The Higher Education 2050 Report Update

The Benefits of Emphasis on S.T.E.M. Education in Primary Schools

Compiled By

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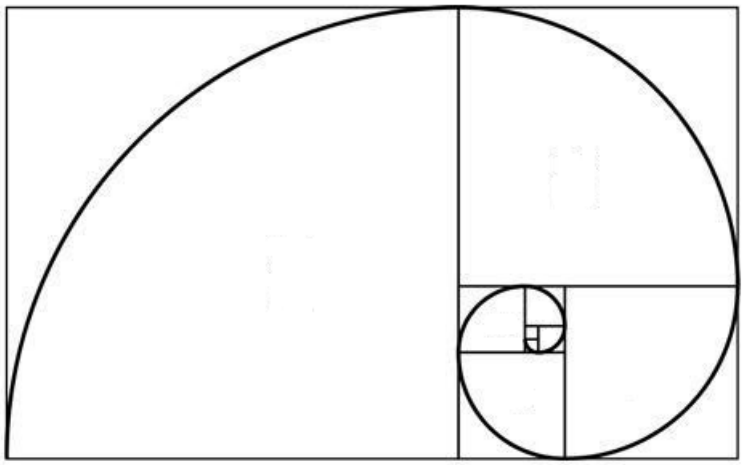

The Benefits of an Emphasis on S.T.E.M. Education in Primary Schools

STEAM & STEM Starter Resource Hub: Hands-On Learning with Purpose

Whether you're just beginning your STEM / STEAM journey or looking to take your program to the next level, this resource hub has everything you need. Backed by global research and real classroom success, these practical tools will help you plan, pitch, and launch a dynamic STEAM initiative that engages students and wins stakeholder support. Explore our STEM & STEAM Starter Resource Hub, designed to help you build a hands-on, creative learning experience rooted in play, exploration, and real-world application.

What's Inside the Resource Hub:

- Webinar On-Demand
  How to Launch a STEM/STEAM Program in Your School or District
- Whitepaper – Learning Through Play
  Insights from The LEGO Foundation's five-year global research initiative
- Stakeholder Pitch Guide
  Key messages and tools to communicate your vision with decision-makers
- Summer Program Planning Guide
  6 proven tips to run a hands-on STEM / STEAM summer program, based on award-winning schools

STEM & STEAM Education Starter Resource Hub | LEGO® Education

YOU Belong in STEM

YOU Belong in STEM is an initiative designed to strengthen and increase Science, Technology, Engineering, and Mathematics (STEM) education nationwide.

- Partnered with EXPLR to host the first-ever 2024 National STEM Festival.
- Collaborated with Women in Aerospace (WIA), the American Institute of Aeronautics and Astronautics (AIAA), Club for the Future, and the Space Foundation to develop Space4All, a space communication campaign illustrating the value and benefits of the space enterprise.
- Partnered with Beyond100K to identify key challenges regarding the supply and demand of STEM educators. Co-led a product-development sprint with the U.S Census Bureau. Six organizations followed the Opportunity Project model to rapidly prototype solutions in response to a problem statement tackling strengthening the STEM educator workforce.

Background

In an ever-changing, increasingly complex world, it's more important than ever that our nation's youth are prepared to bring knowledge and skills to solve problems, make sense of information, and know how to gather and evaluate evidence to make decisions. These are the kinds of skills that students develop in science, technology, engineering, and math, including computer science -- disciplines collectively known as STEM/CS. If we want a nation where our future leaders, neighbors, and workers can understand and solve some of the complex challenges of today and tomorrow, and to meet the demands of the dynamic and evolving workforce, building students' skills, content knowledge, and literacy in STEM fields is essential. We must also make sure that, no matter where children live, they have access to quality learning environments. A child's zip code should not determine their STEM literacy and educational options.

