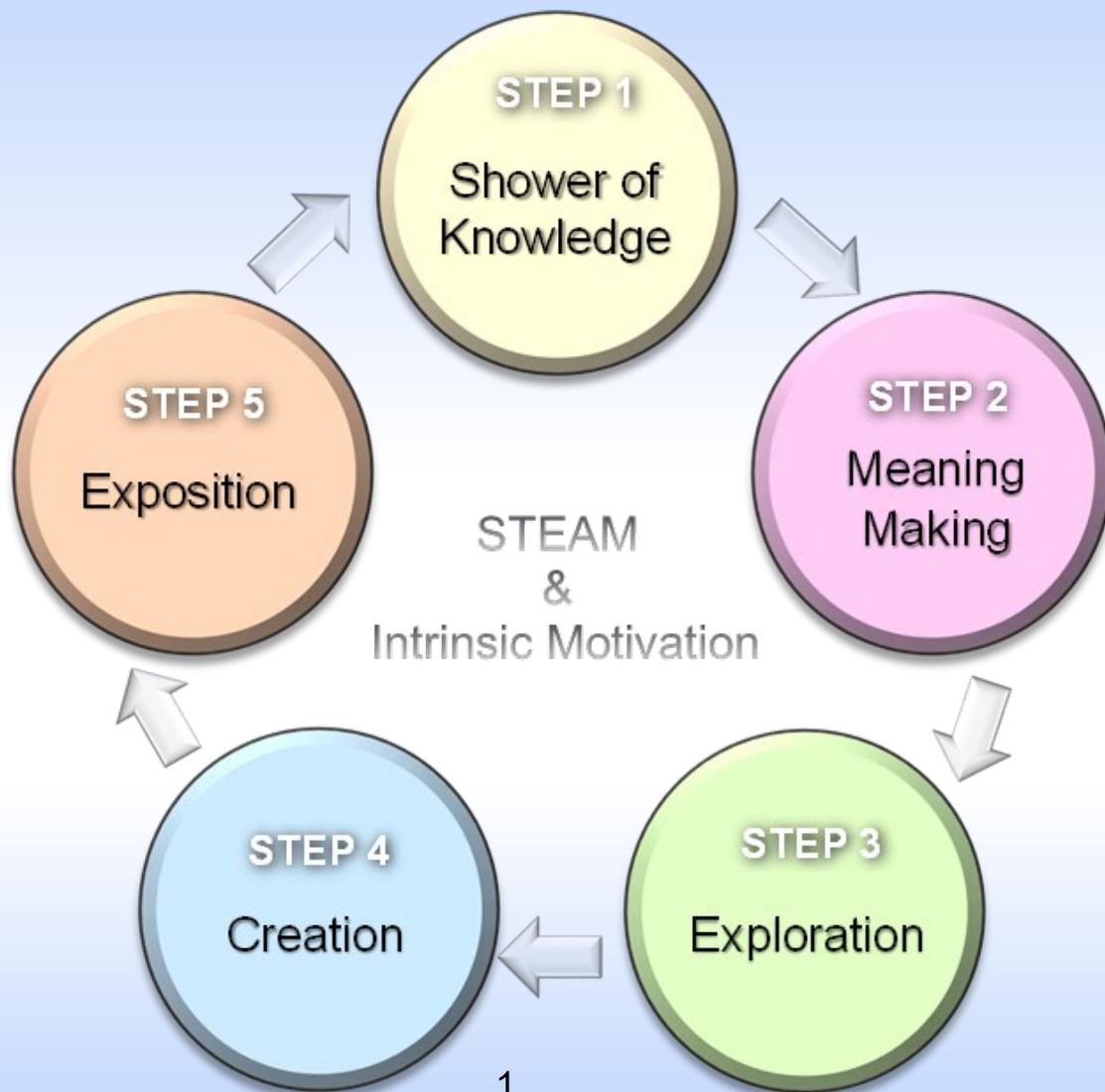




# Suggestions For Integrating **STEAM** Education

--Promoting children's intrinsic motivation through STEAM--

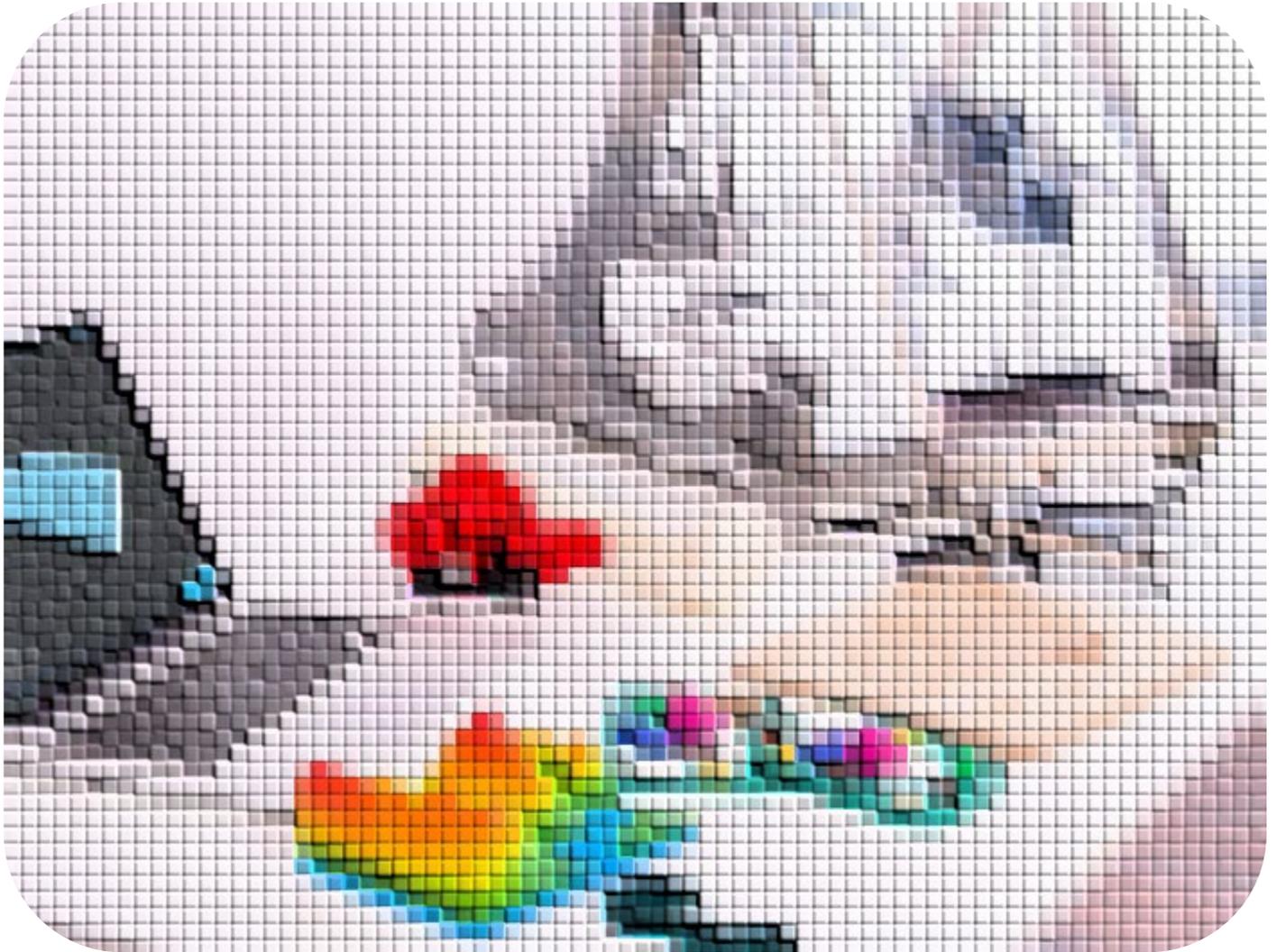


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# Suggestions For Integrating STEAM Education

*Yuno Bounds: University of Florida: Art Education*



This suggestions brochure is part of my capstone project for the Master of Arts in Art Education at the University of Florida. I decided to investigate the connection between intrinsic motivation and STEAM education for my research. As the final part of my project, I created this brochure to provide afterschool programs and other community programs with ideas regarding how to integrate STEAM education.

