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Introducing littleBits™

At littleBits™, our mission is to empower everyone to create inventions, large and small.

littleBits makes it easy for both teachers and students to engage in STEAM by using a universal, 21st-century language: electronic building blocks. We are surrounded by technology every day and yet have little idea how it works or how to create with it. littleBits changes that.

The intuitive, color-coded Bits™ each have a specific function (ie. motion, lights, sound, sensors, internet connectivity), and all the Bit snap together with magnets to make larger circuits. Building circuits is simple and intuitive, allowing students to create powerful, sophisticated electronics in a matter of seconds. With an ever-expanding library of Bits, educators and students can grow their collection and engage in increasingly complex projects as their understanding of the system and Bits grows.

A global community of educators is using littleBits to ignite their students’ curiosity and engage them in active inquiry and problem solving. The flexibility and adaptability of the Bits mean students of all ages and abilities can use them to create very simple or very complex inventions. Both novice and experienced educators use littleBits as a cross-curricular, multisensory tool to reach students through multiple learning modalities.

HOW ARE LITTLEBITS USED?

In addition to being used across all grade levels, littleBits can also be used across a variety of formal and informal learning environments.

In the classroom, educators use littleBits to supplement and enhance their existing curriculum, or often as part of a larger project-based unit. The open-ended design and real-world application of littleBits make it a natural fit for any project-based learning curriculum.

littleBits can be used as a material to enhance cross-curricular projects. By incorporating Bits into larger projects and assessments (for example, a diorama, poster, etc.), students are able to add another level of creativity and interactivity to their projects.

Some educators, particularly those with younger students, collaborate with older “buddy classes” to support inquiry and engage students in higher-level learning. littleBits can also be used as part of an independent learning center or choice time activity, serving as a hands-on learning resource for students who complete in-class assignments early. They are also valuable as an in-class contingency plan for the absent educator.

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<td>In K-5 schools, Bits are used in science, math, literacy, music and arts lessons as well as STEM/STEAM fairs and competitions. Small hands love to explore and invent with littleBits.</td>
<td>At the secondary level, students can explore more complex concepts in physical science, logic, design, computer science and music. They can integrate the cloudBit™ to create smart technologies or practice coding with the Arduino Bit to design robots and other inventions.</td>
<td>College students dive deeper into engineering, electronics, product design and entrepreneurship by prototyping new Bits and sophisticated devices. Pre-service teacher programs are also using littleBits to train and equip the next generation of educators.</td>
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Beyond the classroom

Educators are finding creative ways to use littleBits with students in less formal settings. Before-school and after-school programs and clubs can be an effective way to attract students to science, math, and engineering concepts, and can target underrepresented populations such as girls. Other implementation models include summer school and remedial intervention programs.

In addition, makerspaces are being implemented in school library programs to encourage innovation and creative design. Educator-led design workshops give students an opportunity to experiment with littleBits in open-ended design challenges.

WHO ARE LITTLEBITS FOR?

littleBits is a full range tool for students across all grade and ability levels. While the products are recommended for ages 8 and up, successful programs have been run with younger students under adult supervision.

Students can work with littleBits at their own level and pace thanks to the opened-ended design. From elementary school to college and from special education to gifted and talented programs, littleBits is a useful hands-on learning tool for all students. littleBits also encourages communication and collaboration, making it a useful tool for English language learners. Even students in university courses, pre-service teachers, and teachers involved in professional development use littleBits for hands-on learning about STEAM.

littleBits is a solution that brings all students together. Students are all included, regardless of gender, interests, culture, language, socio-economic class, or skill level. littleBits is not a prescriptive or linear tool. All students can innovate, invent, and achieve their creative vision with littleBits.

The home-school connection

littleBits is a tool that can transition between learning spaces and environments. While technology literacy may begin within the school, littleBits can build strong home-school connections as students transfer their skills into an interest in electronics and design thinking at home. littleBits can foster both parent and child growth through shared invention and collaboration.

littleBits encourages students to play and experiment through active experiences, enabling them to construct knowledge that can be applied to real-life situations.
Becoming Familiar with littleBits

HOW LITTLEBITS WORK
The Bits are designed to snap together, end to end, to create a complete circuit. The magnets inside each of the Bits’ connectors ensure that students always attach the Bits the right way.

The Power Bit, Battery & Cable
Each student or student group will need a power Bit, a 9V battery, and a littleBits battery cable. All three components are necessary to start a circuit.

