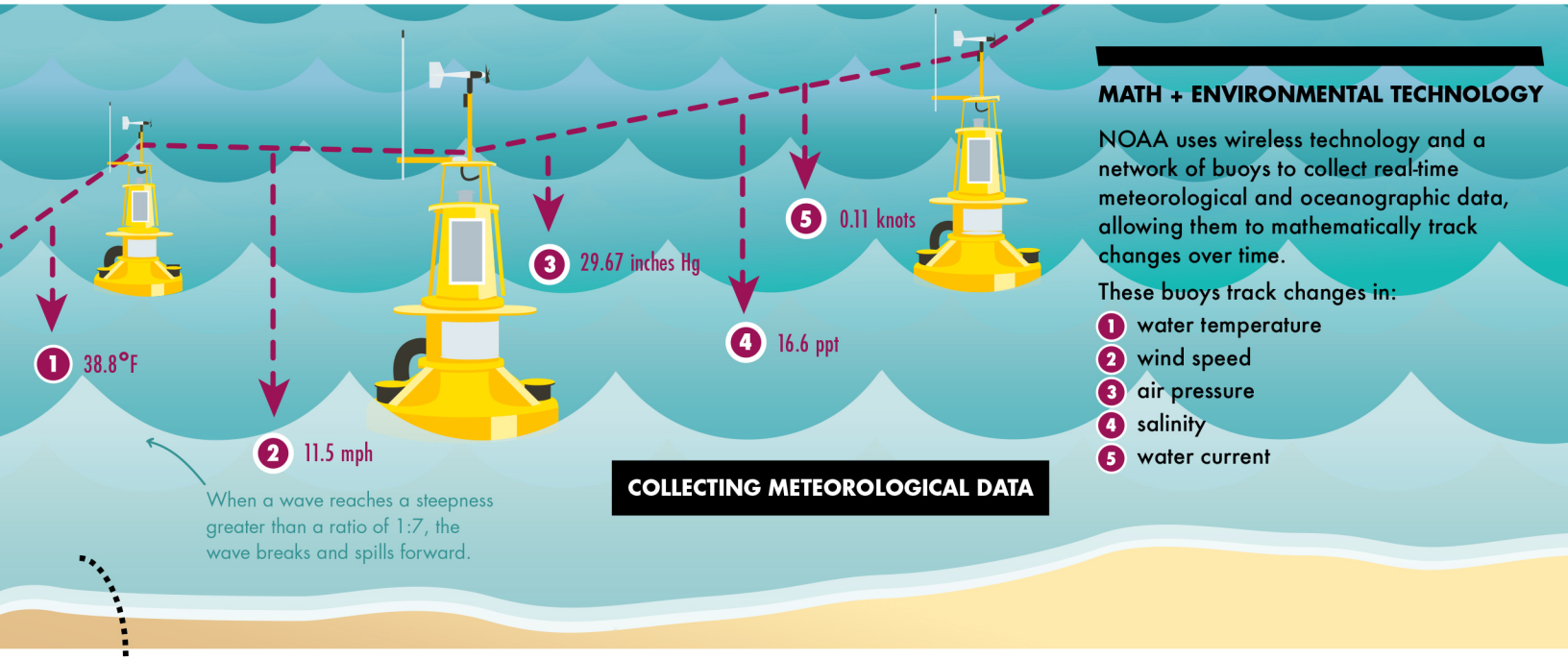
Migration Math Madness (Grades 5-8)
Migration Science and Mystery
Students discover that shorebirds migrate long distances between their northern and southern habitats, using five defined corridors or "highways" in the sky. By using the migration map provided, they measure and calculate the distances some shorebirds travel and come to understand why shorebirds must stop to feed and rest along the way.

Urban Heat Islands (Grades 6-9)
Arizona State University's Ecology Explorers Program
This unit can be used in the classroom in a variety of ways. The full sequence of lessons allows students to explore the abiotic and biotic factors involved in this phenomenon before applying what they have learned toward mitigation of urban heat islands using the engineering design process.

Using Real-Life Data to Understand Climate Change (Grades 7-12)
Earth Day Network
This lesson is aimed at increasing students' general knowledge of climate change on local, national, and global scales, and how such changes in climate will affect humans. Students use climate records to strengthen their math and analytical skills and understand average temperature change over time. After the activity, students will have gained an understanding of how math can be applied to real life data and situations.

Data Resources for Educators (All Grades)
NOAA
The Data Resources for Educators collection is designed to help educators find NOAA and NOAA-related data resources that range from classroom-ready, student-friendly interfaces to raw real-time and historical data. The resources are grouped into several topic areas. *Classroom-ready* resources are defined as those resources which need little or no teacher preparation before sharing with students.