Full Study Here : <http://yuzu.site/?p=4529>



## What is STEAM and why is it important?



The acronym “STEAM” (science, technology, engineering, art, and math) is an expansion of the term “STEM” to include art. The “A” in STEAM represents art and the liberal arts, such as the humanities and social sciences (Quigley & Herro, 2019). While our society tends to emphasize curricula that focus on STEM topics, I consider it important to include the arts for their ability to bring joy to learning. While knowledge is important, but the intrinsic desire to know more is essential for learning. STEM curricula can benefit from integrating arts or other creative endeavors, thus fostering creative solutions (Conradty et al., 2020). Art has its roots in creativity, expression, and emotions—it encompasses more than just drawing and creating. Art provides the threads that connect separate pieces together; it allows us to weave a one-of-a-kind tapestry of learning. STEAM education allows us to approach problems from multifaceted perspectives rather than teaching subjects in isolation. Based on my study’s core findings, I have compiled my STEAM suggestions into this book. In the first section, I will introduce four aspects of STEAM education that enhance intrinsic motivation in children..

## ENVIRONMENT

The learning environment plays a significant role in stimulating intrinsic motivation. An environment that encourages passion and meaning inspires children.

## AUTONOMY

Autonomy is the capacity to control oneself and act spontaneously based on one's visions and decisions. Being interested in a matter increases autonomy.

# 4 aspects of how STEAM can promote children's intrinsic motivation

## DIVERGENT THINKING

Divergent thinking is said to be the source of creativity. Divergent thinking seeks a range of different types of answers to explain a given phenomenon.

## SYNERGISTIC EXTRINSIC MOTIVATORS

Synergistic extrinsic motivators are essential in healthy learning. While synergistic extrinsic motivators are outside factors, they work with intrinsic motivation.

**“Interest” is the key to all**

# Environment

## The Environment that Promotes Intrinsic Motivation



An environment that encourages passion and meaning inspires us. It is also important to cultivate an environment that sparks children's curiosity. Reggio Emilia's approach supports this perspective; they refer to the environment itself as an educator (Strong-Wilson & Ellis, 2007). The environment is much more than just the appearance of one's surroundings. In fact, the most important aspect is how the children feel from a learner's perspective. For example, educators may place furniture, toys, or materials in unexpected ways to spark discussion among students (Strong-Wilson & Ellis, 2007).



## What Can We Do?

# Meaning in the Environment

Does your program express or embody a passion about something? Often people are attracted to “why” we do things more than “what” we do.

- Make sure to include an embodiment of passion or meaning that’s unique to your program.
- Identify an item or place that children can relate to and be passionate about.

## Unusual Setting to Promote Discussion

Something “different than usual” catches our attention and give us wonder. Change an aspect of your usual classroom into something unique. For example,

- Use blue cellophane to change the color of the windows. Why does the room become blue when the windows are blue?
- Paint the wall with math equations! Does it feel different than notebook?
- Add science of soap questions on the bathroom wall. Can you find answers to particular questions?

## Fun & Inspiring Decoration

We perceive lots of information visually, and things that “look fun” attract children.

- Do you have a pillar in your facility? You and the children can wrap the pillar with brown paper to make a huge tree inside your facility! Children could also create bugs and animals to go with it.
- Place inspiring quotes throughout your facility.

## Free Area

Free areas provide uninterrupted play, which can help unfold children's creativity. For smaller children, adult intervention can hinder the expression of their innate creative abilities (Zimmerman & Zimmerman, 2000). Children become little inventors when left alone with materials in a free area. Free areas can also encourage a relaxed mind and provide incubation time to process one’s thoughts in a calm environment.

- Provide children with open-ended materials and no instruction.

# AUTONOMY

## STEAM Increases Autonomy

STEAM activities focus on children's interest, and thus increase their autonomy. Autonomy is the capacity to control oneself and act spontaneously based on one's visions and decision. Jaquith (2011) stated that learners who have educational autonomy and are in control of their own learning solve problems through intrinsic motivation. The moment children feel they want to know more about a specific matter, it is the best time to engage them in the activity and children get the most out of it.

Autonomy often invites children into the flow. Flow is the name of a phenomenon, the feeling of being in one's zone. STEAM enhance autonomy by providing intrinsically motivating activities from various fields, and thus, increase chance of flow. Csikszentmihalyi (1990) explains that flow is a state in which people are so involved in an activity that nothing else seems to matter; the experience is so enjoyable that people will continue to do it for the sake of doing it. Flow occurs due to intrinsic motivation to do things that make us genuinely happy. Being in flow, children learn to feel learning is fun.



