Standards-Aligned CaveSim Programs for Tennessee Elementary Schools

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Right: Loving CaveSim at a program at Winchester Christian Academy, Winchester, TN, 2022

Administrator quotes:

"What a great experience for our students!" **— Caroline Simmons, Head of Schools, Winchester Christian Academy, Winchester, TN**

Teacher quotes:

"Thanks again for bringing CaveSim to Youngs Grove on Monday! The kids could not stop talking about it!" **— Lisa Saroka, Gifted Teacher, Polk County Schools, GA**

"I got great feedback from all the students about CaveSim. I hope to get to see CaveSim again!" **— Katie Stiers, teacher, Barnwell Elementary, Fulton County, GA**

"CaveSim was amazing. I had students come up to me the next day, give me a big hug and say 'Thank you Ms. Jones for having the cave at our school. It was so fun.' The students were able to understand cave formations, organisms and cave safety. You and the other cave experts were fantastic. You were able to share important content related to earth science and life science. Each part of the presentation was aligned to our science standards. They particularly loved climbing through the cave and the 'tower'. Mike was great. Thanks for all that you do. We would love to see you back next year." **— Patricia Jones, teacher, Houston Elementary, Austin, TX**

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Summary

Thank you for your interest in CaveSim! The centerpiece of our programs is our mobile CaveSim system, which we'll bring to your school from Colorado Springs in a 26' trailer. The cave is filled with formations, critters, and ancient artifacts (all artificial), and students get a computerized score based on how carefully they avoid the stalactites and other objects as they explore.

We'll also bring you an entire program of Tennessee Academic Standards-aligned[1] hands-on lessons/activities with the mobile cave. Our elementary programs are tailored specifically to elementary standards, and cover a wide range of subjects including science, math, language arts, engineering, PE and art.

Our programs are led by CaveSim inventor, educator, and MIT-trained engineer Dave Jackson. Dave and his wife Tracy are both real cavers, and have been doing CaveSim programs at schools around the country since 2010 (for over 30,000 students). Our lessons are designed by Tracy, who has a Masters of Art in Teaching from Colorado College, and brought to you by Dave and other highly skilled CaveSim staff.

In addition to learning a wide range of classroom subjects, students also learn that they can do what Dave and Tracy have done: take what they've learned in school and use it to follow their passions to make the world just a little bit better.

We look forward to bringing CaveSim to your school to engage your students in a whole new way, and we're excited about working with you.

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[1] https://www.tn.gov/education/instruction/academic-standards/science-standards.html

Schools nationwide that have done and loved our programs

TN: Winchester Christian Academy (ES & MS)
GA: Hillside Montessori, Barnwell ES, Youngs Grove ES.
KY: Barren County Intermediate Center, Allen County MS.
MS: Jackson Academy, Jackson, MS.
OK: Grove Lower ES, Upper ES, and HS, Centennial ES, John Ross ES, Frontier ES.
TX: Austin HS, McCallum HS, Andrews ES, Baranoff ES, Barrington ES, Bear Creek ES, Blanton ES, Brentwood ES, Cowan ES, Hill ES, Houston ES, Wooldridge ES, Frost ES, Dahlstrom MS, Brawner Intermediate, Baccus ES, Lakeway ES, Sanchez ES, Metz ES, Summitt ES, Winn ES, Uphaus Early Childhood Education Center, Menchaca ES, Pillow ES, Padron ES, Eastside Memorial HS, TA Brown ES, Sunset Valley ES, Kiker ES, Mathews ES.
CO: Peoria ES, Fulton Academy, Ryan ES, Aspen Creek K-8, Avery Parsons ES, Gold Camp ES, Academy International ES, Buena Vista ES, Cresson ES, Arrowwood ES, Legacy Academy, Falcon MS, Carson MS, Patriot ES, Aragon ES, Abrams ES, Atlas Prep, Palmer Lake ES, Ute Pass ES, Manitou Springs ES, Lake George Charter School, Ridgway ES, Las Animas ES, Queen Palmer ES, Eisenhower ES, Good Shepherd School, Cedar Ridge ES, Ben Franklin Academy, The Colorado Springs School, The University School of Colorado Springs, Longfellow ES, Mountain Song Community School, University Schools (middle school), Remington Elementary, Springs Ranch Elementary, Meridian Ranch Elementary, La Veta elementary and La Veta middle school.

