Teaching STEM builds creative, scientific, and mathematical thinking—job skills that are in high demand. iPad is ideal for STEM students because it goes anywhere learning takes them. With iPad, students can easily capture and analyze data and create almost anything they can imagine.
How iPad can help

By bringing together science, technology, engineering, and math, STEM helps students see the relevance of what they’re learning and lets them apply their learning to problems in the real world. iPad is ideal for teaching STEM topics because it supports the whole learning journey—from data collection and mathematical analysis to design thinking, prototyping, collaboration, content creation, and coding.

As a mobile device with a high-quality Retina display, cameras front and back, microphone, and seamless connection to a range of peripheral devices, iPad is perfect for students who need to capture physical phenomena in the world around them. All on one device, students can organize data into spreadsheets, apply mathematical thinking and skills, and visualize data with charts and graphs.

When challenged to create solutions to real-world problems, students with iPad can collaborate, brainstorm, and use design skills to sketch their ideas. The built-in features on iPad, along with access to a breadth of available resources, make it invaluable for supporting STEM teaching and learning. iPad can transform into almost any tool students need—a telescope, a graphing calculator, a camera, a sketch pad, a book—the list goes on.
Built-in features for capturing data

iPad includes built-in apps and features that support STEM by helping students capture scientific data. Here are some examples.

**Camera.** Cameras front and back allow students to capture photos and movies and save them to Photos to use in their projects. They can record science experiments or see and compare daily images to understand how a flower blooms. And with slo-mo in video, they can analyze rapid movements like a pitcher throwing a ball or changes during a lab experiment.

**Microphone.** With the microphone, students can record the sounds of the world around them, then store or manipulate them in GarageBand. It’s also great for creating explanatory narration for a video.

**Maps.** Saving the exact location where students capture pictures, video, sound, or data in Maps is an important part of geography, geology, and environmental science.

**Clock.** The stopwatch and timer features of the Clock app can help students use or capture precise durations when studying physical properties like speed and velocity.

**Apple Pencil support.** STEM students need to capture their ideas with notes and sketches, and Apple Pencil support on iPad is the perfect way to do it. Students can jot down notes and sketch ideas and observations on iPad as naturally as they do on paper.
Built-in features for demonstrating understanding

iPad also includes powerful apps to support students as they demonstrate their understanding of STEM knowledge.

**Pages.** For documents that range from science reports to product plans, Pages helps students enhance their writing with pictures, movies, audio recordings, video, drawings, and 3D models. They can also use the digital book templates to create interactive books that include image galleries, videos, drawings, and shapes.

**Keynote.** Students can bring their presentations to life with drawings, images, charts, and audio recordings.

**Numbers.** As students collect scientific data, they can organize it in a Numbers spreadsheet using any of the built-in templates for quick formatting. They can apply mathematical formulas to make sense of the data, analyze it using graphs and charts, then enhance the data story through images, video, illustrations, and sound.

**iMovie.** Students can share their learning in engaging ways using iMovie. Once they’ve collected or analyzed scientific data in the form of pictures, sketches, charts, or video, they can assemble it all in iMovie and add their own narration.

**GarageBand.** This great tool lets students collect audio samples and build narrative explanations in the form of podcasts.

**Clips.** Students can create videos that capture learning quickly and easily for assessments, how-tos, and more. And Live Titles lets them add animated captions and titles—just by talking—that sync perfectly with their voice.
Engaging learning materials

A wide variety of learning materials are available for iPad that support students in STEM subjects. Many of these outstanding resources are ideal for teachers as well.

App Store. A vast collection of engaging apps on the App Store can turn iPad into any tool or resource a student needs. These apps can help students improve numeracy skills, discover and explore science concepts, capture and analyze data, and create content in many different ways.

iBooks Store. From science textbooks to how-to books and lesson plans, thousands of engaging books are available on the iBooks Store on STEM topics. Many of these are Multi-Touch books, which have built-in reading tools, such as spoken text, instant access to dictionary definitions, and study cards that help with comprehension.

For example, All About Space is an elementary iBooks Textbook that offers students a new way to read to learn. The Yellow Cab of the Universe textbooks explain astronomy and physics in innovative ways. And Pearson Chemistry and McGraw Hill Algebra 2 turn traditional textbooks into engaging and interactive experiences.

iTunes U. This online catalog includes free education courses from top schools and prominent institutions worldwide.

Much of this content is ideal for teachers, such as the STEM courses from String Theory and many of the courses from Apple Distinguished Educators.

Collections. Our editors have created hundreds of collections to help educators find great resources on iTunes. Click the images below to explore collections that are especially valuable for STEM.
Apps for teaching and learning STEM subjects

Here are just a few examples of how engaging apps can support STEM learning and teaching.

