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Please enjoy this complimentary excerpt from the second edition of *From STEM to STEAM*, by David Sousa and Tom Pilecki. Use this template to guide you as you design a STEAM unit across grade levels at your school.

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Sample Template for Designing a STEAM Unit Across Grade Levels

Topic:		
Grades K–4	Grades 5–8	Grades 9–12
(Activities to be conducted)	(Activities to be conducted)	(Activities to be conducted)

PROFESSIONAL DEVELOPMENT TO MAINTAIN STEAM

This book suggests strategies that teachers can try in order to integrate arts-related skills into STEM classes: in other words, how to modify STEM into STEAM. The strategies have been derived from the current research on how we learn, especially on the recognition that creativity can be taught. Many of them have already been used in the schools we have been helping to implement STEAM. Teachers who try the STEAM strategies for the first time may need support and feedback on the effectiveness of their implementation. The school-based support system is very important to maintaining teacher interest and commitment, especially if the new strategies don't produce the desired results in the classroom right away.

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Role of the Building Principal/Head Teacher

Building principals and head teachers play a vital role in establishing a school climate and culture that are receptive to new instructional strategies and in maintaining the support systems necessary for continuing teacher development. Schools that develop into professional learning communities report better teacher morale, improved student achievement, and a more positive school and classroom climate (Hughes & Kritsonis, 2007). Providing opportunities for STEM teachers to master an expanded repertoire of research-based instructional techniques that include arts-related activities is an effective way for principals to foster collaboration, establish their role as an instructional leader, and enhance the teaching staff's pursuit of professional inquiry. Such opportunities can include peer coaching, in-building study groups, action research projects, and workshops that keep the faculty abreast of continuing discoveries about the teaching-learning process.

Peer Coaching

Schools organized as professional learning communities find that peer coaching is an effective means of maintaining interest and furthering growth in a new instructional initiative. This structure pairs two teachers who periodically observe each other in class. During the lesson, the observing teacher is looking for the use of a particular STEAM strategy or technique identified in a preobservation conference. After the lesson, the observing teacher provides feedback on the results of the implementation of the STEAM strategy. The nonthreatening and supportive nature of this peer relationship encourages teachers to take risks and to try new techniques that they might otherwise avoid for fear of failure or administrative scrutiny. Peer coaches undergo initial training in how to set the observation goal at the preconference and on different methods for collecting information during the observation.

Peer visits can become a learning experience for the observing teacher by reflecting on some questions regarding the class visited. This can be done in writing or at the post-observation conference with the teacher or teaching artist. Here are some example questions:

- What were some instructional techniques that you found interesting?
- What evidence did you have that students were engaged in the lesson?
- What is one (or more) strategy you would like to incorporate into your own teaching?
- Is there anything else you learned from observing this class?

Study Groups

Some schools that are already using STEAM form small groups of teachers and administrators to study STEAM applications further as an effective means of expanding

understanding and methods of developing new strategies. The group members seek out new research on the topic and exchange and discuss information, data, and experiences in the group setting. Each group focuses on one or two topics, such as integrating arts-related activities in science or in mathematics classes. Groups within a school or district can use cooperative learning techniques as a means of sharing information across groups.

Action Research

Fortunately, more school administrators are encouraging their teachers to engage in action research. Conducting small research studies in a class or school can provide teachers with the validation they may need to incorporate new STEAM strategies permanently into their repertoire. Action research gives the practitioner a chance to be a researcher and to investigate specific problems that affect teaching and learning.

For example, noting whether students remember more using music to show the practical application of mathematical concepts yields data on how effective the music was in achieving a learning objective in mathematics. If several mathematics teachers carry out this research and exchange data, they will have the evidence to support the continued use of music as an effective STEAM strategy. STEM teachers can then share their results with colleagues at faculty meetings or study group sessions. This format also advances the notion that teachers should be involved in research projects as part of their professional growth.

Workshops on New Research

Periodic workshops that focus on new research findings in the teaching and learning process are valuable for updating teachers' knowledge base. One of the main reasons for encouraging arts integration is to enhance student creativity. This is an area of considerable research and should be monitored to determine whether new findings are appropriate for district and school workshops. True professionals are committed to updating their knowledge base constantly, and they recognize individual professional development as a personal and lifelong responsibility that will enhance their effectiveness.

Maximizing Professional Development

With tight teacher schedules and even tighter school budgets, professional development activities should be selected carefully so that they achieve a focused purpose. The primary purpose of professional development is to expand the knowledge and skills of educators so they can make decisions that are more likely to result in greater student success. This is important because all the research over the years continually points to the teacher as having the most significant school-based impact on student learning. We suggest in this book that students in STEM subjects are more likely to be successful if they

are exposed to art-related skills that enhance creativity. Thus, if you are the administrator or professional development leader managing a training program to help STEM become STEAM, you might consider these tips recommended by Douglas Reeves (2010).

