Editorial

Welcome to the *Journal of STEM Arts, Crafts, and Constructions*: What the *Journal* is All About

Audrey C. Rule, Editor in Chief
University of Northern Iowa

Abstract

The *Journal of STEM Arts, Crafts, and Constructions* is a scholarly journal that seeks to engage professionals, including preK-12 teachers, in a conversation about the benefits of arts integration; the ways that the STEM subjects can be integrated with the arts to produce effective teaching (STEAM Education); and how the Next Generation Science Standards (NGSS), can be effectively implemented with integrated arts, crafts, or constructions. Manuscripts, including guest editorials, are blind peer-reviewed by usually two reviewers and an associate editor or by three reviewers. This editorial explains the *Journal*'s origin in a faculty professional learning community. The *Journal* has a national reach with plans for two issues each year. The editorial discusses what the Journal is looking for in manuscript submissions, how the Journal may be of use to readers, and highlights of the articles in this issue. Finally, the editor explains the 5E's learning cycle lesson model, which is an effective format for inquiry lessons to readers who may be interested in incorporating this format into lessons and future manuscripts.

Key Words

Editorial, STEM Education, STEAM Education, Learning Cycle, 5E's Lesson Format.

Journal of STEM Arts, Crafts, and Constructions

Volume 1, Number 1, Pages 1-9.

The Journal's Website:

http://scholarworks.uni.edu/journal-stem-arts/

Introducing our *Journal* and its First Issue!

Welcome to the *Journal of STEM Arts, Crafts and Constructions*! The goal of our new journal is to support arts integration into STEM subjects (Science, Technology, Engineering, and Mathematics) through publication of editorials, research articles, and practical articles. Thank you for your interest in our first issue!

About the *Journal of STEM Arts, Crafts, and Constructions*

Origin. Several members of the Editorial board are faculty at the University of Northern Iowa in the College of Education because this place, in the heartland of America, is where the idea for the journal began. For several years, a group of faculty members in the Department of Curriculum and Instruction met regularly in a professional learning community to share ideas about arts integration into the curriculum and its benefits. I was one of those colleagues. Besides the *Journal* being an outgrowth of that faculty study group, other members have started an arts-integration program at a local public school, bringing their preservice teachers to the school to attend their methods courses there and to directly implement their arts-integrated lesson ideas in participating classrooms. Hopefully, future articles will

originate from this university-school partnership. Dr. Gaetane Jean-Marie, Dean of the College of Education at the University of Northern Iowa, supports these arts-integration enterprises: “This journal will continue to build and broaden our approaches to research in all of its forms to sustain the advancement of these arts-integration enterprises, and align with the conceptual framework of the College. I want to thank Dr. Audrey Rule as the new Editor for cultivating the collective knowledge and expertise of practitioners, researchers, and educators to engage in the development of relevant, provocative research that explores both the underlying principles and rationale, as well as the true value of generalized education.”

Current Housing. Our website is currently hosted by UNI ScholarWorks, UNI's institutional repository. Ellen Neuhaus, Digital Scholarship Librarian, states "The purpose of UNI ScholarWorks is to showcase the knowledge, creativity and innovative spirit of the University of Northern Iowa." Our journal platform, including submission software and website, uses Digital Commons software managed by bepress.

National Reach. Our Editorial Board has Associate Editors from across the United States and we are growing. Our reviewers are located in many different states. If you are a STEM or STEAM (STEM with an added “A” for Arts integration) education professional and have an interest in being a reviewer or an Associate Editor, please contact the Editor-in-Chief. The aim of the Journal is to serve a national and international audience of professionals interested in STEAM Education.

Frequency of Publication. The *Journal* Staff plans to publish two or more issues per year, depending upon submissions. All *Journal* Staff, including myself, are volunteers. We appreciate the efforts of all of our reviewers who volunteered to read manuscripts and offer advice for improvement. The *Journal* does not have page charges or other author fees. We are education professionals working together to promote STEAM education because we believe in its positive effects.

Aims and Scope

This journal was developed to meet the needs of STEM educators and their arts education colleagues to publish peer-reviewed editorials, practical articles, and research about arts-integrated STEM curriculum and its effects in a timely manner.