**Solar Walk 2.** This app offers an interactive 3D model of space that lets students navigate the solar system, see planet positions, and explore how and why they move.

**Molecules.** Using Theodore Gray’s app, students can poke, prod, and rotate hundreds of molecular models, see how they react and respond, and discover how they’re assembled into all the substances our world is made of.

**iBiome-Wetland.** Professor Bio leads students to build four unique bio domes and interact with food webs. Students learn environmental science through exploration, discovery, and problem-solving.

**Tinybop.** This series of apps helps elementary students learn foundational science literacy through exploration of the human body, plants, skyscrapers, mammals, space, and more.

**New York Hall of Science.** This app collection includes Playground Physics, which lets students explore the motion, forces, and energy of their own movements by analyzing videos that they make of themselves. Additional apps encourage students to explore other math and science relationships.

**DreamBox Learning Math.** These two apps provide a highly personalized and motivating math learning experience for students in grades K–8. The apps differentiate content, pace, and lesson sequence in real time.

**GeoGebra Graphing Calculator.** This graphing calculator app lets students easily graph functions, solve equations, find special points of functions, and save and share their results.

**WolframAlpha.** This knowledge engine instantly generates facts and answers on a wide range of STEM topics, from solving math equations to revealing the tallest buildings on Earth.

**BioDigital Human.** This app offers a comprehensive set of anatomy and health condition models. Students can add and remove layers and fly around and through an accurate 3D model of the body.

**Augmented reality apps**

**Froggipedia.** This augmented reality experience brings organs, systems, and vocabulary to life in the context of a lifelike frog. Students can see the life cycle, study a living frog in AR, and then dissect a virtual frog.

**Free Rivers.** Through this interactive storytelling experience, students learn how wildlife, people, and the landscape depend on healthy, flowing rivers. Students can build and remove dams and see the impacts throughout the landscape.

**GeoGebra Augmented Reality.** GeoGebra AR lets students explore math by walking around 3D shapes that they create. And guided activities let them discover math in the real world by taking screenshots from different perspectives.
Books for teaching and learning STEM

Here are a few examples of how iBooks Author and books on the iBooks Store can support STEM learning and teaching.

**iBooks Author.** With iBooks Author on a Mac, educators and students can create their own interactive books for viewing on iPad. Teachers can develop personalized learning materials, and students can document what they've learned. An outstanding example of a student-created book is *Health: Inside Out*, which was developed by students at Coppell High School in Texas to help other students learn about the human body and healthy living habits. Another good example is *Invertebrates*, written by eighth-grade life science students from Scenic Middle School in Central Point, Oregon.

**Life on Earth.** One of the best examples of what's possible with iBooks Author is *E. O. Wilson's Life on Earth*. This seven-unit free iBooks Textbook gives students a deep understanding of the central topics of introductory biology. The book series and accompanying course are designed to inspire students to take responsibility for conserving nature's biological treasures.

**Books by Apple Distinguished Educators.** These educators have created many free books on STEM topics. Here are just a few examples.

- *Digital Data: Apps to Capture Scientific Data*
- *Inventing a Better World: Design Thinking Through STEAM Education*
- *Thinking Like a Scientist: Students as Mobile Researchers*
- *In the Science Lab: Introduction to Being a Scientist*
Teaching students to code

We believe coding is an essential skill that everyone should have the opportunity to learn, so we designed the Everyone Can Code program to give anyone the power to learn, write, and teach coding. The Everyone Can Code resources support a complete curriculum path from kindergarten to college.

Coding resources for elementary schools on iPad
The Get Started with Code Teacher Guides are designed to help you bring coding into the elementary classroom using visual-based programming apps like codeSpark Academy and Tynker. The two Teacher Guides provide the support you need to help students in grades K–5 explore coding concepts and begin to think like coders. Learn more about the Get Started with Code curriculum.

Coding resources for middle schools and above on iPad
Swift Playgrounds is a free iPad app from Apple that makes learning and experimenting with code interactive and fun. The app includes a complete set of Apple-designed Learn to Code lessons that let students use real Swift code to solve puzzles and guide a character through a 3D world. And the Learn to Code Teacher Guides help you bring Swift Playgrounds into the classroom, no matter your level of coding experience. Learn more about the Swift Playgrounds curriculum.

App development resources for high schools on Mac
The Intro to App Development with Swift and App Development with Swift curricula were designed to teach high school and college students with little or no programming experience how to be app developers, capable of bringing their own ideas to life.

The Intro to App Development with Swift course introduces students to the world of app development and the basics of Swift and Xcode. The course culminates in a final project where they can choose one of two basic iOS apps to build.

App Development with Swift takes students further, whether they’re new to coding or want to expand their skills. If they’re already familiar with Swift, Xcode, and iOS development, they can move through early lessons quickly or go straight to the labs where they’ll build miniprojects and test their code in playgrounds. By the end of the course, they’ll be able to build a fully functioning app of their own design.