YOU Belong in STEM Webinar Series

- YOU Belong in STEM 2nd Annual National Convening - Opening Remarks (April 2024)
- Developing and Supporting STEM Educators (April 2024)
- Unlocking Math Fun_ The Impact and Importance of engaging Out-of-School Math Time for K-12 Students (May 2024)

- Enhancing P-12 STEM Education for Students with Disabilities (June 2024)
- Supporting Girls and Women of Color in STEM (July 2024)
- Inclusive Higher Education STEM Pathways (August 2024)
- Cultivating STEM Classrooms of Belonging: BIPOC STEM Teacher Representation and Retention (September 2024)
- Elevating STEM Education in Rural Communities (October 2024)
- Reimagining STEM Innovation Beyond Technology (November 2024)

Examples of the Department's discretionary grants that can support STEM:

- $3.6 million for the Alaska Native Education Equity Program
- $300,000 for Braille training (rehabilitation services demonstrations and training)
- $5.1 million for the College Assistance Migrant Program (CAMP)
- $5 million for the Comprehensive Centers Program
- $185 million for the Education Innovation and Research Program (EIR) (awarded in early FY 2021)
- $124.7 million for Gaining Early Awareness and Readiness for Undergraduate Programs (Partnership Grants) (GEAR-UP)
- $23 million for Graduate Assistance in Areas of National Need
- $25 million for Innovative Approaches to Literacy
- $5.7 million for the Jacob K. Javits Gifted and Talented Students Education Program
- $900,000 for Migrant Education Consortium Incentive Grants (CIG)
- $29 million for the Native Hawaiian Education Program
- $12.6 million for the Minority Science and Engineering Improvement Program (MSEIP)
- $1.4 million for the Perkins Innovation & Modernization Grant Program
- $300,000 for Strengthening Asian American and Native American Pacific Islander Serving Institutions (AANAPISI)
- $2.3 million for Strengthening Native American Nontribal Serving Institutions (NASNTI)
- $1.5 million to provide special education programs in educational technology, media, and materials for students with disabilities via a cooperative agreement with the Center on Early STEM Learning for Young Children

- $9.3 million to provide special education programs educational technology, media, and materials for individuals with disabilities via Stepping Up
- $151.2 million for Federal TRIO Programs
- $73.7 million for Supporting Effective Educator Development (SEED)
- $49.4 million for the Teacher Quality Partnership (TQP)
- $28.2 million for Education Research Grants Programs
- $1.5 million for the Fulbright-Hays Doctoral Dissertation Research Abroad Program
- $4.3 million for the Small Business Innovation and Research (SBIR) Program
- $11.1 million for the Special Education Research Grants Program
- $6.3 million for Research Training in the Education Sciences
- $2.6 million for Research Training in Special Education
- STEM Investment Summary FY2018-2020

Grant Applicant Resources

The Department published in spring 2020 two new grant applicant resources. These resources were developed to (1) provide an overview of the discretionary (or competitive) grants application process and (2) offer more details intended to be used by prospective applicants, including new potential grantees. These support one of the Secretary's new administrative priorities on New Potential Grantees that was published in March 2020. They can also be found under the "Other Grant Information" on the ED's Grants webpage.

Call for Peer Reviewers

The Department is seeking peer reviewers for our Fiscal Year 2024 competitive/discretionary grant season, including in the STEM/CS areas (among others). The Federal Register notice spotlights the specific needs of the Office of Elementary and Secondary Education (OESE), the Office of English Language Acquisition (OELA),, the Office of Postsecondary Education (OPE), and the Office of Special Education and Rehabilitative Services (OSERS). The How to Become a Peer Reviewer slide deck provides additional information and n

Archived STEM Briefings

Public Health and STEM with CDC
The Pathway to Convergence
Science: Call to Action
Rural STEM Education
Think Globally, Teach Locally

Energizing STEM
Data Literacy
Advanced Manufacturing: Industry of the Future
Summertime STEM
Differing Abilities in STEM, featuring Dr. Temple Grandin
Inspiring STEM Interest
New Frontiers in K-12 Computer Science
Federal STEM Strategic Plan: 2 Years Later
Invention Education
STEM Teacher Preparation
Cybersecurity Education
Early Math

Resources

Assisting Students Struggling with Mathematics: Intervention in the Elementary Grades
Designing and Delivering Career Pathways at Community Colleges
ESEA, IDEA, and Perkins Resources
Work-Based Learning
Stackable Credentials that lead to careers
IES data and statistics, research and evaluation, and tools for educators
K-12 Practitioners' Circle
STEM Innovation in Early Education (STEMI2E2) Center
A Transition Guide to Postsecondary Education and Employment for Students and Youth with Disabilities