MATH + ENVIRONMENTAL TECHNOLOGY



Chesapeake Exploration **(Grades 6-12)** ***Featured Resource***
NOAA
This new and innovative collection of online activities for middle and high school students brings the science of the Chesapeake Bay to life. Chesapeake Exploration gives teachers and their students unprecedented access to lessons designed around real-time observational data from the Chesapeake Bay Interpretive Buoy System (CBIBS).

Mathabitat (Grades K-5)
Hands on the Land
In this math game, students build a trophic pyramid for three ecosystems: alpine, rainforest, and river. Students complete each puzzle by dragging food web components into the trophic pyramid and using algebra to figure out which components fit in each ecosystem.

Dendochronology (Grades K-5)
National Park Service/Department of the Interior
This simulation allows students to determine how old a tree is by counting the number of rings in a core sample and challenges them to match other wood grain samples against the core to determine how old the wood is.

Gather Data: A Weather Watch Activity (Grades 3-8)
Scholastic
In the Gather Data activity, part of the Weather Watch series, students can test-drive the tools meteorologists use every day! Scholastic provides step-by-step instructions for building and using each tool.

Geothermal Energy (Grades 5-8)
Office of Energy Efficiency & Renewable Energy
This lesson includes five activities that give students information on the principles of heat transfer and the technology of using geothermal energy to generate electricity.

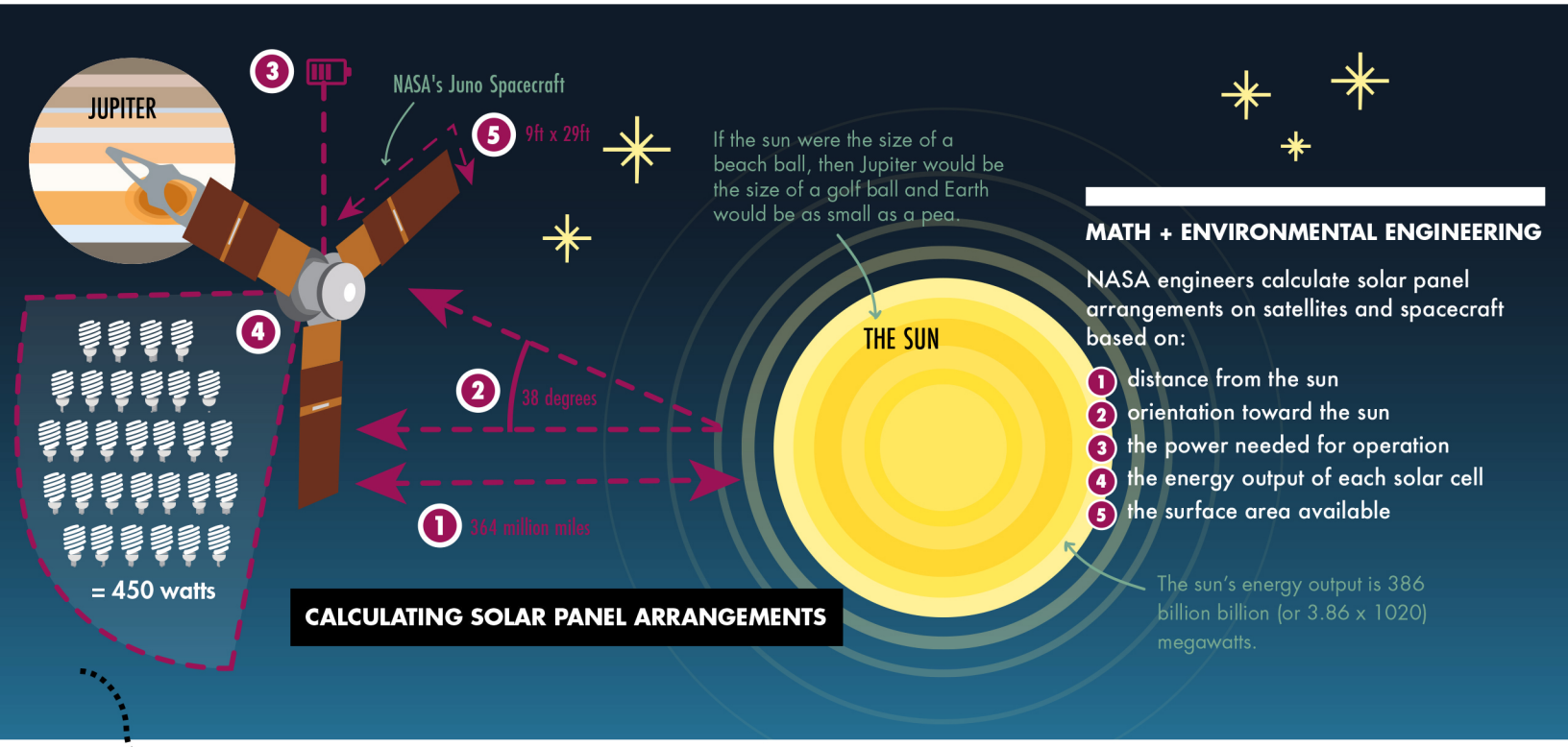
ESRI ArcGIS Earth Science GeoInquiries (Grades 6-9)
ESRI offers free online mapping tools and activities for students and educators. The engaging and innovative nature of ArcGIS Online web maps foster deeper inquiry, span subjects, and support many modes of learning.