Aims. The *Journal of STEM Arts, Crafts, and Constructions* is a scholarly journal that seeks to engage professionals including preK-12 teachers, informal educators, museum or zoo educators, STEM coaches and lead teachers, and university faculty in a conversation about the benefits of arts integration; the ways that the STEM subjects can be integrated with the arts to produce effective teaching (STEAM Education); and how the Next Generation Science Standards (NGSS), including the engineering standards of the NGSS, can be effectively implemented with integrated arts, crafts, or constructions. Manuscripts, including guest editorials, are blind peer-reviewed by usually two reviewers and an associate editor or three reviewers. Editorials from the Editor are peer-reviewed by associate editors or other colleagues.

Scope. The journal addresses learners who are preschool through adult, encompassing preK-12 education, college, and graduate school learners. Learners in non-school settings such as museums, parks, clubs, recreational programs, summer programs, afterschool programs, and other institutions are also part of the journal’s scope.

What is the *Journal* Looking for in Submitted Manuscripts?

Our new website provides guidelines for authors of practical articles and research articles. Guest editorials that examine an aspect of STEAM Education in a scholarly manner are also welcome and undergo a blind, peer-review process, as do all manuscripts.

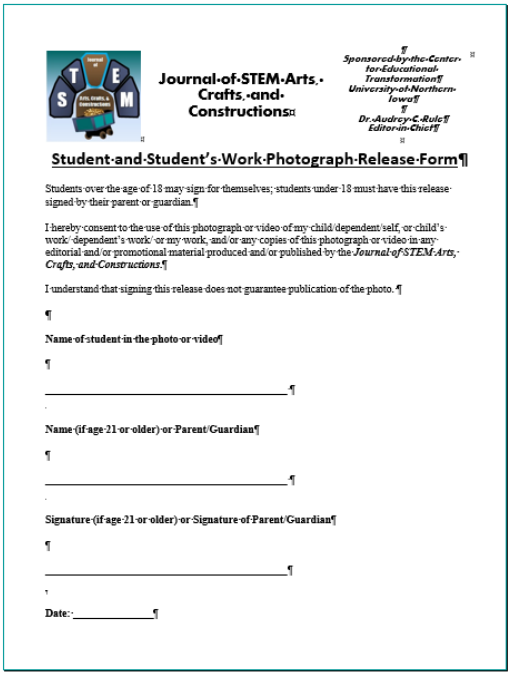
Practical Articles. Practical articles provide a forum for discussion and dissemination of best practices in arts-integrated STEM instruction through classroom-tested examples of successful lessons. The *Journal* seeks practical articles showcasing effective arts-integrated STEM lessons that include many photographs of students in action and/ or

their products. Signed consent forms are needed to publish these photographs, so please plan ahead to obtain student and parent consent. See Figure 1. A consent form for the journal is available on our website in the Author Guidelines Area tab. We also accept Human Subject Internal Review Board consent forms that explicitly give consent for photographs of students and products. The *Journal* needs to retain copies of the signed consent forms; copies can be scanned and submitted electronically to the *Journal*.

Important components of practical lessons include: pedagogy that supports student inquiry, such as the 5E's Learning Cycle described later in this editorial or other interactive, conceptual change, or argument-based student-centered teaching (Balci, Cakiroglu, & Tekkaya, 2006); reflection on how the incorporation of the arts enhanced learning; rubrics or criteria for evaluating the lesson or student work; along with tips and suggestions for implementing the lessons. Practical articles must address lessons that have been classroom-tested with students or participants; the *Journal* does not publish lesson plans alone, nor does it publish lessons closely based on lesson plans that have already been published. Additionally, commercially produced and published worksheets cannot be re-published by the *Journal*. When writing a practical article, it is a good idea to check the review guidelines for practical articles to make sure that your work satisfies the requirements.

Research Articles. Research articles may also address verification of effective instructional techniques or other STEAM-related research, providing findings from a quantitative, qualitative, or mixed-methods analysis.

One line of useful research involves studies that compare learning through the arts to a control group or control condition in which students spend the same amount of time engaging in effective non-arts-integrated activities. More evidence of the benefits of arts integration may emerge from such studies. Another approach for research articles may be to focus on different techniques for developing student creativity in STEM areas through arts, crafts, or constructions.