Other Federal Agency STEM websites

- Centers for Disease Control & Prevention (CDC)
- Department of Defense (DOD)
- Department of Energy (DOE)
- NASA
- National Science Foundation (NSF)
- National Initiative for Cybersecurity Education (NICE) at National Institutes of Standards and Technology (NIST) (U.S. Department of Commerce (DOC)
- National Oceanic and Atmospheric Administration (NOAA)
- U.S. Geological Survey (USGS) (U.S. Department of the Interior)
- STEM4ALL - website for federal internships, scholarships, and training opportunities.

- Q-12 Education - K-12 quantum learning tools and inspire the next generation of quantum leaders.
- Quantum.gov - home of the National Quantum Initiative.
- AI.gov - National Artificial Intelligence Initiative.

Office of Elementary and Secondary Education (OESE)

STEAM Education is an approach to learning that uses Science, Technology, Engineering, the Arts, and Mathematics as access points for guiding student inquiry, dialogue, and critical thinking.

Using STEAM education results in students who take thoughtful risks, engage in experiential learning, persist in problem-solving, embrace collaboration, and work through the creative process. These are the innovators, educators, leaders, and learners of the 21st century! This comprehensive article will help you understand the keys to a meaningful STEAM effort.

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Why is STEAM Education Important?

For far too long in education, we've been working with the presumption of teaching to ensure our students get a "good job". But what does that look like? We are preparing students for jobs that don't even exist.

We are at a point where it is not only possible, but imperative that we facilitate learning environments that are fluid, dynamic, and relevant. None of us go outside and look at a tree and say, "that's a tree, so that's science" or, "the sky is blue, so that's art."

Our world is a beautiful, complex, and intricate tapestry of learning all in its own right. Why do we believe that we have the ability or the right to box it in behind brick walls and classroom doors in a place called school?

Integrating concepts, topics, standards and assessments is a powerful way to disrupt the typical course of events for our students and to help change the merry-go-round of "school."

It takes what we do when we open the doors to the real world and places those same practices in our cycles of teaching and learning. So we can finally remove the brick walls and classroom doors to get at the heart of learning.

What the Research Says

Recent research shows that STEAM is a promising approach to positively impacting student achievement and teacher efficacy. In a 2016 study, researchers investigated the impact of STEAM lessons on physical science learning in grades 3 to 5 in high poverty elementary schools in an urban district. Findings indicated that students who received just nine hours of STEAM instruction made improvements in their science achievement *(Brouillette, L., & Graham, N. J.)*.

Another study from 2014 shows the connecting STEAM and literacy can positively impact cognitive development, increase literacy and math skills, and help students reflect meaningfully on their work and that of their peers *(Cunnington, Marisol, Andrea Kantrowitz, Susanne Harnett, and Aline Hill-Ries.)*.

This is further supported by a study on the relationship between theater arts and student literacy and mathematics achievement from 2014. *"Results showed that students whose language arts curricula were infused with theater arts often outperformed their control group counterparts, who received no arts integration, in both math and language arts" (Inoa, R., Weltsek, G., & Tabone, C.).*
And in an international study published in the Journal of Educational Change, researchers found that secondary teachers' reflections *"revealed inter-, trans- and cross-disciplinary learning shaped by teacher collaboration, dialogue and classroom organization that fosters critical and creative thinking." (Anne Harris and Leon R. de Bruin).*

STEM vs. STEAM

The STEM to STEAM movement has been taking root over the past several years and is surging forward as a positive mode of action to truly meet the needs of a 21st century economy. STEM alone misses several key components that many employers, educators, and parents have voiced as critical for our children to thrive in the present and rapidly approaching future.
Much has been proclaimed about the need for more STEM "programs" in our schools. The logic is simple: the wave of future economic prosperity lies in a workforce that is well-versed in rising job markets like science, technology, engineering and math. Thus, there has been an increased investment in STEM initiatives in schools. This includes (but is not limited to):

- providing mobile devices for students (sometimes in the forms of computer labs, and other times in the form of 1:1 – a single device for each student)
- after-school STEM clubs or programs
- STEM curriculum, where projects using STEM practices are embedded
- BYOD initiatives (bring your own device)

- STEM days to encourage hands-on exploration within each of these disciplines

- robotics programs

While these initiatives are a wonderful start into the exploration of these four areas of study, the critical process of creativity and innovation is missing. Students in STEM programs may have more experiential learning opportunities, but they are limited to only science, technology, engineering and math. Our economy requires so much more than an understanding of these areas – it requires application, creation and ingenuity. STEM alone does not foster these essential nutrients.