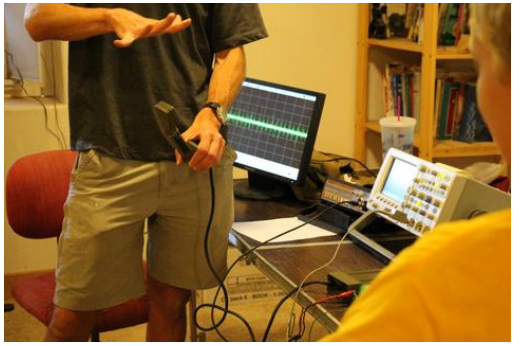
Standards Alignment and Program Details

Standard components are included in the cost of the program. Programs are typically conducted by having students work with us at a series of different stations/lessons, as follows:

CaveSim program element: Horizontal Cave Exploration	Corresponding Tennessee standards	Photos of past CaveSim programs
In CaveSim mobile cave (contains 60' of passage with multiple levels in a 24' trailer), students explore in small groups (while wearing helmets) and:		
• Try to avoid bumping into artificial cave formations. Students learn that oil & water do not mix, & that touching formations can cover them with skin oil, which stops formations from growing.	4.ESS3: Earth and Human Activity 1) Obtain and combine information to describe that energy and fuels are derived from natural resources and that some energy and fuel sources are renewable and some are not (fossil fuels, minerals).	
• Look for cave biota (critters, all artificial), and discuss the cave ecosystem after they exit the cave. CaveSim staff teaches about the cave food web, including the amazing lampshade spider, which eats fungus gnats, which eat fungus, which eat deceased bats, etc.	5.LS3: Heredity: Inheritance and Variation of Traits 1) Distinguish between inherited characteristics and those characteristics that result from a direct interaction with the environment. Apply this concept by giving examples of characteristics of living organisms that are influenced by both inheritance and the environment.	
• Learn about how cave passage forms. CaveSim staff talk about special bacteria that use enzymes to eat limestone (breaking chemical bonds to get energy). We also discuss the possibility of caves on Mars, and ongoing research in exoplanetary biology. We can also discuss the formation of sinkholes, and the benefits / dangers that they afford humans. Demo available upon request: dissolution of carbonate rocks using weak acid. Discussion of how humans use cave-based resources (e.g., limestone, guano)	5.ESS1: Earth's Place in the Universe: Use evidence from the presence and location of fossils to determine the order in which rock strata were formed. 5.LS4: Biological Change: Unity and Diversity 1) Analyze and interpret data from fossils to describe types of organisms and their environments that existed long ago. Compare similarities and differences of those to living organisms and their environments. Recognize that most kinds of animals (and plants) that once lived on Earth are now extinct.	 *Thrilled to explore CaveSim in Glenwood Springs, CO, 2018. Photo by Chelsea Self, Post Independent.*
• CaveSim staff explain how aqueous cave formations (helictites, soda straws, gypsum) form. Topics covered: water flow is usually downhill due to gravity; sometimes water flows up due to capillary action (examples: water climbing up a towel, water flow inside cave formations). Vocab: "capillary action." • Look for modern equipment in the cave, including rescue cache and vertical caving rope ladder (etrier). Students learn that the etrier (rope ladder) is named after the French word for stirrup. Students expand vocabulary with the word "cache."	4.ESS2: Earth's Systems 1) Collect and analyze data from observations to provide evidence that rocks, soils, and sediments are broken into smaller pieces through mechanical weathering (frost wedging, abrasion, tree root wedging) and are transported by water, ice, wind, gravity, and vegetation.	 *Elementary students in Cascade, CO explore the mobile cave.*
• Look for artifacts and rock art. Discuss the importance of artifacts to native people and to archaeologists and anthropologists. Hear a real story about a CaveSim staff member's experience with artifacts while exploring caves in Mexico. Students discuss why we don't take native artifacts or damage native art. Differences between graffiti and art are discussed. • Available upon request: prior to entering the cave, students are asked to make cave paintings with black paint on butcher paper. Students are encouraged to reflect on their paintings and write a few sentences about what story their picture tells. During exploration of the mobile cave, students are given extra time in the cave to make sketches of the cave paintings that they find. After they exit the cave, students are given time to write a few sentences on their sketch to tell a story about what they saw in the cave paintings. As a group, students are invited to share the stories that they wrote.	4.ESS3: Earth and Human Activity 2) Create an argument, using evidence from research, that human activity (farming, mining, building) can affect the land and ocean in positive and/or negative ways.	
Space required: the 24' trailer is typically kept outside. See www.cavesim.com/site-logistics for more details. In inclement weather, we may close the trailer and do indoor activities.		