Focus

Consult with your STEM and arts-related teachers to determine which ones are interested in STEAM. Clearly express your expectations for the short term, and discuss what type of professional development format would work best with them.

Keep It Simple

When STEAM is the focus of the professional development, stick to it. Often, we try to cover too many topics in the same workshop and participants feel overwhelmed. Stick with STEAM and strive for depth.

Practice

True learning is grounded in practice. Pace the training sessions so that STEM teachers have time to try out a STEAM lesson and discuss their experience at the next session. In this way, teachers have time to reflect on their implementation and look for ways to make it a permanent part of their instructional repertoire.

Prepare for Errors

Just as we should be telling students to learn from their mistakes, so should we. STEAM lessons do fail on occasion, and when they do, STEM teachers and their coaches should see this as a learning opportunity.

Do the Modeling

If you are a STEM teacher, model a STEAM lesson for participants. Otherwise, invite some STEM teachers who are already doing STEAM lessons to do the modeling. Perhaps they can even co-teach a STEAM lesson with a willing participant. Be sure to attend the sessions with the STEM teachers and give them articles about STEAM initiatives in other schools.

Monitor Progress

Implementation of STEAM lessons is more likely to occur if teachers recognize that you will be visiting their STEAM classes and offering constructive feedback about what you

observed. Using the peer coaching format, find ways for STEM teachers and teachers in the arts to observe each other periodically as they implement STEAM lessons and confer about how the lessons went.

Remove Barriers

Look ahead to what may be barriers to the implementation of STEAM lessons. Are the STEM and arts-related teachers' schedules too tight, or do they conflict and thus prohibit collaboration and peer coaching? Which of these problems are within your control, and what can you do to smooth the way? Participants need to feel that you are doing your best to make this initiative succeed. Otherwise, why should they put in their time and efforts for what they believe may be a short-lived project?

Our experience is that many STEM teachers believe they have no artistic talent and that trying to implement a STEAM lesson is bound to fail. In reality, all of us possess some degree of talent in one or more of the arts-related fields. Successful implementation of STEAM means convincing STEM teachers that they will have the support and resources needed to build upon their existing knowledge and to learn STEAM strategies.

CONCLUSION

Those of us who have been in education for more than a few decades have seen many types of instructional programs come and go. Teachers often remark about the “flavor of the year” with vestiges of the intensity and fervor of the “flavor” little more than a memory within a few years. What does remain, however, is simply “what works,” and in observing thousands of teachers over the years, the thing that works best is good teacher intuition. This intuition comes from having been taught by great teachers in elementary and high school (yes, we do tend to emulate the teachers we had) and from having good, basic teaching instincts and strategies that are culled from a soupy mix of college courses. Teacher education programs in too many colleges focus heavily on educational theory rather than on encouraging growth mind-sets and on creating a blend of theory with interactive and innovative instructional strategies that have sound research to back them up. Bravo to those institutions of higher learning that have been forging ahead on this necessary and dynamic path.

At the end of the day, teaching is a great vocation. People are called to this lifelong profession with noble intent, fierce devotion, and boundless energy. Unfortunately, we continue to lose our best teachers at an alarming rate. High-stakes testing, well-meaning

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unions that have overreached, lack of parental and guardian support and involvement, insensitive administrations, and ill-inspired politicians are collectively causing the weakening of this wonderful vocation. As a result, we see a decline in the kind of instruction that produces creative young adults who have the capability to solve problems and who contribute to their communities and to their country. Selecting a, b, or c on a test is not going to solve their real-world challenges.

From the early days of the last century through the late 1980s, students learned in schools with clear codes of conduct, caring yet strict teachers, parents and guardians who supported school policies, and plenty of role models who had finished reconstructing an economically destroyed nation after the Great Depression and two world wars. Although our current research and understanding of how our brain learns and of what provides the best instructional strategies did not exist, somehow our schools were successful. It was called a *liberal arts education*. Building on the little scientifically based research that was available, schools created balanced instructional days including lunch and recess periods. Elementary schools typically had one teacher in the classroom, and art, art appreciation, and vocal and instrumental music classes were simply expected.

STEAM is one of the most logical concepts to come along in recent years. Schools are now beginning to realize the need to take a liberal arts look at what and how we teach. We have mentioned in previous chapters the crying need for creativity in the classroom. STEAM is a “call to arms” for an overhaul of how we train teachers and administrators, how we inform our politicians, and—the biggest challenge of all—how we significantly increase parental involvement. In many ways, realigning the arts with the sciences puts trust back in the teachers and their capabilities and instincts, and makes for a more exciting, creative, and successful classroom.