STEAM is a way to take the benefits of STEM and complete the package by integrating these principles in and through the arts. STEAM takes STEM to the next level: it allows students to connect their learning in these critical areas together with arts practices, elements, design principles, and standards to provide the whole pallet of learning at their disposal. STEAM removes limitations and replaces them with wonder, critique, inquiry, and innovation.

The STEAM Model

The pathway to STEAM is exciting, but can also be dangerous without an understanding of what STEAM truly means in both its intention and its implementation. Like its STEM predecessor, STEAM can stop short of its best manifestation without several core components:

- STEAM is an integrated approach to learning which requires an intentional connection between standards, assessments and lesson design/implementation

- True STEAM experiences involve two or more standards from Science, Technology, Engineering, Math and the Arts to be taught AND assessed in and through each other
- Inquiry, collaboration, and an emphasis on process-based learning are at the heart of the STEAM approach
- Utilizing and leveraging the integrity of the arts themselves is essential to an authentic STEAM initiative

In order to accomplish these goals, schools must consider a variety of factors, including:

- Collaborative planning, including a cross-section of teachers on each team
- Adjusting scheduling to accommodate a new way of teaching and learning
- Professional development for all staff in STEAM practices and principles
- STEAM schema-mapping for the curriculum and assessment design process
- Alignment and unpacking of standards and assessments
- Seamless lesson implementation processes and strategies

How to Use STEAM: Process and Product

There are actually 6 steps to creating a STEAM-Centered classroom, no matter what area you teach. In each step, you're working through both the content and the arts standards to address a central problem or essential question.

What's great about this process is that you can as easily use it to help plan for a lesson as you can to facilitate the actual learning process in your STEAM classroom. Let's take a look at each step.

1. Focus

In this step, we're selecting an essential question to answer or problem to solve. It's important to have a clear focus on both how this question or problem relates to the STEM and the Arts content areas you've chosen.

2. Detail

During the detail phase, you're looking for the elements that are contributing to the problem or question. When you're observing the correlations to other areas or why the problem exists, you begin to unearth a lot of key background information, skills or processes that students already have to address the question.

3. Discovery

Discovery is all about active research and intentional teaching. In this step, students are researching current solutions, as well as what ISN'T working based on the solutions that already exist. As a teacher, you can use this stage to both analyze the gaps your students may have in a skill or process and to teach those skills or processes explicitly.

4. Application

This is where the fun happens! After students have dived deep into a problem or question and have analyzed current solutions as well as what still needs addressed, they can begin to create their own solution or composition to the problem. This is where they use the skills, processes and knowledge that were taught in the discovery stage and put them to work.

5. Presentation

Once students have created their solution or composition, it's time to share it. It's important that the work is presented for feedback and as a way for expression based on a student's own perspective surrounding the question or problem at hand. This is also an important opportunity to facilitate feedback and help students learn how to give and receive input.

6. Link

This step is what closes the loop. Students have a chance to reflect on the feedback that was shared and on their own process and skills. Based on that reflection, students are able to revise their work as needed and to produce an even better solution.

Connecting STEAM and Literacy

STEAM's foundations lie in inquiry, critical thinking, and process-based learning. That is extremely important. The entire idea surrounding STEAM lessons and the STEAM approach is that it's based around questioning, and really deep questioning. We want to start asking non-Googleable questions. Inquiry, curiosity, being able to find solutions to a problem, and being creative in the finding of the solutions is at the heart of this approach. This means that the humanities are woven into STEAM just like everything else.

Using STEAM does not mean letting english language arts or social studies go to the wayside.

You can use a STEAM lesson with those ideas, because it's fundamentally built upon asking really good questions, and then seeking solutions to the problems that are presented in those content areas.