CaveSim program element: Vertical Caving	Corresponding Tennessee standards	Photos of past CaveSim programs
On CaveSim portable 12' A-frame w/ crash pads:		
• While wearing helmets, students use a Bosun's chair, ropes, and pulleys to learn about mechanical advantage afforded by 1:1 and 5:1 pulley systems, and learn that work is unchanged when a mechanical advantage is introduced. Students work together to lift a fellow student up the tower using the different systems. Students use their understanding of fractions to determine that the 5:1 pulley system reduces the required lifting force by a factor of 5.	5.PS2: Motion and Stability: Forces and Interactions 1) Test the effects of balanced and unbalanced forces on the speed and direction of motion of objects. 2) Make observations and measurements of an object's motion to provide evidence that a pattern can be used to predict future motion. 3) Use evidence to support that the gravitational force exerted by Earth on objects is directed toward the Earth's center. 4) Explain the cause and effect relationship of two factors (mass and distance) that affect gravity. 5) Explain how forces can create patterns within a system (moving in one direction, shifting back and forth, or moving in cycles), and describe conditions that affect how fast or slowly these patterns occur.	*Above, a student in Colorado uses mechanical advantage to lift herself up the A-frame.*
• CaveSim staff use harnesses and mechanical ascenders to climb the A-frame. Staff discuss ascender mechanics, as well as equipment safety and the important differences between caving and rock climbing equipment. Students learn the words "ascend," "descend," "vertical", and "horizontal." Students learn about current events in vertical caving, including ongoing efforts in Mexico to find the world's deepest cave. Students learn that some cavers who help w/ CaveSim have been 6000' underground.	4.ETS1: Engineering Design 1) Categorize the effectiveness of design solutions by comparing them to specified criteria for constraints.	*Below, students in Montana work together under direct supervision from staff to lift a fellow student .*
• With the help of students, CaveSim staff demonstrate the power of friction to rapidly destroy Nylon rope. Before the demonstration, students are encouraged to develop hypotheses about what will happen when two ropes are rubbed together, and then develop hypotheses about which rope will break first. After the two ropes are rubbed together rapidly and the larger rope breaks, students are encouraged to try to figure out why the larger rope broke. CaveSim staff explain the outcome by introducing the concept of "concentrated" (because of the way the experiment is done, the heat is *concentrated* in just one spot on the larger rope, and spread out on the smaller rope, hence the melting of the larger rope).	4.PS3: Energy 3) Describe how stored energy can be converted into another form for practical use. 2.PS3: Energy 2) Make observations and conduct experiments to provide evidence that friction produces heat and reduces or increases the motion of an object.	
• Lab activity: Egg Drop. Students design a "helmet" to protect an egg. Students work in pairs and use paper to document their design. Students then use recyclable materials, tape, glue, and other materials to design their egg protector. Students test their design using plastic eggs, and have the chance to refine their designs. Once students are done with their designs, we test each design by dropping it from the top of the CaveSim vertical caving tower. As a group, we talk about each design and discuss what attributes made the design successful or unsuccessful. We teach students that even the designs that don't work are successes because we can learn even more from a design that fails than from one that succeeds.	5.ETS2: Links Among Engineering, Technology, Science, and Society 1) Use appropriate measuring tools, simple hand tools, and fasteners to construct a prototype of a new or improved technology. 4.PS3: Energy 1) Use evidence to explain the cause and effect relationship between the speed of an object and the energy of an object. 2) Observe and explain the relationship between potential energy and kinetic energy. 3.PS3: Energy 1) Recognize that energy is present when objects move; describe the effects of energy transfer from one object to another.	
Space required: typically outdoors on flat ground. May also be placed indoors where ceiling height is >14'. Footprint is 8' x 9'.		