Journal of STEM Arts, Crafts, and Constructions

Sponsored by the Center for Educational Transformation University of Northern Iowa

Dr. Audrey C. Rule Editor-in-Chief

Student and Student's Work Photograph Release Form

Students over the age of 18 may sign for themselves; students under 18 must have this release signed by their parent or guardian.

I hereby consent to the use of this photograph or video of my child/dependent/self, or child's work/dependent's work/or my work, and/or any copies of this photograph or video in any editorial and/or promotional material produced and/or published by the *Journal of STEM Arts, Crafts, and Constructions*.

I understand that signing this release does not guarantee publication of the photo.

Name of student in the photo or video

_____

Name (if age 21 or older) or Parent/Guardian

_____

Signature (if age 21 or older) or Signature of Parent/Guardian

_____

Date: _____

Figure 1. Consent form for photographs, available on the *Journal's* website under Author Guidelines.

How the *Journal* Might be Useful to You

We all need continued sources of inspiration in our lives. I am often inspired by seeing school projects on display or reading articles about them, especially articles with attractive photographs. Perhaps the articles in our first issue will inspire you to include more arts integration into your teaching or to pursue a related problem through research. Practical articles provide ideas that classroom teachers might want to implement.

As Examples for Replication or Critique

Articles from the *Journal* might be used in methods classes taught by teacher educators as examples of projects preservice teachers might design for a course assignment. Classroom teachers may share these articles with colleagues as part of an arts-integration or STEM study group. Graduate students may want to critique some of the articles to consider additional aspects that might have been considered by practitioners or ways a study might be improved or extended.

To Aid in Professional Development

Involvement as a reviewer or associate editor for *the Journal of STEM Arts, Crafts and Constructions* may help you on your professional development journey. Reviewing is a good way to become more intimately involved with the professional literature. Even though I am the Editor in Chief for this journal, I still review for other journals because it gives me a better perspective on what is happening in my field. I credit my work as an associate editor of the *Journal of Geoscience Education* quite a few years ago when I was an assistant professor as exposing me to effective research designs and ways of drawing conclusions from studies of other researchers. Being an associate editor and examining the diverse views of the reviewers I had found for manuscripts broadened my thinking. Because of this position, I was forced to read and re-read manuscripts, thinking about clarity and support for claims. This review of manuscripts, along with having my own manuscripts come back from review, helped me learn effective ways of presenting results and phrasing conclusions. This experience caused me to notice and commit to memory many conventions used in writing manuscripts. Considering the comments from reviewers of problems within manuscripts I reviewed perhaps made the greatest impression on me as I tried to remember *not* to make these mistakes in future manuscripts I wrote. Such non-examples or near-misses help learners to refine their understandings (McLure, Friedman, & Forbus, 2015).

Highlights of the Articles of the *Journal*'s First Issue

Here, I draw attention to the exciting features of the STEAM articles in our current issue. Be sure to browse them because they all have something unique to offer! One important aspect of all of the articles is that they provide viable examples of how the arts were integrated into STEM areas and of how engineering standards of the Next Generation Science Standards were incorporated into lessons. These components alone make them useful examples for practitioners attempting to integrate these important constituents.

Practical Articles in this Issue

Three practical articles are included in this issue of the journal. The first two articles emerged from partnerships between teachers enrolled in a professional development workshop on the Next Generation Science Standards who were partnered with doctoral students in a seminar course focused on STEAM education. This partnership work was supported by a NASA grant and by a second grant from the Iowa Biotechnology Association.

First Practical Article. The first article, authored by Anastasia Carignan and Mahjabeen Hussain (2016), was titled, **Designing an earthquake-proof art museum: An arts-and-engineering integrated science lesson**. In the lesson they describe, fourth graders created clay sculptures of animals for an imagined art museum. Students created a structure of plastic straws, twist ties, and masking tape to support the delicate natural clay sculptures during a simulated earthquake on a shake table. Through the process of comparing the results of different geometries of sculptures and supports on the shake table, students built a foundation of engineering principles. Students were highly invested and motivated in the experiments, after designing the sculptures and support structures themselves. See Figure 2 for a preview of one of the sculptures on a shake table.