That doesn't have to just happen in the STEM areas, or in the arts areas with STEM; you can connect all of the humanities through STEAM through the idea that you're looking for a solution to a very specific problem which comes out of the inquiry process.

But this begs the question: if STEAM stands for Science, Technology, Engineering, the Arts and Math, what happens to reading and writing? Do we just drop them completely, or do we move to something else and call it STREAM (adding "reading" into the acronym)? And then… aren't we back to teaching everything?

These are excellent questions. The answers come down to two deep understandings →

1. Literacy is a part of every content area – always.

You can be literate in math, art, reading, social studies, music and science. Literacy is an action with common components that are embedded into how we consume and share information. As such, it is naturally a part of STEAM.

2. Intentional selection of naturally aligned standards is key.

STEAM is the intentional alignment of standards within these identified content areas and includes equitable assessment of both areas in the lesson. It's guided by inquiry and is focused on application, creation and evaluation. Adding another letter isn't the point.

STEAM and Literacy Strategies

With those understandings in mind, there are many ways to integrate literacy and STEAM intentionally in your classroom. Here are some examples that you may find helpful in your planning for this year.

Visual Thinking

Utilizing visual thinking is drawing upon the foundation of literacy itself. You can read a piece of art or music, the same way you can read a piece of traditional text. Visual thinking strategies are a terrific way to introduce this concept to your students and to practice literacy across all content areas.
A well-known VTS is looking at a piece of text (arts, fiction, informational, etc) and asking these three questions:

1. What's going on in this text/image/process?
2. What do you see/hear that makes you say that?
3. What more can we find?

The foundation to visual thinking is in the questions that are asked and in listening to student responses. These are also the hallmarks of STEAM, so visual thinking and literacy makes sense.
Here are some additional Visual Thinking resources to help you get started:
OpenThink: Visual Thinking Strategies
10 Visual Thinking Literacy Strategies
The Visual Thinking Strategies Website

Embodying Text

Being able to make personal meaning requires moving from the abstract to the literal. Many of the STEM areas deal with abstract concepts which are hard to visualize or feel. This can be done quickly and easily through movement. Using dance as a tool to explore a concept and then translate that into a literal interpretation is a form of writing. Just because it's done with the body doesn't make it any less of a composition.
Here are some specific strategies that use dance composition as a medium for STEAM:
Inspiring Dance Literacy
4-Read Strategy
ARTISTIC Critique

Reciprocal Teaching

Reciprocal teaching is all about using comprehension strategies to have formal conversations about text. If the text is a piece of art, or if it's a scientific finding, the reciprocal teaching strategy will work regardless of content. Here's the steps you need:

1. Predict
2. Question
3. Clarify

4. Summarize

Start by asking students to predict an outcome based on a problem, process, or artistic prompt. Then, ask some guiding questions and encourage your students to ask each other questions about the work. Students can then point out elements of the problem, process, or arts prompt that they don't understand. They can then research answers to these questions and summarize their findings. This strategy is often used to analyze traditional text and is a core component of literacy, but can easily be applied to any content area.

Here's a list of five best practices for purposefully planning STEAM projects your special needs students in mind.

1. Give Options Rather than a Set Outcome

By providing your students with a rubric and the freedom to produce their own end product, they will surprise you with how creative they can be! This approach prepares our students for life in the real-world office place where projects are more open-ended with professional freedom. My students competing in the social media challenge were highly motivated. They were engaged in the project because they had buy-in to their creative solution.

2. Allow for Wait Time

I have found that one of the most difficult aspects of supervising a STEAM lesson is providing additional wait time, allowing my students to productively struggle, and ignoring my instinct to suggest a given strategy. For instance, remind your students of the tools that they have around the classroom. Encourage them to communicate their

ideas or questions to a partner. However, try to avoid jumping in with guided assistance or additional prompting the moment your students begin to struggle. Having a discussion with your class afterwards about the challenges they faced and what they liked about this type of lesson can help them process it as they may be new to this STEAM approach.

3. Make it Concrete, Not Abstract

Many students with special needs, especially those with autism, tend to struggle with figurative language. During one lesson when my group was reading lyrics to a song, several of the students were confused by the phrase "he was as slow as a turtle". Since then, I made an effort of previewing abstract concepts and figurative language with my students.