CaveSim program element: Carbide Demonstrations	Corresponding Tennessee standards	Photos of past CaveSim programs
To illustrate chemistry and physics concepts, CaveSim staff bring working carbide lamps and carbide to programs. Demonstrations can include: ● CaveSim staff light a working carbide lamp by placing carbide and water in the lamp to produce a small (and safe) quantity of flammable gas. The resultant gas (acetylene) burns to produce light and heat, but the lamp body also becomes warm because of the exothermic reaction between the carbide and water. Students can touch the lamp body to get a better understanding of the concept of an exothermic reaction. Older students gain an understanding of the concept of reflectors by observing the behavior of the reflector on the lamps. New vocabulary explained by CaveSim staff: “exothermic,” with connection drawn to “exoskeleton.” ● CaveSim staff place carbide and ice in an open pan. As the ice melts, the water reacts with the carbide, producing the aforementioned acetylene gas. CaveSim staff discuss states of matter (solid ice turns to liquid water as it’s heated by the carbide, and then to vapor as it boils). For older students, the concept of limiting reactants is introduced. By watching the exciting reaction occur, students gain a more intuitive understanding of the concept of a chemical reaction. New vocabulary taught by CaveSim staff: “reaction”, “reactant.” ● Science experiment safety is emphasized (e.g., firmly close containers when not in use). ● Fire safety is emphasized, with an emphasis on who is allowed to make a fire (a responsible adult), what must be present (a method of extinguishing the fire), where the fire should be made (in a safe container away from other fuel sources). Space required: typically conducted outdoors, but cannot be done in the rain. May be done indoors in an appropriate lab setting where a small quantity of smoke may be safely produced without setting off alarms or creating hazardous conditions. The smoke produced in this activity is equivalent to the smoke produced by extinguishing about a dozen birthday candles.	5.PS1: Matter and Its Interactions 1) Analyze and interpret data from observations and measurements of the physical properties of matter to explain phase changes between a solid, liquid, or gas. 2) Analyze and interpret data to show that the amount of matter is conserved even when it changes form, including transitions where matter seems to vanish. 3) Design a process to measure how different variables (temperature, particle size, stirring) affect the rate of dissolving solids into liquids. 4) Evaluate the results of an experiment to determine whether the mixing of two or more substances result in a change of properties. 3.PS1: Matter and Its Interactions 1) Describe the properties of solids, liquids, and gases and identify that matter is made up of particles too small to be seen. 2) Differentiate between changes caused by heating or cooling that can be reversed and that cannot. 3) Describe and compare the physical properties of matter including color, texture, shape, length, mass, temperature, volume, state, hardness, and flexibility.	 *Above, carbide lamp demonstration by CaveSim staff at a program in Colorado.* *Below, stock photo of the lamps we use.* 

CaveSim program element: Cave Rescue Phones	Corresponding Tennessee standards	Photos of past CaveSim programs
Hands-on lessons about basic circuits using a pair of wired cave rescue phones. Activities include:		
• We bring two cave rescue phones to our programs. The phones are connected by wire, which allows us to discuss basic circuits, and demonstrate that a circuit requires at least one complete loop to function. Students can disconnect and reconnect wires for hands-on learning about conductors and insulators. Students talk with each other over the phones. CaveSim staff discuss the relationship between wire length, electrical resistance, electrical energy dissipation in the wire, and phone volume. Electrical circuits involving the earth as one of the conductors are discussed.	4.PS3: Energy 3) Describe how stored energy can be converted into another form for practical use. 3.PS3: Energy 2) Apply scientific ideas to design, test, and refine a device that converts electrical energy to another form of energy, using open or closed simple circuits.	
• Demonstrations with waterproof speakers and high-tech engineering equipment (including oscilloscopes and function generators; see https://whatis.techtarget.com/definition/oscilloscope) by CaveSim owner Dave Jackson, who has designed high speed computer chips for oscilloscopes. The oscilloscope produces a graphical representation of voltage on the cave rescue phone wire vs. time, which allows students to visualize their vocal energy on a screen. We discuss graph axes, and the relationship between time-based and frequency based graphs. Resonances/oscillation of electrical and sound signals are also discussed. The waterproof speaker allows us to discuss different forms of energy (mechanical, electrical, thermal, etc.) and allows us to demonstrate the relationship between electricity and magnetism.	4.PS4: Waves and their Application in Technologies for Information Transfer 1) Use a model of a simple wave to explain regular patterns of amplitude, wavelength, and direction. 3) Investigate how lenses and digital devices like computers or cell phones use waves to enhance human senses.	*Two friends enjoy talking on the cave rescue phones during a 2013 CaveSim program in Colorado.*
Space required: typically outdoors for convenience, but can also be done in any classroom or indoor setting. Oscilloscope demo must be done indoors if raining. The oscilloscope has a VGA output, which can be projected to a smartboard, projector, or computer monitor for better viewing by students.		 *A CaveSim staff person teaches students about electricity and magnetism using cave rescue telephones and electronic test equipment (oscilloscopes).*