What Can We Do?

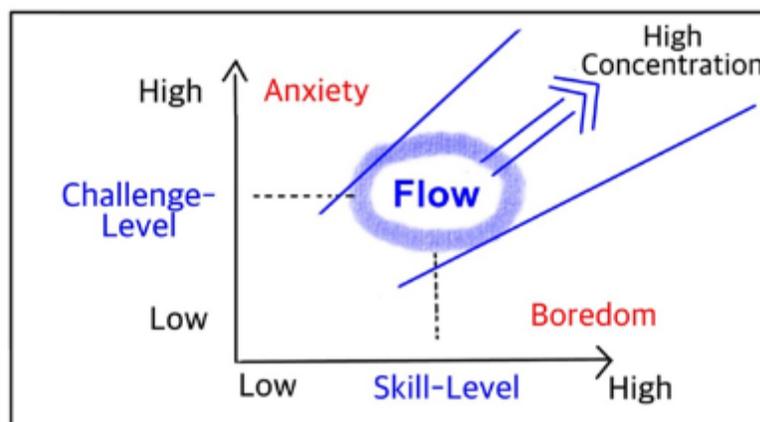
# Know Your Children, Find Their Interests.

While there is no specific way to get into a flow state, Csikszentmihalyi (1990) explained when their skills are challenged in a balanced way, children can end up in a flow state. However, when things are out of balance—for example, activities are too challenging—children may develop anxiety. Similarly, if the challenge is too easy for a child's current skills, they may get bored. Therefore, a good balance of challenge and skill is essential to induce flow. The key is to know the children you will be working with.

- What are the age range of your children?
- What are their interests?
- What skills do they currently have?

Example.

- Second graders are interested in bugs, so we can offer a bug-cage making activity at the facility and take them on a field trip to a national park or on a nature walk to catch bugs. They can then observe, create or draw the details of the bugs and have an exhibition at the facility.
- Or we can plant a plant that attracts butterflies at the facility to attract caterpillars and have the children make observation diaries of metamorphosis process.
- It is important to provide plenty of time for each activity so that when children experience flow, whether it's while they are catching bugs, making bug cages, or drawing, they have enough time to concentrate and enjoy. The point of flow is to enjoy life and come to understand that learning is fun.



(The chart was created based on the concept flow by Csikszentmihalyi, 1990)

④ Digital Logic  
voltage → threshold of feeling  
volts → Maximum  
Basic Circuits  
current - equals flow and is measured in amp  
voltage - is the force and it is labeled as volts  
DIVERGENT

THINKING  
NAND  
A B X  
 $X = \overline{A \cdot B}$   
NOR

## DIVERGENT THINKING



STEAM promotes divergent thinking. Dr. Kenneth, the author of *Creativity and the Brain*, claims that while there are many definitions of creativity, the best approach is to consider creativity to be divergent thinking. "Creativity is finding unity in what appears to be diversity" (Heilman & Miles, 2020, 2:25).

- **Convergent Thinking:** is when there are right answers, we stick to the right answer to solve a problem.
- **Divergent Thinking:** is to think there could be a range of different types of answers to a problem.



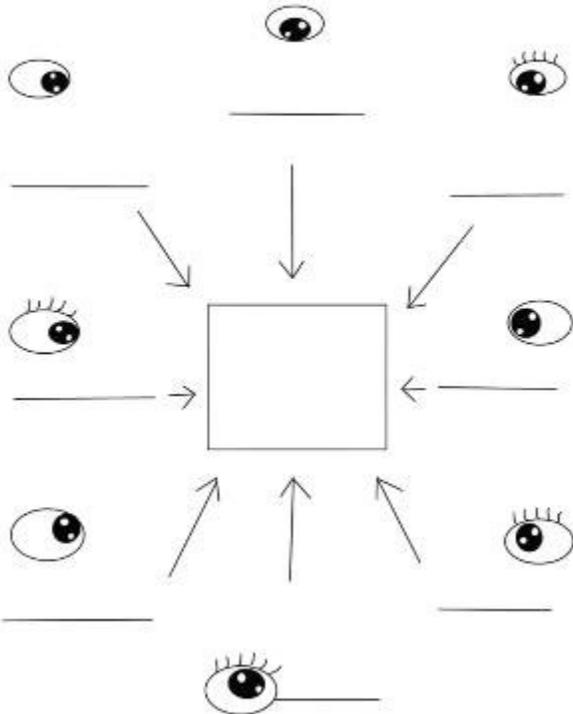
What Can We Do?