4. Thinking Maps Can Be Your Best Friends

During the initial planning stage of a project, many students need to organize their thoughts, arrange their reading notes, and visualize the bigger picture. This is especially true for students who have a difficult time with inferential reasoning. Thinking maps and graphic organizers can help bridge this divide. A flow map (similar to the step by step boxes of a cartoon) can help students recognize or plan out the steps to an experiment or research project. Another time-saving tip is to ask your technology or media teacher (if your school is lucky enough to have one) to align their lessons with an upcoming project in your classroom. The technology teacher at my school trains the students to choose their own graphic organizers on the Vizzle computer program.

5. Align Student Goals and Accommodations with your Lesson

The students' IEPs (Individualized Education Plan) may have goals in math, reading foundational skills, reading comprehension, written language, behavior/self-management, and social/emotional (among others) that could provide useful information for student groupings and the focus of your lesson. For instance, you may need to pre-teach vocabulary, scaffold and model any writing, integrate a math or ELA strategy, purposefully group students for self-management, and/or differentiate any articles based on reading level or provide a text-to-speech option on the computer for students who are reading significantly below grade level. Check with the special educator if you need a copy of any student's IEP, have any questions, and/or would like to collaborate on planning an upcoming lesson. It takes a village!

What to Look for in STEAM Lessons and Schools

When it comes to using STEAM in the classroom, how do you know what you should look for in outcomes for students, teachers and lessons? It's one thing to design a lesson, but it's totally different to see STEAM in practice.
The practice is one of the most exciting things about using the approach. During these lessons, students engage on a totally different level and often produce work that is much more vigorous. But in any active classroom, it's easy to confuse activity with deep learning.

STEAM OUTCOMES

The best way to ensure that your lessons are authentic to the STEAM process is with a simple look-for list. We have one developed for arts integration look-fors, but STEAM is a bit different. It has a different focus and intention that arts integration. So it also requires a slightly different list of outcomes. Let's dive into each component below.

INTENTIONAL CONNECTIONS

Similar to arts integration, the best quality STEAM lessons intentionally connect 2 aligned standards. The first two components of this list break this down a bit. We want to make sure we purposefully select standards, content areas and topics that make sense together. The easiest way to do this is through seeking similar verbs across standards.
For example, if the science standard asks students to "demonstrate" something and the art standard asks students to "apply" their skills, this can be an indicator of a possible alignment. It's not a hard and fast rule, but it definitely helps to eliminate standards that won't work together and leave us with the best options available.

INQUIRY BASED

Any good STEAM lesson is grounded in inquiry, problem-solving and process-based learning. In fact, this is one of the distinguishing characteristics between Arts Integration and STEAM. So when viewing STEAM in the classroom, you want to pay close attention to the essential question and the process surrounding its exploration.
What problems are being investigated and solved? How are both contents being used to explore the problems? Why is the process important to the question posed? These are all important components to a STEAM classroom or lesson.

INTEGRITY

Whenever a STEAM lesson is being used, it's imperative that the arts content has been selected purposefully and that it's being taught with integrity and not in service of the other content. This is a non-negotiable.

Many times, we'll see lessons where students are creating a craft at the end of the lesson and educators call it "STEAM". Things like creating a shadow-box about the planets for a science lesson or painting a derby car that was built in an engineering unit.
Simply adding paint, tape and glue doesn't make it a STEAM lesson. That diminishes the deep process-based learning that is inherent to the arts. Instead, the lesson should be actively teaching the arts standard through application of skills students have learned during dedicated arts times.

21st CENTURY SKILLS

The 4Cs of 21st century skills – Collaboration, Creativity, Critical Thinking and Communication – aren't going anywhere. They are a critical component to student success in a rapidly changing workforce and society. Luckily, these are easily woven into any quality STEAM lesson. This is where the active engagement really starts to shine with student groups, creating original solutions and compositions and exploring questions from multiple perspectives.

EQUITABLE ASSESSMENT

Finally, a true STEAM lesson requires assessing both the content and arts standards that were selected and taught. As all good teachers know, if you teach it – you assess it. But remember that assessment is not the same as evaluation. Assessment is a measurement of growth, not a judgment of mastery. So in a STEAM lesson, you're looking for student growth in both content areas from the lesson. If you need support in how to do this, or examples of maker-based assessments, definitely check out our Checking for Understanding online course.