CaveSim program element: Bat games and lessons	Corresponding Tennessee standards	Photos of past CaveSim programs
Bat skeleton and guano demonstrations and lessons: • Discussion of similarities and differences between bat wing structure and human hands. Discussion of evolutionary pressures that may have created the similarities and differences. • Discussion of bat tail structure and usage of the tail in steering, balance, and in catching insects. • Discussion of different types/sizes of bats, and the role that they play in helping humans. Real-life lesson about bat eradication by farmers and the impact on their crops. • Photographic and/or video demonstration of the ongoing White Nose Syndrome (WNS) epidemic that has killed nearly 6 million bats in the last ~10 years. For older grades, lesson about the WNS fungus (Pseudogymnoascus destrucans) and how it eats (metabolizes) bats alive. • Discussions about history and the role that caves played in the civil war (as sources of saltpeter for the production of gunpowder). Space required: typically done by the trailer to engage students as they wait to explore. Can also be done anywhere inside. **Bat echolocation game**: Two at a time, students take turns roleplay a bat and a moth. The bat (blindfolded) tries to locate and tag the moth using only the "bats" voice and their hearing. The other students form a circle to contain the two students playing the bat and moth. Students learn about echolocation, and gain personal confidence. Space required: may be played indoors or outdoors. If outdoors, a safe surface must be used (to allow a blindfolded student to move in a small circle of other students without tripping on uneven ground. **Bat Migration Challenge game**: Working individually or in groups (depending on grade level), students act out the lives of bats as they encounter daily challenges and opportunities. Students learn about the ways in which humans can act to help or harm bats. Space required: may be played indoors or outdoors.	5.LS4: Biological Change: Unity and Diversity 2) Use evidence to construct an explanation for how variations in characteristics among individuals within the same species may provide advantages to these individuals in their survival and reproduction. 5.LS3: Heredity: Inheritance and Variation of Traits 1) Distinguish between inherited characteristics and those characteristics that result from a direct interaction with the environment. Apply this concept by giving examples of characteristics of living organisms that are influenced by both inheritance and the environment. 2) Provide evidence and analyze data that plants and animals have traits inherited from parents and that variations of these traits exist in a group of similar organisms. 4.ESS2: Earth's Systems 3) Provide examples to support the claim that organisms affect the physical characteristics of their regions. 4.LS2: Ecosystems: Interactions, Energy, and Dynamics 2) Develop models of terrestrial and aquatic food chains to describe the movement of energy among producers, herbivores, carnivores, omnivores, and decomposers. 3) Using information about the roles of organisms (producers, consumers, decomposers), evaluate how those roles in food chains are interconnected in a food web, and communicate how the organisms are continuously able to meet their needs in a stable food web. 4) Develop and use models to determine the effects of introducing a species to, or removing a species from, an ecosystem and how either one can damage the balance of an ecosystem. 3.LS4: Biological Change: Unity and Diversity 1) Explain the cause and effect relationship between a naturally changing environment and an organism's ability to survive. 3) Explain how changes to an environment's biodiversity influence human resources. 3.LS2: Ecosystems: Interactions, Energy, and Dynamics 1) Construct an argument to explain why some animals benefit from forming groups. 3.LS1: From Molecules to Organisms: Structures and Processes 1) Analyze the internal and external structures that aquatic and land animals and plants have to support survival, growth, behavior, and reproduction. 2.LS3: Heredity: Inheritance and Variation of Traits 1) Use evidence to explain that living things have physical traits inherited from parents and that variations of these traits exist in groups of similar organisms. 2.LS1: From Molecules to Organisms: Structures and Processes 1) Use evidence and observations to explain that many animals use their body parts and senses in different ways to see, hear, grasp objects, protect themselves, move from place to place, and seek, find, and take in food, water, and air.	 *CaveSim program lead Dave Jackson teaches kids about bat biology in Glenwood Springs, CO. Photo by Chelsea Self, Post Independent.*