# Divergent Thinking Exercise

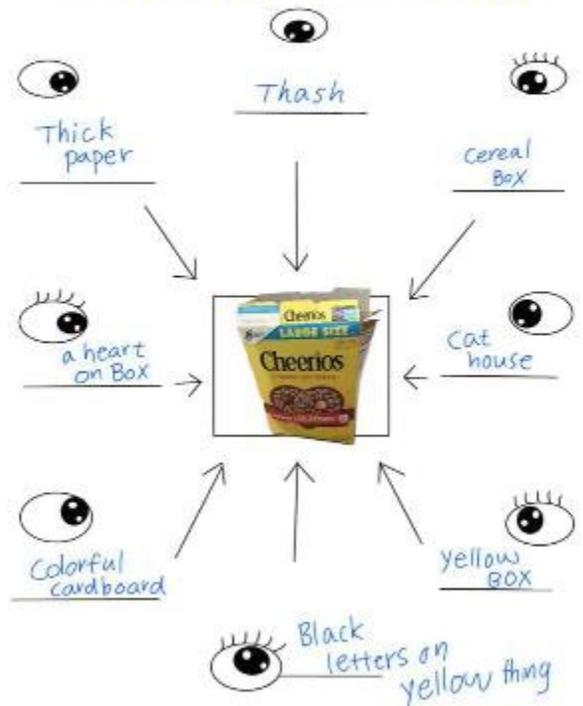
## DIVERGENT THINKING

Children can practice divergent thinking by using this worksheet I created. For example, if we focus on a cereal box, we realize that while we normally call it a cereal box, if we disengage from it, we can consider other ways we might see it.

**I can see this as.....**



**I can see this as.....**



1. Ask students to bring in an item that was going to be thrown away.
2. Divide students into small groups and have them place the “trash” items they brought on the table. Pass out a few “I can see this as” worksheets to each group and have them fill one out for each item at their table.
3. One-by-one, each group will show their items to other groups and share their responses. For example: “Our group saw this item as (1) trash, (2) a cereal box, (3) thick paper, (4) a cartoon on a box, (5) colorful cardboard, and (6) a cat house,” and so on.
4. Discuss with the students by asking questions such as: “What did others think of the item you brought in today that you thought was trash?” “Why did you get different answers?” “What is the purpose of this material, and what else could it be used for?” “What potential does this material have?” “What is trash and what are materials?”

# SYNERGISTIC EXTRINSIC MOTIVATORS

## SYNERGISTIC EXTRINSIC MOTIVATORS



Synergistic extrinsic motivators play a vital role in healthy learning. Synergistic extrinsic motivators are motivators from outside that work together with intrinsic motivations (Jaquith, 2011). Such as:

- Peer encouragement
- Community involvement
- Opportunity for exhibits or presentation

What Can We Do?



# Encouragement and Involvement

You are a synergistic extrinsic motivator for the children you interact with!

- Make sure to be an enthusiastic facilitator.
- Show that you care about the children; let them know that their ideas matter.
- Involve children in activities that are based on their interests.
- Never point out children's mistakes. Making mistakes are an important part of learning. Celebrate mistakes; analyze them to determine what went wrong and what could be changed for next time.

## Opportunity for Exhibitions and Presentation

As a synergistic extrinsic motivator, set a goal for something the children can feel good about accomplishing.