The Color Code
Bits are grouped into four color-coded categories:

- **POWER** is needed in every circuit and is the start of all your students’ creations.
- **INPUT** Bits add control to the circuit, through information provided from your students and/or the environment, and send signals to the Bits that follow.
- **OUTPUT** Bits complete an action or a task (for example, light, buzz, or move). These are the Bits that “do something.”
- **WIRE** Bits expand the circuit’s reach and change direction. Students use the wire Bits to help place Bits exactly where they want, especially if they are embedding inside a structure. Some orange Bits also add a level of complexity and programmability to the circuit.

Order is Important
Power Bits always come first and input Bits only affect the Bits that come after them.

1 CONNECT BATTERY AND CABLE TO BLUE BITS.
2 TURN IT ON.
3 PINK BITS AFFECT BITS AFTER THEM.
4 GREEN BITS DO SOMETHING.

*Occasionally Bits get updated, so the features or appearance of your Bits may differ from those used in this guide.*
Why Are littleBits Valuable for Students?

littleBits’ products are at the intersection of important trends in education today: STEAM programs, the Maker Movement, project-based learning, personalized learning, 21st-century skills and design thinking. The electronic building blocks that make up the littleBits system represent a powerful and universal design language to help students become not only intelligent consumers of technology, but also inventors of the world around them.

STEAM Education

STEAM education is an approach to teaching and learning that integrates the content and skills of science, technology, engineering, art, and mathematics. littleBits encompasses this approach through authentic and creative design exploration and challenges that foster hands-on learning about the scientific and mathematical world.

STEAM education focuses on innovation and creativity as a way to build key skill sets for students. littleBits fits well into this design, providing an opportunity for students to build innovative circuits that merge electronic building blocks with other materials, such as rubber bands, cardboard, and 3D printed objects.

Experimentation and playful thinking with littleBits often produce unique and creative outcomes, which can reach across many areas of the curriculum. In addition to learning about science, students develop key mathematics skills and learn to communicate their designs through writing and drawing. Younger students may even learn foundational skills, such as logic and directionality.

Maker Movement

The Maker Movement describes a move in education toward experiential environments in which students construct their learning through hands-on exploration and “do-it-yourself” or “do-it-with-others” projects. Making happens any time students use technology to make something.

littleBits supports the modern Maker Movement by adding new technologies to the mix, including hardware (the Bits), computing platforms, and programming tools (for example, Arduino) alongside traditional materials and tools.

Educators can use littleBits as a Maker’s tool for modern invention and innovation. littleBits sparks curiosity and heightens student awareness of electronics and their proliferation in our everyday lives. Because the Bits require no prior expertise, students of all ages can use littleBits to experience the joy of building with electronics instantly.

FROM THE CLASSROOM

STEAM DESIGN CHALLENGE

Students follow the design process as they use littleBits to create a generative Art Bot, a device that draws for you. Through experimentation and play, they learn important concepts about engineering while creating innovative designs that merge new technologies with everyday objects.

FROM THE CLASSROOM

STUDENTS AND MAKERSPACES

Students are given a littleBits challenge: Make an interactive electronic game. Through innovative design, they combine littleBits with a variety of materials to make their creative game ideas come to life.
Project-Based Learning

littleBits can play an integral role in any project-based learning unit. The open-ended design possibilities give students an opportunity to innovate solutions to real-world problems for authentic learning that they can use to understand the world around them.

According to the Buck Institute for Education (BIE), students engaged in high-quality project-based learning with a facilitating educator are actively involved in the learning process. littleBits encourages students to play and experiment through active experiences, enabling them to construct knowledge that can be applied to real-life situations.

As students work on projects with littleBits, educators can conduct formative assessments, prompt students to deeper thinking, and serve as a general resource for helping students develop content understanding. Students can use littleBits to create a project that demonstrates knowledge or learn a concept through the experience of creation with littleBits.

Projects ask students to document their learning with a product or performance in which they share their learning. This stage of the project encourages students to communicate their understanding and helps them develop technology skills that will be useful in their further education and the workplace. The sharing of littleBits projects with peers and/or the public also highlights the importance of the project and provides an authentic audience for their work.