CaveSim program element: Geology	Corresponding Tennessee standards	Photos of past CaveSim programs
Cave Formation: Students learn about how caves and cave formations grow ● CaveSim staff explain how aqueous cave formations (helictites, soda straws, gypsum) form. Topics covered: water flow is usually downhill due to gravity; sometimes water flows against gravity due to capillary action (examples: water climbing up a towel, water flow inside cave formations). Students expand vocabulary with “capillary action.” ● Learn about how cave passage forms. CaveSim staff talk about special bacteria that use enzymes to eat limestone (breaking chemical bonds to get energy). We can also discuss the formation of sinkholes, and the benefits / dangers that they afford humans. Demo available upon request: dissolution of carbonate rocks using weak acid. Discussion of how humans use cave-based resources (e.g., limestone, guano)	5.ESS1: Earth’s Place in the Universe: Use evidence from the presence and location of fossils to determine the order in which rock strata were formed.	 *CaveSim program lead Dave Jackson teaches kids about limestone soluablity in weak acid during a demo in Austin, TX. Photo by Austin Parks & Rec staff.*

CaveSim program element: Squeezebox and Math	Corresponding Tennessee standards	Photos of past CaveSim programs
We bring an adjustable-height wooden box through which students can crawl to safely test their ability to navigate tight spaces. Students use a tape measure to quantify how tight a space they can move through. Students practice addition and subtraction of whole numbers and fractions. Space required: typically set up near the stretcher (see above). Any indoor or outdoor setting is fine.	Mathematics | Grade K: Counting and Cardinality; Number and Operations in Base Ten; Measurement and Data K.NBT.A.1 Compose and decompose numbers from 11 to 19 into ten ones and some more ones by using objects or drawings. K.MD.A.1 Describe measurable attributes of objects, such as length or weight. Describe several measurable attributes of a single object. K.MD.A.2 Directly compare two objects with a measurable attribute in common, to see which object has more of/less of the attribute, and describe the difference. For example, directly compare the heights of two children and describe one child as taller/shorter.	 *Students at a 2018 Austin, TX program use a tape measure to quantify their squeezebox skills.*

CaveSim program element: Rescue Stretcher	Corresponding Tennessee standards	Photos of past CaveSim programs
We bring a cave rescue stretcher (Sked) to our programs. Students take turns getting into the stretcher. With the direct supervision of CaveSim staff, the student in the stretcher is carried through and around obstacles by fellow students. Students learn teamwork, communication, and leadership. Space required: any indoor or outdoor setting. May be done in classrooms or even hallways.	3.ESS3: Earth and Human Activity 1) Explain how natural hazards (fires, landslides, earthquakes, volcanic eruptions, floods) impact humans and the environment.	 *With direct supervision from CaveSim staff, a team of kids gets ready to lift and carry a friend in the stretcher.*

The value of education: As an inventor and educator, lead CaveSim educator Dave Jackson encourages students to study hard, find their passion, and understand that education is very important in life. During each program, Dave uses his personal story (including getting multiple degrees from MIT) to teach students that education leads to great success and adventure.

Keynote presentation in Lake George, CO.

Labs

Standard programs (above) can be enhanced by adding our labs. Labs provide an in-depth educational experience in a specific subject, like biology or engineering. We never use kits because our goal is to teach students that engineering and science projects are accessible to them without the use of pre-prepared materials. We emphasize conservation by using post-consumer recyclable materials in our engineering labs. Labs require extra funding for materials and staff time. Contact us for pricing.

Engineering Lab: Students create circuits with LEDs, switches, batteries, etc. to create an LED flashlight. They get hands-on experience with soldering (with staff supervision), and then design and make their own caving flashlight enclosure from recyclable materials. After creating their lights, students test their work in water to see if their lights are waterproof. Students have the chance to revise their designs if needed.