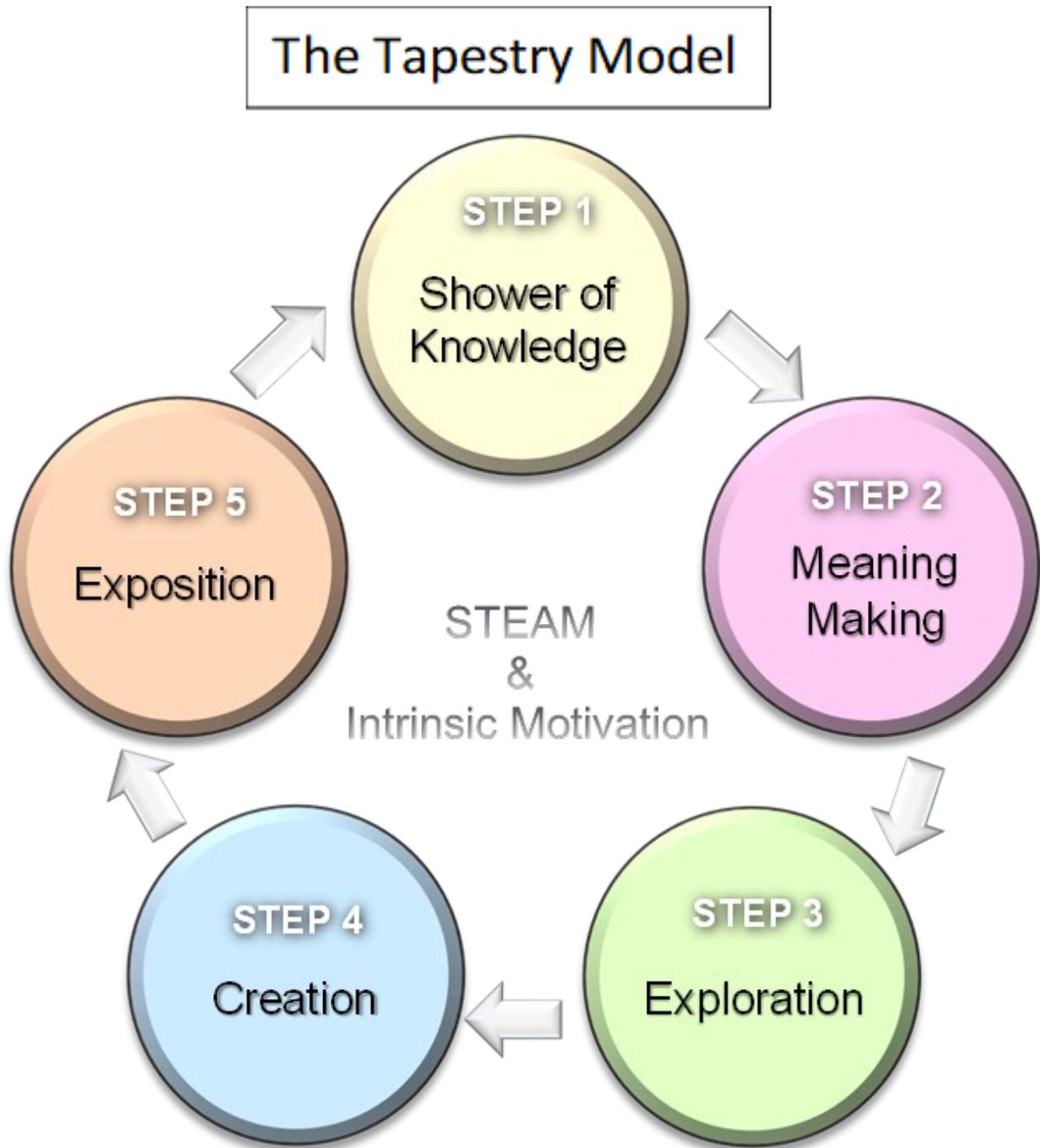
- Plan an exhibit that will allow the children to showcase their creations or creative ideas.
- Provide time for presentations so the children can present what they explored and share their findings with others.
- Open an exhibition to the public. This is a great way to show the community what the children are doing, and some audience members might find good use of the ideas.
- Decorate the facility with children's creations and ideas on regular days.

## Invite and Collaborate with Community and Family

It is great to have a good connection with the local community. Are there any local community groups, schools, libraries, or museums you can collaborate with?

- Connect with local schools to stay informed about what students are learning at school so you can build on that with fun activities!
- Take children on local field trips or bring people to your facility to share their knowledge.
- Encourage involvement from the children's families. Do they have special skills they could share with the children? Or could they volunteer to help out and encourage them? Invite them to a family day or an exhibition..