BONUS: MAKING MEANING

Making meaningful connections isn't really a bonus. It's wrapped around the whole lesson like a warm coat. Making connections to career pathways and real-world applications is a way for students to understand that what they're doing in the STEAM classroom matters. It's not just "playing" – what they're learning, creating and applying has real possibilities and opportunities.

USING THIS LIST

The great thing about a list of look-fors like this is the ability to use it for many different reasons. If you're a teacher, use this list as a way to tighten up your STEAM lesson development and implementation. If you're an administrator, use this as a checklist during a STEAM lesson observation. Or use it as a way to make sure you're on the right track towards becoming a STEAM Teacher or STEAM School. No matter what, these 7 basic outcomes will help take your students to the next level.

Becoming a STEAM Teacher

As more schools are shifting to include a STEAM approach, there's a general question that many start to ask: Who are the STEAM teachers? Then, of course, we start to explore follow up questions like:

- When does STEAM occur? Is it a class or is it throughout the day?
- What makes a person qualified to teach STEAM?
- Are there STEAM credentials?
- Do we just transform STEM teachers into STEAM teachers?
- Is STEAM reserved for the art class? Does that mean we need to reconfigure art time?

Once you head down this path, you start to see all of the forks in the road. These can lead you down a totally different journey than what you originally anticipated. Let's explore each of these variations to get some clarity around an expanding and evolving approach.

Who teaches STEAM?

The answer to this is one is easy: everyone. Everyone in a school has the capacity to be a STEAM teacher. It's not limited to just the art teacher or just the science teacher. It's everyone.

This can seem oversimplified, but honestly, it's an inherent quality of this approach. STEAM, like it's counterparts STEM and Arts Integration, is based on a foundation of integration. We're trying to look at these areas of science, technology, engineering, the arts and math in tandem, rather than apart.

By limiting or labeling someone as the "STEAM Teacher", you're cutting out the very heart of this idea. We're all STEAM teachers.

This goes back to the idea of "it's not my job to teach that". We've all heard people say some version of this:

"It's not my job to teach those kindergarteners to tie their shoes."

"It's not my job to explain basic math functions to these kids."

"It's not my job to show my students how to hold a paintbrush".

Guess what? It IS your job. It's all of our jobs. We are a community and we all help each other. That's how communities work. What benefits students, benefits us all.

With that in mind, if the opportunity is there to teach a STEAM lesson, take it! No one teacher has ownership of an approach. We're all in this together.

When does STEAM occur?

This question ties back to our first one. If everyone is a STEAM teacher, that means that STEAM can happen everywhere at anytime. It's not limited to a specific STEAM class.

What if your school has a dedicated STEAM time or course? That's okay! There's nothing wrong with that. This is usually a first step that schools take to ensure that there is time built in for STEAM. Also, many schools just don't know where to start. So they appoint a STEAM teacher to become the expert for the building.

Again, this isn't wrong – it's just not the only part of the process. You can't just put a STEAM class in place and call yourself a STEAM school. It's not just one person's job to "teach STEAM".

This is an approach, not a scripted curriculum. STEAM is meant to encourage curiosity, ask big questions and provoke creativity in the exploration of problem-solving. Everyone can be a part of that in every class.

STEAM occurs throughout the day. It's embedded as an approach to use when it's appropriate and a natural fit for the intent of the learning opportunity. That means you can integrate STEAM into your math class, your music class, your field day – anything. This is something that is woven into the fabric of our school culture. It's just "how we do things". But that also means, this comes with some responsibilities.

What makes a person qualified to teach STEAM?

Just because everyone can teach through STEAM, doesn't mean that they can immediately do so with integrity. In fact, most teachers aren't sure of what STEAM really is, so how can they teach it effectively?

As with most approaches in education, we need to ensure that our teachers receive high-quality professional development *before* implementation. There are plenty of options available, including STEAM conferences and courses. Whichever you choose, just be sure that teachers have the ability to learn more about how this approach works and how to use it in their classrooms.