Subjects covered: Electromagnetics, product design, material science, and mechanical engineering.
Recommended time: 55 to 90 minutes. Recommended class size: Up to 25 students. Recommended grade levels: 5th grade and up
Standards addressed: 5.ETS1: Engineering Design: 1) Research, test, re-test, and communicate a design to solve a problem. 2) Plan and carry out tests on one or more elements of a prototype in which variables are controlled and failure points are considered to identify which

elements need to be improved. Apply the results of tests to redesign the prototype. 3) Describe how failure provides valuable information toward finding a solution



Above, students work on the Engineering Lab

Biota Lab: Students culture cave biota in Petri dishes, and learn that single-celled organisms can demonstrate intelligence. Students choose from multiple experiments, and discuss the factors that impact the outcome of their experiments.

Subjects covered: Experiment design, scientific method, and biology concepts.

Recommended lab time: 30 to 45 minutes, with a follow-up on a second day (with or without CaveSim staff present).

Recommended class size: Up to 30 students. Recommended grade levels: 4th grade and up.

High school students at a two-day program in Oklahoma get ready to inoculate their Petri dishes.

Karst Lab: Students make karst topography (cave landforms) with safe household materials. Students learn hydrology, geology, chemistry, landforms, states of matter.

Recommended lab time: 30-40 minutes.
Recommended class size: Up to 30 students.
Recommended grade levels: Spring-semester 3rd grade and up.
Standards addressed: 4.ESS1: Earth's Place in the Universe 1) Generate and support a claim with evidence that over long periods of time, erosion (weathering and transportation) and deposition have changed landscapes and created new landforms.

Formation Lab: Students make cave formations (e.g., stalactites) using safe household materials. We also do exciting demonstrations with the safe chemical sodium acetate (from reusable heat packs). Students learn hydrology, geology, basic chemistry, states of matter.

Recommended lab time: 30-40 minutes.
Recommended class size: Up to 30 students.
Recommended grade levels: 2nd grade and up.

Above, 5th graders in Colorado work on the Karst Lab

Waves and Energy Lab: After watching a demo with real cave rescue phones, students make their own version using cups and string. Students conduct several experiments with their phones and record their observations. Students learn about waves, energy, and graphing.

Recommended lab time: 30-40 minutes.
Recommended class size: Up to 30 students.
Recommended grade levels: 2nd grade and up.
Standards addressed: 2.PS4: Waves and Their Applications in Technologies for Information Transfer 1) Plan and conduct investigations to demonstrate the cause and effect relationship between vibrating materials (tuning forks, water, bells) and sound. 2) Use tools and materials to design and build a device to understand that light and sound travel in waves and can send signals over a distance. 3) Observe and demonstrate that waves move in regular patterns of motion by disturbing the surface of shallow and deep water.

Geology Lab: Using small collections of rocks, students conduct geologic tests including hardness, solubility, density, and magnetism. Students record findings on a worksheet and compare results with classmates to gain an understanding of the three major rock types, geologic classification, soil formation, etc. Students learn about the many ways in which humans use rocks and minerals in our everyday lives.

Recommended lab time: 30 minutes.
Recommended class size: Up to 50 students (two simultaneous classrooms).
Recommended grade levels: 2nd grade and up.

States of Matter and Chemical Reactions: Students watch several safe combustion demos with carbide lamps to learn about chemical and exothermic reactions, states of matter, pressure, and other physical science concepts. Students conduct several experiments with vinegar, water, and powdered laundry detergents. Students record observations on a worksheet and compare with the class. Allergy accommodation: if students have concerns about contact with laundry soap, please let us know and we will provide Latex-free gloves for those students.

Recommended lab time: 30 minutes.
Recommended class size: Up to 50 students (two simultaneous classrooms).
Recommended grade levels: 4th grade and up.

Bat Science: Students learn about a disease that is killing millions of bats, but which does not hurt humans at all. Using fluorescent dye in test tubes, students role-play bats and learn about how diseases spread among animal populations. As a group, we graph the results of the game to learn about the basics of graphing. Students also get to see an exclusive interview that CaveSim staff did with a bat rehabilitation expert.