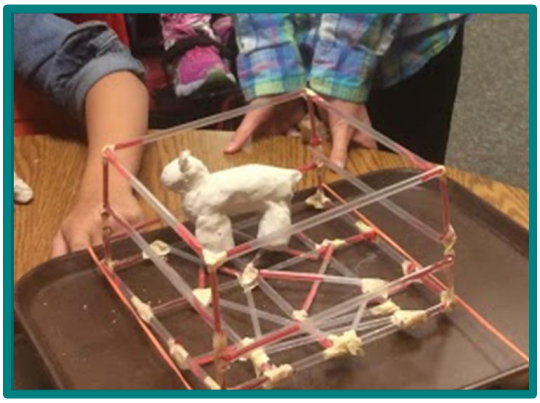


Figure 2. Example clay sculpture and support structure on the shake table.

Second Practical Article. Another practical article credited to the classroom teacher -- doctoral student partnerships just described involved preschool children

visiting a greenhouse and making a model. The authors of this article titled, **Preschoolers explore greenhouses by visiting a greenhouse, making a model, and growing plants**, were Leann Perkins and Dessy Stoycheva (2016). Preschoolers created their greenhouse models by turning a clear plastic rectangular bin (recycled from being a container in which salad greens were sold) upside-down and decorating it with photographic stickers made from photos taken during their greenhouse visit. Inside, students not only placed models of plants they had created, but planted bean seeds in small plastic bags filled with moistened cotton that were taped to the greenhouse interior wall. Students watched the bean plants sprout and emerge inside the model greenhouses. See Figure 3 for a preview of an image from this practical article.

Figure 3. Preschoolers with the greenhouse model they created.

Third Practical Article. This article originated in a science methods course in which preservice teachers created shadow puppet plays to learn and teach their peers about the lives and accomplishments of scientists of color. The authors of the article, titled, **Shadow puppet plays in elementary science methods class help preservice teachers learn about minority scientists**, are Phyllis Gray, Audrey Rule, Anneliese Gentzsch, and Denise Tallakson (2016). A highlight of this article is the Appendix, which features puppet play scripts written by the contributing undergraduate student authors. Photographs of the shadow puppets the preservice teachers made to illustrate their scripts are included. See Figure 4 for an example.

Figure 4. Shadow puppets made by preservice teachers used in a puppet play about African American scientist Granville T. Woods.

Research Articles in this Issue

Three research articles are featured in this premier issue of the journal. The first two research articles originated from doctoral students enrolled in the STEAM seminar course who were partnered with classroom teachers. The third article was the result of a special after-school project in which a doctoral student and several professors collaborated.

First Research Article. Kyrie Borsay and Page Foss (2016) authored this research article titled, **Third graders explore sound concepts through online research compared to making musical instruments.** A pretest-posttest-distal posttest, counterbalanced repeated measures experiment was conducted to compare arts-integrated lessons on making musical instruments to investigating the same content through online searches. Examples of student-made musical instruments are showcased in the article; an example is previewed in Figure 5.

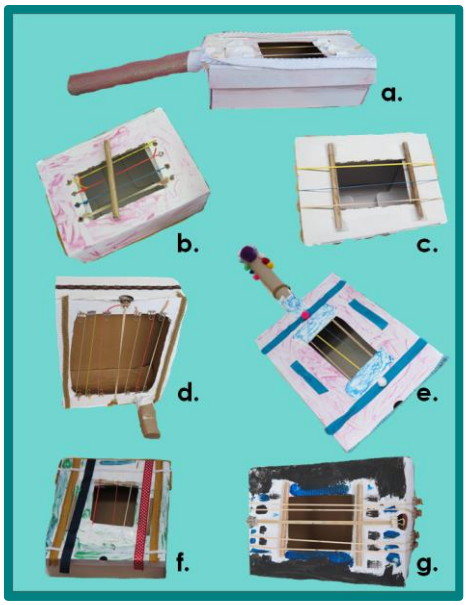


Figure 5. Student-made stringed instruments.

Second Research Article. The second research article titled, **Zebras and jaguars, Oh My! Integrating science and engineering standards with art during prekindergarten block time**, was authored by Brandy Smith and Jane Cline (2016). This study compared student animal habitat block constructions when provided additional art materials or not. The study also investigated student recall of animal habitat information under the two conditions. The authors examined student motivation and creativity during this study, finding that these were enhanced by the incorporation of art materials. A preview of one of the constructions made in the experimental condition is show in Figure 6.