Since STEAM is an approach, teachers need to understand how to align curricular standards, create integrated assessments, develop lessons that ensure both the arts and the STEM areas are taught with integrity, and specific strategies that can be used with students.

This isn't just a step-by-step curriculum or a place to house a maker space or 3D printing lab. STEAM is so much more than that, and you need to have teachers trained in how to use it. So no matter what option you choose, get everyone on your team some training to ensure the best opportunity for success.

Are there STEAM credentials?

This is an evolving approach which means that we're all actively learning and researching the best possible implementations. Many institutions are now beginning to offer STEAM certificates or STEAM-focused graduate programs. These can be a great option for teachers who want to do a deep dive study. You might want to consider programs like:

University of San Diego's STEAM Master's Degree

Concordia University's STEAM Master's Degree

Many other institutions offer courses in STEAM, though not a full degree. And of course, our Institute offers an online Arts Integration Specialist Certificate which also deeply addresses STEAM. The only word of caution here is to keep in mind that everyone in your school is a part of STEAM. So you'll want everyone to have at least a baseline of knowledge and understanding in the approach. This can include teacher-led PD days or even school-wide attendance at an online conference or course.

Do we just transform STEM teachers into STEAM teachers?

In an effort to evolve schools into 21st century learning hubs, many have chosen to simply rename their STEM teachers as STEAM teachers. This unfortunately does a disservice to both the teachers and the approach. Often, this switch comes without any training. The STEM area teachers are not equipped with an understanding of what makes STEAM different than STEM. So they continue to teach their content the way they've always done, with a new STEAM challenge thrown in here or there.

This is also tied to the release of funding due to the updated ESSA law in 2015. This allowed schools to receive funds if they chose to integrate the arts. Many schools added this to their improvement plans without a true knowledge of what it really takes to weave STEAM in and through a learning pathway. Instead, they asked STEM teachers to become STEAM teachers and add in the arts to their current curriculum.

However, it's important to note that neither STEM nor STEAM can happen without direct instruction of those individual skills/concepts. You can't teach a STEM or STEAM lesson connecting two areas if students haven't learned the skills in each area directly. For example, if you want to connect parabolas and action art making, you can't do that unless students already know what a parabola is and the specific techniques that artists use to create action art. You need to teach each of these things individually first. That means that we only use STEAM when it's appropriate – not all the time. Those science, math, technology and engineering classes need to focus on teaching those skills first. Only then can we intentionally provide a STEAM lesson that puts it all together.

Is TEAM reserved for the art class?

If all this is true, then surely STEAM becomes something that happens just in the arts classes, right? Wrong. STEAM isn't something we just stick somewhere. We don't reconfigure an entire arts class to become a STEAM class.

Just like in the STEM areas, in order for STEAM to occur, students also need to have direct instruction in the arts skills and processes. STEAM cannot happen if students haven't explored arts techniques, master artists and composers, and the critical arts skills for creating, responding, performing/presenting and connecting.

Can STEAM lessons happen in the art or music room? Sure! But they can also happen in the math or science room.

Additional STEAM Resources and Ideas

Looking for even more strategies for integrating STEAM into your classroom, school or district? Here's a list of ideas we've shared over the years that you may find helpful:

- How to Add Engineering to the Arts

- STEAM Careers for the 21st Century
- 40 STEAM Apps and Websites
- Free Arts Integration and STEAM Lessons
- How to Create a STEAM Classroom Library
- Preparing Students for a STEAM-Powered Workplace
- Your Guide to STEAM Design Challenges
- 15 Ways to Integrated Math and Art in Elementary Classrooms

Final Notes

STEAM is not about what, where or when – it's about why and how. STEAM is a process of application. It allows our students to create meaning for themselves and others. If we're going to reconfigure anything, it should be our intentions for what we teach and how we can provide more time for application, creation and evaluation. That can occur in any class with any teacher.

This approach to learning is certainly not an easy task, but the benefits to students and the entire school community are tremendous. Students and teachers engaged in STEAM make more real-life connections so that school is not a place where you go to learn but instead becomes the entire experience of learning itself. We are always learning, always growing, always experimenting.

School doesn't have to be a place, but rather a frame of mind that uses the Arts as a lever to explosive growth, social-emotional connections, and the foundation for the innovators of tomorrow...today!