Recommended lab time: 30 minutes.
Recommended class size: Up to 25 students.
Recommended grade levels: 4th grade and up.
Standards addressed: 2.LS2: Ecosystems: Interactions, Energy, and Dynamics 2) Predict what happens to animals when the environment changes (temperature, cutting down trees, wildfires, pollution, salinity, drought, land preservation).

Cave Art: Students use charred wood and water to make a simple, safe paint. Students then use the Bernoulli principle to blow their paint onto paper with straws. Students use their hands or stencils to make art the way that prehistoric people did.

Recommended lab time: 30 minutes.
Recommended class size: Up to 25 students.
Recommended grade levels: 2nd grade and up.

Pricing and FAQ

How much do programs cost? This depends on factors like travel distance, number of days, and number of students. Our average price for the current school year is $1958/day plus transportation costs, and typically works out to between $10 and $14 per student. Please contact us for a quote.

Are deposits or contracts required? No. We will reserve your program date(s) once we agree on a price and you send us an email stating that you want us to visit your school at the agreed-upon price.

How are payments made? By check, made out to CaveSim LLC, as specified on the invoice that we'll email you. W9 available upon request.

Does CaveSim carry insurance? Yes. Once you commit to working with us, please let us know if you need a Certificate of Additionally Insured.

Are permission slips required? Yes. Paperless and printable versions in both English and Spanish are available: www.cavesim.com/waiver.

How much space is needed? Is power required? See www.cavesim.com/pages/site-logistics

Is this an outdoor activity? Typically yes. The cave stays inside the trailer (we don't move it into your school). Some activities can be moved inside in inclement weather (the tower can be moved indoors if you have 13+ foot ceilings in some part of your school). In light to moderate rain/snow, we put up tents to protect students and the cave.

Is the cave heated and air conditioned? Yes. Please provide access to 1 working 20A outlet in summer, and 2 outlets (15A and 20A) in winter.

How much setup and takedown time are needed? Typically 1.5 hours for setup, and 1 hour for takedown.

Does CaveSim do multi-day programs? Yes. We have done as many as six days in one school district.
How many students can participate in a day? For elementary, 150-200. For MS/HS, 100-150. Educational value and number of students are inversely related. We're excited about working with you to size your groups for the best possible educational experience.

Contact us: Email jacksondmit@cavesim.com or call 914-330-7824.

COVID-19 precautions

We are quite cautious about SARS-CoV-2, and we take numerous steps to protect everyone involved in our programs:

- All staff wear N-95 masks at all times during our programs.
- Staff are vaccinated.
- We decontaminate the cave after each day of program.
- We continuously ventilate the cave with an HVAC system on the roof of the trailer
- Between groups, we open large doors on the trailer and use portable fans to replace the air in the cave with fresh outdoor air.
- We use an ultraviolet decontamination lamp and sanitizing wipes to clean high-touch surfaces such as helmets.
- We are developing an in-cave UVC decontamination system which will be deployed soon.
- We make hand sanitizer available to everyone.

If you have any questions or concerns about any of these steps, or would like to ask us to take additional precautions, please contact us.

Safety and special needs

Teachers/staff can explore the cave, and students with special needs (physical or otherwise) may be assisted by school staff, students, and/or CaveSim staff. While each student is different, numerous wheelchair-bound students have explored CaveSim. Some students may have more difficulty avoiding cave formations, and our only requirement is that each student understand their goal of not touching the formations (for the safety of the system and students). Students who are unable to understand the careful-caving goal may participate in our other activities. CaveSim has cameras for checking on students as they explore. We have five access points to let participants out of the trailer if needed.

We follow the BSA's Youth Protection policy, which includes no 1:1 student/adult interaction.

Challenge by Choice

Most students love exploring CaveSim. Occasionally we have a student who is unsure, uncomfortable, or afraid. We encourage him/her to set a goal for themselves and see if they can attain that goal. We teach Challenge by Choice, and have plenty of activities for students to try.

Classroom management

We've been doing our programs since 2010, and our staff includes former classroom teachers, so we have a good handle on classroom management. Because we spent over two years creating CaveSim, we set expectations at the start of the program: we expect students to respect the equipment and everyone involved in the program. We rarely experience discipline problems, but when we do we ask students to either change their behavior or take a break from the activity until they are ready to participate properly. Our goal is to work as a team with you, so please feel free to communicate with us about any issues that you foresee.