Figure 6. A creative animal habitat construction.

Third Research Article. The third article originated from a collaboration between faculty members and a doctoral student in Curriculum and Instruction with faculty from the School of Music to produce an afterschool program for students from several schools in a local urban school district. The article titled, **Learning form and function by dance-dramatizing cultural legends to drum rhythms wearing student-made animal masks**, was authored by Phyllis Gray, Audrey Rule, Gloria Kirkland Holmes, Stephanie Logan, Andrea Alert, and Cynthia Mason (2016). Animal body part form and function concepts were taught in many ways throughout the instructional unit in which students participated. Students made animal masks, created drum rhythms and dance steps to represent animal movements, and wore their masks while performing animal legends from three cultures. An appendix provides the traditional legends modified to emphasize animal form and function. Figure 7 shows a preview of a student wearing an animal helmet crest mask she made representing a whale.

Figure 7. Student wearing the helmet crest mask she made.

An Effective Format for Lessons: The Learning Cycle

The 5E's Learning Cycle is one effective way to structure a lesson to support inquiry. Although lessons that are part of practical and research articles are not *required* to

use the 5E's Learning Cycle format, lessons *must* use an effective pedagogical delivery system. The 5E's format supports student inquiry and STEM learning. Because this lesson format has been shown to be effective in many settings and through many studies (e.g., Ajaja & Urhievwejire, 2012; Bybee, Taylor, Gardner, Van Scotter., Powell, Westbrook, & Landes, 2006; Ceylan, 2008), I will review its parts here.

Engage

In the first phase of this model, represented by the E for Engage, the teacher gains student attention and focuses it on the lesson topic. This first step is crucial because students must pay attention to learn (Wittrock, 1986). As Nakamura and Csikszentmihalyi (2003) state, "Information appears in consciousness through the selective investment of attention. People's subjective experience, the content of consciousness from moment to moment, is thus determined by their decisions about the allocation of limited attention" (p.85).

A factor supporting the success of proficient classroom teachers is their constant monitoring of student engagement and use of strategies that increase attention, motivation, and participation in the lesson (Szafir & Mutlu, 2012). These strategies include asking questions, injecting humor, calling on students by their first names, facial expressions, gestures, eye-contact, smiling, postures, and proximity (Gorham, 1988; Gorham and Christophel, 1990; Richmond, Gorham, & McCroskey, 1987). Therefore, ways of gaining student attention in the Engage Phase might be to ask a provocative question, or to show students an exciting object, demonstration, phenomenon, or humorous visual. This phase provides the opportunity to gain student attention by showing topic-related art, such as animal sculptures by Troy Emery (Barnes, 2013) that are realistic resin shapes covered with pompons or yarn.

During the Engage Phase, the teacher activates students' prior knowledge of the topic. The teacher learns what students know about the topic (a diagnostic assessment), allowing just-in-time modification of lesson plans to ensure effective instruction. The teacher also may uncover misconceptions or alternate understandings about the topic.

This phase may start with a surprising or anomalous demonstration, raising student curiosity to understand how and why that occurred. This demonstration is called a discrepant event and causes students to experience mental disequilibrium. The teacher should not immediately explain the event because this state of disequilibrium is a very valuable aspect of the lesson. This state of confusion is uncomfortable and stimulates students to learn so that everything in their experience again makes sense; disequilibrium prompts the motivation to pay attention and learn (D'Mello, Lehman, Pekrun, & Graesser, 2014).

Instead of a discrepant event, the teacher may ask students to complete a K-W-L chart on what they currently "Know," and what they "Want" to know, leaving the third column of what they have "Learned" blank until later in the lesson. This graphic organizer task activates a lot of self-examination regarding the topic and often leads to some disequilibrium of wondering what will be addressed during subsequent instruction. Instead of a K-W-L chart, students may be asked to create a concept web of ideas related to the topic, or write some responses to questions. Advance organizers generate interest in the topic and allow students to make connections to their prior learning (Clapper, 2014).

Explore

The second E stands for Explore. During this phase, the teacher encourages students to make connections between the topic and other experiences (Lederman, 2009). Students use inquiry skills to explore the topic through observation, classification, inference-making, measurement, collection and organizing data or making claims from evidence.