A Very, Very Simple Climate Model Activity (Grades 6-12)
UCAR
Through a simple online model, students learn about the relationship between average global temperature and carbon dioxide emissions while predicting temperature change over the 21st Century.

Virtual Ballooning to Explore the Atmosphere Activity (Grades 6-12)
UCAR
In this computer-based virtual lab, students learn about the layers of Earth's atmosphere by launching virtual balloons to collect temperature and pressure data at various altitudes. Given a limited number of balloon flights, students must plan carefully to gather data that generates a good "picture" of the atmosphere's structure.

Landsat Math (All Grades)
NASA
Through these worksheets, students apply math skills to explore and understand various processes that relate to the Landsat mission. The topics range from how remote sensors collect and interpret photons to how Landsat is currently used to monitor the effects of climate change on the Earth. Some problems discuss satellites other than Landsat, but still shed light on how instruments like Landsat operate.

MATH + ENVIRONMENTAL ENGINEERING



Solar Energy: Measurement and Geometry (Grades 6-8) ***Featured Resource***
NASA
Students learn how solar panels can be used to generate electrical power and how the size and area of the panels affects energy production. By reading a NASA press release and viewing a NASA eClips video segment, students see how solar energy is used by various NASA satellites and technology.

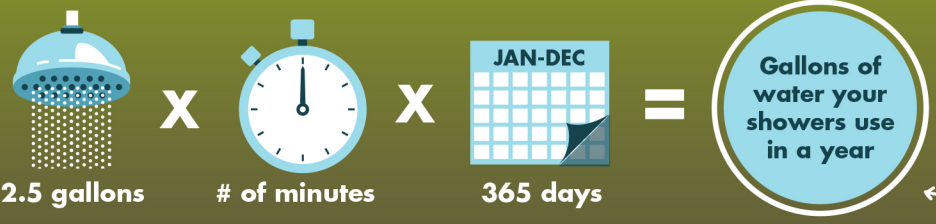
Environmental Interactions (Grades 3-5)
TeachEngineering
In this activity, students create a "web" to identify and demonstrate the interactions among the living and non-living parts of an environment. This information allows students to better understand the many connections within an environment and to consider how engineers solve some of the world's most challenging environmental problems.

The Math of Renewable Energy (Grades 6-8)
Green Education Foundation
Students learn to differentiate between renewable and non-renewable energy sources, describe the effects human actions have had on the environment over time, and explain the value of alternative energy sources.

Navigating by the Numbers (Grades 7-9)
TeachEngineering
Ancient land and sea navigators started with the most basic of navigation equations (speed x time = distance). Today, navigational satellites use equations that take into account the relative effects of space and time. In this lesson, students learn through associated activities how even these high-tech wonders designed by engineers cannot be created without pure and simple math concepts like basic geometry and trigonometry.

QUICK CALCULATIONS

Did you know that a standard showerhead uses 2.5 gallons of water per minute? Next time you take a shower, time the number of minutes you let the water run.



COMPARE: Repeat these calculations, shortening the usage time of each resource, to see how much you could save!

You can calculate pounds of CO_2 emissions by common household electronics. For a lightbulb, use this equation:

[Materials for the Cool Schools Challenge]
National Wildlife Federation
Use these tools and worksheets to calculate your classroom carbon emissions.

[What's My Carbon Footprint?]
Nature Conservancy
Use this carbon footprint calculator to estimate how many tons of carbon dioxide and other greenhouse gases your choices create each year.

[Greenhouse Gas Equivalencies Calculator]
US EPA
The greenhouse gas equivalencies calculator can help you understand what reducing carbon dioxide (CO_2) emissions means in everyday terms. Translate abstract measurements into concrete terms your students can understand, such as the annual emissions from cars, households, or power plants.

[The Lowdown | How California Distributes Its Water in Dry Times: Percent and Proportions]
PBS LearningMedia
Use this infographic to explore the math of water use, water rationing, and drought in California, with a focus on percentage and proportion. In the accompanying classroom activity, students estimate their family's daily water usage in gallons. They display these figures in a pie chart and consider how the chart would change if they used less water.