Personalized Learning

Personalized learning invites educators to create opportunities for meaningful learning that takes advantage of natural curiosity about technology and utilizes the digital skills that most students today already possess. It’s learning specifically tailored for each student’s strengths, needs, and interests in order to ensure the highest achievement possible.

littleBits allows educators to design lessons and projects that are more open and flexible than traditional models. Students can become more invested in designing their own personal learning path where they can learn at their own pace and capitalize on their unique skills. littleBits can fuel personalized learning by giving students more control, a sense of ownership, and accountability in the learning process.

EDUCATOR SPOTLIGHT

RACHEL ALBERT
Art Educator, Fairfax County Public Schools, VA
Students from diverse backgrounds create a project with littleBits that encourages real-world problem solving while also engaging students in project work that expresses their cultural heritage and life experiences.

EDUCATOR SPOTLIGHT

ASHLEY ELSDON
Producer, Soundlab UK
Students with learning disabilities create music through personalized learning experiences supported by the use of littleBits. The Bits offer real opportunities for students to experiment with different ways of creating sound.
**21st-Century Skills**

With a focus on real-world problem solving with technology and critical thinking, littleBits help students develop key 21st-century skills for learning and career readiness. They provide a natural environment for students to practice collaboration, critical thinking, communication, and creative design. These skills, outlined by the Partnership for 21st Century Learning, are vital for today’s students to survive in tomorrow’s job market. Twentieth century skills — rote memorization, repetitive tasks and general knowledge — just won’t cut it.

Although students can work on littleBits projects individually, most projects involve small groups. Collaboration is perhaps the most important 21st-century skill, one that is consistently mentioned as desirable for the workplace. Collaboration is one of the ways in which littleBits connects students to the real world as they also work with students in other grades, schools, or even countries, and with community mentors and experts.

**Design Thinking**

Students use littleBits to prototype solutions to authentic problems and implement design solutions. The Bits are easy to use, allowing students to come up with more sophisticated solutions as part of the design thinking process developed by Stanford University, in which students empathize, define, ideate, prototype, and test design solutions. littleBits creates a low-risk environment for students to experiment with ideas that may not have been possible before.

Once students design and test prototypes, they may revisit the iterative design process to improve upon their designs and develop working prototypes that could potentially be taken to market or “marketed” in the classroom. As students take action on their products, they develop entrepreneurship skills in business strategy, marketing, branding, and finance.
**MEETING STANDARDS WITH LITTLEBITS**

The implementation models for littleBits are flexible and adaptable. Lessons or units that incorporate littleBits align well to contemporary standards, such as the Next Generation Science Standards (NGSS) and Common Core State Standards (CCSS).

In addition to being a useful learning tool, littleBits can also serve as a key assessment tool that, when used in conjunction with education standards, can provide educators with an authentic assessment of how students understand and perform on key indicators. littleBits provides opportunities for both formative and summative assessments that may incorporate cross-curricular standards, such as English Language Arts and Math.

The most apparent standards alignment can be made to NGSS for Engineering, Technology, and Applications of Science (ETS). Find your appropriate level and begin to think about how you might use littleBits to align with these standards:

**Elementary school students who demonstrate understanding can:**

| K-2-ETS1-1. | Ask questions, make observations, and gather information about a situation people want to change in order to define a simple problem that can be solved through the development of a new or improved object or tool. |
| K-2-ETS1-2. | Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem. |
| K-2-ETS1-3. | Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs. |
| 3-5-ETS1-1. | Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost. |
| 3-5-ETS1-2. | Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem. |
| 3-5-ETS1-3. | Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved. |

Students of all ages problem solve with littleBits.
Middle school students who demonstrate understanding can:

| MS-ETS1-1. | Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. |
| MS-ETS1-2. | Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. |
| MS-ETS1-3. | Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. |
| MS-ETS1-4. | Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved. |

High school students who demonstrate understanding can:

| HS-ETS1-1. | Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. |
| HS-ETS1-2. | Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. |
| HS-ETS1-3. | Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts. |
| HS-ETS1-4. | Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem. |

High school students design solutions for complex problems.
Common Core State Standards for Writing
While working on a littleBits lesson or a project that uses littleBits, your students will likely be writing quite a bit for documentation, explanation, and expression, undoubtedly addressing CCSS writing standards, such as:

- **CCSS.ELA-LITERACY.W.6.1**
  Write arguments to support claims with clear reasons and relevant evidence.

- **CCSS.ELA-LITERACY.W.6.2**
  Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.

- **CCSS.ELA-LITERACY.W.6.7**
  Conduct short research projects to answer a question, drawing on several sources and refocusing the inquiry when appropriate.