Asking students to play with or manipulate items to sort them or to see what they can do and to record their observations is another exploration strategy. Similar to these activities is involving students in solving a puzzle of some sort that relates to the topic. Perhaps students are asked to interpret a work of art that is related to the topic. There are many effective strategies for the exploration phase. Notice that none of them involve explaining terms or concepts to students, so as to make use of the advantages of having students feel disequilibrium or curiosity and wonderment of

what the lesson is really about. The 5E's model is not a direct instruction model because the lesson does not begin with explanation of goals or concepts. Those activities take place during the next phase.

Explain

Before the teacher begins explaining the concepts, students should voice their understandings of the phenomenon or inquiry activities in which they had engaged. Students are encouraged to construct arguments based on the evidence they had gathered.

Once the students have presented their ideas and reasoning, the teacher begins to explain the lesson concepts through lecture, class discussion, slide show presentations, videos, experiments, models, defining terms, reading texts, demonstrations, or other student activities. Note that these explanation activities do not occur during the previous exploration phase and are not the way the lesson is initiated.

During this explanation phase, the teacher provides examples and explanations of the concept. Students return to mental equilibrium as they begin to understand the lesson concepts. Although teacher lecture can be part of the instruction at this phase, interactive involvement of students with materials and lesson concepts is recommended to maintain attention and promote learning. Hands-on activities such as examining and classifying items or specimens, creating constructions or three-dimensional models, engaging in field work and collection or photography of specimens or instances of the concepts are examples.

At the end of the explanation phase, the teacher should check for closure and student understanding by having students demonstrate what they learned through brief summaries, oral question-and-answer, student presentation of findings, models, etc. (another formative assessment). The arts may be incorporated into the explanation phase as a closure activity through making of a model, a collage, a poster, or designing a skit to communicate essential learning.

Expand or Elaborate

The Expansion Phase brings the occasion to apply topic concepts to a new domain. This is often the place at which the arts are integrated, but the arts may be combined with the topic in any phase or all phases of the lesson. Application of the new learning to another domain conditionalizes the learning, making it easier to access and apply to new situations in the future. Applying knowledge to a new domain allows the learner to recognize and organize the ideas around important concepts or big ideas, allowing the student to recognize the contexts in which it is applicable and allowing this knowledge to be transferred to new contexts in the future (Bransford, Brown, & Cocking, 1999). Students should practice their learning with teacher guidance and then independently relate the concepts to the new domain. This brings the opportunity for project work.

Evaluate

The last part of the 5E's Learning Cycle is to evaluate student learning through a summative evaluation. This may take many forms such as evaluation of student understanding exemplified through performance or an arts, crafts, or construction project/ product. A rubric may be used to score this work. Evaluation may also include more traditional forms such as written report or a multiple-choice test. Please provide the criteria used to evaluate student learning in your manuscript.

Conclusion

The Journal's staff members are very excited to publish this inaugural issue of the *Journal of STEM Arts, Crafts, and Constructions* to begin our conversation with other education professionals about the benefits of arts integration into STEM. Together, we will explore how the integration of arts, crafts, or constructions can facilitate and enhance student learning of concepts defined by the Next Generation Science Standards.

I hope I have convinced you to become involved with the *Journal of Stem Arts, Crafts, and Constructions* as a reader, author, reviewer, or Associate Editor. As the Journal grows through its subsequent issues, there will be additional opportunities to host a themed issue. Contact the Editor in Chief if you have ideas for a themed issue.

Acknowledgements

Some of the articles in this issue of the journal described in this editorial are based upon work supported by NASA under Grant No. NNX15AJ16H. A grant from the Iowa Biotechnology Association also supported this work.

One of the articles mentioned in this editorial was made possible through generous gifts to the College of Education Dean's Fund for Excellence, at the University of Northern Iowa Foundation. Thank you to those who have made contributions to the Dean's Fund for Excellence.

References

Ajaja, P. O., & Urhievwejire, O. E. (2012). Effects of 5E learning cycle on students' achievement in biology and chemistry. *Cypriot Journal of Educational Sciences*, *7*(3), 244-262.

Balci, S., Cakiroglu, J., & Tekkaya, C. (2006). Engagement, exploration, explanation, extension, and evaluation (5E) learning cycle and conceptual change text as learning tools. *Biochemistry and Molecular Biology Education*, *34*(3), 199-203.