Teacher Guides provide additional activities, discussion questions, solutions code, and prompts for an app design journal. Learn more about the App Development with Swift curriculum.

App Development with Swift Level 1 Certification
Educators teaching App Development with Swift can register to have their students earn recognition for their knowledge of Swift and Xcode. Certification is available through an exam administered by Certiport, and shows that students are ready to take the next step in becoming app developers.*

Learn more about Everyone Can Code and explore additional coding resources.
STEM hardware

A wide range of third-party hardware products connect to iPad to extend learning through innovative STEM apps.

Sensors, probes, and microscopes

PASCO sells more than 80 different sensors and probes that connect to iPad for collecting scientific data that can be captured, displayed, and analyzed using the SPARKvue app. Students can also use the app with the built-in microphone and accelerometer on iPad to collect data on sound level/intensity and acceleration.

Vernier offers a wide range of sensors for collecting scientific data, such as temperature, motion, force, and pH. The Vernier Graphical Analysis app helps students understand and visualize the experimental data using graphs.

Bodelin offers ProScope microscopes for both classroom and mobile use, as well as the ProScope QC app for iPad that helps students take measurements.

Bring code to life

Third-party developers of popular robots and devices offer subscriptions that work in Swift Playgrounds so that students can make their code come to life.

Sphero playgrounds let you guide this spherical robot through tricky courses, accelerate over jumps, and change colors.

Dash playgrounds challenge students to make the robot speak, sing, and respond to sensor inputs to react to its environment.

Use LEGO MINDSTORMS EV3 playground to design, engineer, and program a solution to help an injured turtle.

3D printers

With MakerBot 3D printers and the MakerBot app, students can model and create new objects, and in the process, improve their planning, reasoning, and design skills.
Learning activity: The physics of playing catch

With iPad, the everyday playground activity of playing catch can be turned into an interactive and collaborative physics lesson for middle school students.

Objective
Students use the camera in conjunction with built-in and free apps on iPad to capture, analyze, and understand the motion of a ball when two people are playing catch. In the process, they learn important physics concepts and create a presentation to share what they’ve learned.

Overview
In this workflow, students learn the definitions of motion, distance, speed, velocity, and acceleration. Working in groups of three outdoors, one student uses the Camera app on iPad to film two classmates playing catch with a ball. Students then work together using the Playground Physics app to analyze the motion of the ball. They then construct a Keynote presentation in which they narrate an explanation of the motion using the key terms they’ve learned. Depending on the level of the students, additional terminology, such as slope and parabola, can be added to the lesson. As a challenge exercise, ask students what the optimum angle is when throwing for distance.

Camera  >  Playground Physics  >  Keynote
Learning activity: Create a digital lab report

Hands-on science experiments are a great way to engage students in critical thinking and problem solving. And with Numbers, students can turn traditional lab reports into beautiful documents that include drawings, shapes, tables, charts, and more.

Objective
Students engage in the scientific process by testing varying hypotheses around paper airplane design and flight. They use Numbers to calculate the data and communicate the results.

Overview
Students conduct several experiments to test how paper airplane design affects flight. They start with a general design-versus-distance test, then use the winning model to see how different types of paper affect the distance flown. Finally they study whether there's a correlation between wingspan and distance flown. Using Camera, they capture photos and video of their creations so they can carefully study their designs and make necessary changes. They measure their airplanes' flight times with the stopwatch feature in the Clock app. Next, they create a lab report in Numbers to record and analyze the data from each experiment. Students then add hand-written notes and drawings to expand on their findings, include additional observations, and communicate their results.
Creating science reports help students reflect on what they learned during a field trip. This practice encourages planning, careful observation, note-taking, and continual reflection and revision. Science reports can be even more engaging when they’re collaborative.

Objective
Students studying natural history take a field trip to a local museum and learn about animals like birds, dinosaurs, and African mammals. They create an interactive book to collaboratively record their notes and report back on what they learned.

Overview
Using Notes, students record their observations and experiences at a local museum. They reflect on their favorite exhibits, record key facts about the mammals they discover, sketch observations, and use Camera to document what they see. Next they use a digital book template in Pages to create a shared science report, with one or more pages devoted to each animal they learned about. They enhance their writing with drawings, movies, audio recordings, images, and shapes.

Learning activity: Create a collaborative science report

![BIRDS]

VIVIAN’S COLORFUL LOOK AT BIRDS
I learned so many new facts about birds in the Halls of New York City Birds and Birds of the World. In the greater New York area alone, there are more than 400 species of birds because of the many varied habitats of the state.

But the birds I love most are porpoises because so many of them have bodies with bright colors and powerful beaks. They come in a range of sizes. The Harp seal has a 4-foot wingspan. As tall as I am!
Impact on learning

Schools are seeing great results by providing STEM students with access to iPad and learning content. Here are just a few examples.