- **CCSS.ELA-LITERACY.W.6.10**
  Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Common Core State Standards for Communication
The collaborative nature of littleBits projects also encourages students to communicate for comprehension and express their ideas, addressing CCSS standards for speaking and listening, such as:

- **CCSS.ELA-LITERACY.SL.6.1**
  Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others’ ideas and expressing their own clearly.

- **CCSS.ELA-LITERACY.SL.6.2**
  Interpret information presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how it contributes to a topic, text, or issue under study.

- **CCSS.ELA-LITERACY.SL.6.4**
  Present claims and findings, sequencing ideas logically and using pertinent descriptions, facts, and details to accentuate main ideas or themes; use appropriate eye contact, adequate volume, and clear pronunciation.

- **CCSS.ELA-LITERACY.SL.6.5**
  Include multimedia components (e.g., graphics, images, music, sound) and visual displays in presentations to clarify information.

littleBits provides opportunities for both formative and summative assessments.
Local State Standards
littleBits also aligns with local state standards, such as the Texas Essential Knowledge and Skills (TEKS), across multiple disciplines. States that choose not to adopt CCSS will find that littleBits aligns with their local standards-based curriculum, for example:

- **TEKS for Science, Grade 5: Standard 3**
  Scientific investigation and reasoning. The student uses critical thinking and scientific problem solving to make informed decisions.

- **TEKS for Technology Applications, Grade 8: Standard 1**
  Creativity and innovation. The student uses creative thinking and innovative processes to construct knowledge, generate new ideas, and create products.

- **TEKS for English Language Arts and Reading, Grade 6: Standard 17**
  Writing/Expository and Procedural Texts. Students write expository and procedural or work-related texts to communicate ideas and information to specific audiences for specific purposes.

MEETING STANDARDS WITH LITTLEBITS
An educator uses littleBits to align with NGSS design engineering standard 4-PS4-3: “Generate and compare multiple solutions that use patterns to transfer information” and CCSS ELA-Literacy W.4.1 standard: “Write opinion pieces on topics or texts, supporting a point of view with reasons and information.”

Students are challenged to design and create a device that will transmit information using littleBits and common classroom materials. One group uses littleBits to transmit Morse Code through sound. Another group uses LED Bits and colored light, while a third group uses programming logic with 1’s and 0’s. They share and compare their solutions. Later, students write a short piece describing their design, explaining their thinking process, and supporting their device with information about why the design is useful.
EDUCATOR TIPS
Learn from experienced educators who use littleBits with their students. These responses come from interviews with active educators posted on the littleBits Education blog.

What works well when using littleBits in the classroom?
• “Allow students to bring in their own materials, such as LEGO or K’Nex, for their projects.”
• “Ask the school custodians to save empty paper towel tubes and cardboard boxes for students to reuse in their projects.”
• “The module cards help my students answer many of their own questions about how Bits work or how they can be adjusted. The students were less frustrated because they weren’t waiting on me.”
• “It’s helpful to have several small metal screwdrivers on hand in addition to the plastic screwdriver that’s included in the kits.”
• “Student groups of two work well when students are sharing a kit.”
• “Have the students sketch their circuits and explain them to each other. It really helps them to understand what’s happening.”
• “Let students take a kit home, and pair it with a design challenge that parents and students can work on together. This works well to build home-school connections to classroom learning.”
• “An old t-shirt, fresh out of the laundry, works well for wiping the connectors and the magnets.”
• “Have the project booklets on-hand for more reluctant students to get started.”

What is challenging when using littleBits in the classroom?
• “Bits can fall off of desks and tables, and often end up getting stepped on. Using cafeteria trays when students are working with Bits can help with this problem.”
• “It can be challenging for students to put the Bits back in the original boxes. I find that the littleBits tackle box saves a lot of time and it’s easier for students to find what they’re looking for.”
• “Free play with littleBits has its definite advantages, but students will sometimes disengage after a time. Having a goal or design challenge to help structure the play engages students for a longer period of time and helps me meet specific learning standards.”
• “The battery tends to be a bit heavy and does not have little feet that fit into the holes of the shoes. I find that Velcro, rubber bands, and zip ties work well to secure the battery to different surfaces.”
• “Storage space for large unfinished projects can be a challenge. I find that inexpensive bookshelves can hold a lot and use a small amount of space.”
• “Getting Bits to adhere to other materials can sometimes frustrate students. The littleBits shoes that come with the kit work well, and students can reuse them for different projects too.”