Barnes, S. (2013). Brown paper bag blog: Sculpture: Fake taxidermy of Troy Emery. Retrieved from http://www.brwnpaperbag.com/fake-taxidermy-troy-emery/

Borsay, K. & Foss, P. (2016). Third graders explore sound concepts through online research compared to making musical instruments. *Journal of STEM Arts, Crafts, and Construction, 1*(1), 46-61.

Bransford, J. D., Brown, A. L., & Cocking, R. R. (1999).*How people learn: Brain, mind, experience, and school*. Washington, DC: National Academy Press.

Bybee, R. W., Taylor, J. A., Gardner, A., Van Scotter, P., Powell, J. C., Westbrook, A., & Landes, N. (2006). The BSCS 5E instructional model: Origins and effectiveness. *Colorado Springs, CO: BSCS*,*5*, 88-98.

Carignan, A. & Hussain, M. (2016). Designing an earthquake-proof art museum: An arts-and-engineering integrated science lesson. *Journal of STEM Arts, Crafts, and Construction, 1*(1), 10-17.

Ceylan, E. (2008). *Effects of 5E learning cycle model on understanding of state of matter and solubility concepts*. Doctoral dissertation, Middle East Technical University,.

Clapper, T. C. (2014). Situational interest and instructional design: A guide for simulation. Simulation & Gaming, 45, 167-182.

D'Mello, S., Lehman, B., Pekrun, R., & Graesser, A. (2014). Confusion can be beneficial for learning. *Learning and Instruction*, *29*, 153-170.

Gorham, J. The relationship between verbal teacher immediacy behaviors and student learning. Communication Education 37 (1988), 40–53.

Gorham, J., and Christophel, D. M. The relationship of teachers' use of humor in the classroom to immediacy and student learning. Communication Education 39 (1990), 46–62.

Gray, P., Rule, A. C., Gentzsch, A., & Tallakson, D. A. (2016) Shadow puppet plays in elementary science methods class help preservice teachers learn about minority scientists. *Journal of STEM Arts, Crafts, and Construction, 1*(1), 27-45.

Gray, P., Rule, A. C., Kirkland Holmes, G., Logan, S. R., Alert, A. L., & Mason, C. A. (2016). Learning form and function by dance dramatizing cultural legends to drum rhythms wearing student-made animal masks. *Journal of STEM Arts, Crafts, and Construction, 1*(1), 75-97.

Lederman, J. S. (2009). *Levels of inquiry and the 5 E's learning cycle model*. Monterey, CA: National Geographic Science School Publishing.

McLure, M. D., Friedman, S. E., & Forbus, K. D. (2015, January). Extending Analogical Generalization with Near-Misses. In *Proceedings of the* 29th *Association for the Advancement of Artificial Intelligence (AAAI) Conference on Artificial Intelligence* (pp. 565-571). Austin, TX.

Nakamura, J., & Csikszentmihalyi, M. (2003). The construction of meaning through vital engagement. In C. L. M. Keyes & J. Haidt (Eds.) *Flourishing: Positive psychology and the life well-lived* (pp. 83-104). Washington, DC: American Psychological Association.

Perkins, L. M., & Stoycheva, D. (2016). Preschoolers explore greenhouses by visiting a greenhouse, making a model, and growing plants. *Journal of STEM Arts, Crafts, and Construction, 1*(1), 18-26.

Richmond, V. P., Gorham, J. S., and McCroskey, J. C. (1987).The relationship between selected immediacy behaviors and cognitive learning. Communication Yearbook, 10 (1987), 574–590.

Smith, B. A., & Cline, J. E. (2016). Zebras and jaguars, Oh My! Integrating science and engineering standards with art during prekindergarten block time. *Journal of STEM Arts, Crafts, and Construction, 1*(1), 62-74.

Szafir, D., & Mutlu, B. (2012, May). Pay attention!: designing adaptive agents that monitor and improve user engagement. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 11-20). ACM

Wittrock, M. C. (1986). Education and recent research on attention and knowledge acquisition. In S. L. Friedman, K. A. Klivington, & R. W. Peterson (Eds.), *Brain, cognition, and education* (pp. 15 1-169). New York, NY: Academic.