Ancillae-Assumpta Academy. This K–8 school near Philadelphia is committed to learning with iPad to break down the walls of the classroom and link learning to the outdoors, the community, and the world. Students learn with MacBook Air and iPad to create, publish, connect, communicate, collaborate, research, and problem-solve. STEM is fully integrated into the curriculum for all grades. Students use probeware, coding, programming, and robots. They also rely on iPad in both the STEM laboratory and outdoors to explore the natural world, capture and document learning, then compile data and information. In addition to achieving significant increases in student performance, scholarships to high school have increased. View their book on iBooks.

Cathedral School. Apple technology has enabled Cathedral School to become a leader of innovative education in the Portland area. One-to-one iPad enhances teaching and improves learning by engaging students in the research and critical thinking skills necessary for success in the 21st century. Cathedral has a K–8 coding program that starts younger students working with block coding; by sixth and seventh grade, students begin developing apps. Seventh-grade students use iPad to aid in dissection labs.

String Theory School. This school in Philadelphia uses the Apple ecosystem to spark innovation across the curriculum and inspire leadership among students. Teachers design together, working as a team to build a course for each subject area. As an example of a collaborative lesson, students have used iPad and tools from Biomeme to test sushi across the city and prove or disprove whether fish listed on a menu was the species claimed. They also raised their own tilapia, teamed with local food truck chefs, and even prepared food for those in need. Read the story about how these students are doing real science and solving real problems in their community.

Coppell Independent School District. Jodie Deinhammer is a science teacher in this Texas district. She’s taught anatomy and physiology for 17 years, and she’s earned awards for her innovative and engaging approach in the classroom. She says that it’s her use of iPad and iTunes U that has transformed the way her students are learning, the work they’re doing, and the way they share their knowledge with the world. You can read more about her story here, see the book her students created on iBooks, or explore her course on iTunes U.

“iPad has afforded our students the opportunity to learn science at a deeper level. They’re able to make connections that weren’t really possible before the technology came into the classroom.”

Jodie Deinhammer, science teacher, Coppell Independent School District
New solutions are available that make it easy to guide the use of devices and apps in the classroom, get insight into each student’s progress, and share student work.

**Classroom**
This versatile teaching assistant puts the teacher in charge of every iPad in the classroom, keeping students focused, even when they’re working on different tasks. Learn more >

**Apple TV**
With Apple TV, teachers can mirror any student’s iPad screen to a TV monitor or projector to share student work on the big screen. It’s a great way to encourage collaboration and keep everyone involved. Excellent content for STEM teaching and learning is available on Apple TV, such as TV shows from BBC Earth and Discovery Channel, and video podcasts like TEDTalks Science and Medicine and NASA ScienceCasts.

**Schoolwork**
Schoolwork is a powerful iPad app built to help teachers and students use the creative power of iPad. Teachers can distribute and collect assignments, assign activities within apps, and view student progress. They can also collaborate with an individual student and provide instant feedback, enabling them to tailor instruction based on that student’s needs. And students have one place to see assignments organized by class and due date, submit work, and view their own progress. Learn more >
Resources

Apple provides many resources to help teachers learn how to use our products and integrate them into classroom learning. Here are some to get started.

Apple Teacher
We designed the Apple Teacher program to help teachers build skills to use Apple products in the classroom. It offers self-paced learning with free learning materials, tips, news, and inspiration. After completing online quizzes, they receive an official Apple Teacher logo to share their achievement with the world. And Apple Teachers can go even further and earn recognition for using Swift Playgrounds. Learn more >

Everyone Can Create
Everyone Can Create was designed to give every student the opportunity to develop the skills and techniques they need to become the next generation of innovators, artists, and creators. It includes a versatile set of resources designed to help teachers infuse core creative skills into the topics and subjects they teach every day. Learn more >

Apple Professional Learning
We want your teachers to feel confident using Apple technology. Our specialists are former educators who can support your teachers with onsite coaching and mentoring that helps them design deeper learning experiences for each student. Learn more >

To learn more about Apple in Education, visit www.apple.com/education or call 1-800-800-2775 to speak with an Apple Education representative.

*Fees and terms may apply; see the Certiport website for more information.

© 2018 Apple Inc. All rights reserved. Apple, the Apple logo, Apple TV, Apple Pencil, GarageBand, iBooks, iMovie, iPad, Keynote, Mac, Numbers, and Pages are trademarks of Apple Inc., registered in the U.S. and other countries. Multi-Touch and Swift are trademarks of Apple Inc. App Store and iBooks Store are service marks of Apple Inc., registered in the U.S. and other countries. Other product and company names mentioned herein may be trademarks of their respective companies.