This is the STEAM education unit called *tapestry* that I suggest using when incorporating STEAM learning in afterschool programs. The tapestry has five steps, and each step plays a specific role. (This unit can be also used in other learning environment.)



It was inspired by the unit used in Tinkering School.

## The Tapestry Model

STEP 1	STEP 2	STEP 3	STEP 4	STEP 5
<b>Shower of Knowledge</b>	<b>Meaning Making</b>	<b>Exploration</b>	<b>Creation</b>	<b>Exposition</b>
<ul style="list-style-type: none"> <li>- Pick a big idea.</li> <li>- Based on the big idea, expose children to broad knowledge, skills, experiences, and stimulation.</li> <li>- Bring in experts from each STEAM area that relates to the topic.</li> <li>- Take trips to relevant sites or institutions.</li> </ul>	<ul style="list-style-type: none"> <li>- What is the problem/question each student wants to solve/answer?</li> <li>- Why do you think this specific topic is important? What's your passion?</li> <li>- Educators act as facilitators to help children find meaning in the topic they picked</li> </ul>	<ul style="list-style-type: none"> <li>- Let children explore their interests more deeply.</li> <li>- Look at the matter from different STEAM perspectives.</li> <li>- Use divergent thinking.</li> </ul>	<ul style="list-style-type: none"> <li>- Learn how to express ideas, hopes, and dreams in a way that will engage someone else and convince them that the idea is worth doing.</li> <li>- Connect knowledge about what children learned.</li> <li>- Use any form of expression: build, create, write, visualize, and more.</li> </ul>	<ul style="list-style-type: none"> <li>- Open the school to the public for exhibition.</li> <li>- Share ideas with the public.</li> <li>- Answer questions from viewers.</li> <li>- Children reflect and examine their own motivation and understanding of the topic.</li> <li>- Record results in a portfolio.</li> </ul>
<ul style="list-style-type: none"> <li>- <b>Preparation</b></li> <li>- <b>Inspiration</b></li> <li>- <b>Motivation</b></li> <li>- <b>Skills and knowledge</b></li> </ul>	<ul style="list-style-type: none"> <li>- <b>Find their own interest and meaning (intrinsic motivation)</b></li> <li>- <b>Become self-directed learners</b></li> </ul>	<ul style="list-style-type: none"> <li>- <b>Divergent thinking</b></li> <li>- <b>Curiosity-driven exploration</b></li> <li>- <b>Learner-centered</b></li> </ul>	<ul style="list-style-type: none"> <li>- <b>Creative expression</b></li> <li>- <b>Invention</b></li> <li>- <b>Language arts skills</b></li> </ul>	<ul style="list-style-type: none"> <li>- <b>Sense of accomplishment</b></li> <li>- <b>Synergistic extrinsic motivators</b></li> <li>- <b>Self-analysis</b></li> </ul>

## Afterschool Program Model

### STEP 1: Shower of Knowledge

In the first step, pick a big idea based on children's interests. Then, based on the chosen theme, shower children with knowledge, skills, and experiences that spark their wonder or inspire them to explore further. For example, we picked plastics in the ocean as a theme. Then, we could invite a marine biologist who studies the effects of microplastics on the marine ecosystem, a technologist or an engineer who deals with composition and decomposition machines, or an artist who uses marine debris in their creations. We may do a beach clean-up and think of ways to reuse plastic trash or visit an institution that recycles plastics. The big idea can be explored through specific themes and subthemes that can be revealed through an artist's expressive perspective.



### STEP 2: Meaning-Making

The second phase is the time for meaning-making. After the shower of knowledge, encourage children to find a subtopic they want to explore deeper and have them explain why they are interested in it. Knowing one's reason and purpose for exploration enhances children's autonomy and supports them in becoming self-directed learners. Furthermore, having a solid purpose is important when children present their ideas to others. People are often attracted to why others do things, or their passion, more than the product of that passion.

Once children find their inspiration and purpose, they can create proposals with the assistance of educators and present the proposals to their peers. If children share the same interests, they could also be permitted to do collaborative work.

## Afterschool Program Model

### STEP 3: Exploration

In the exploration phase, children consider their topics from different perspectives and practice divergent thinking. The divergent thinking worksheet (page 11) can be utilized during this time. Provide a wide-open area at the facility that contains five STEAM sections, each with an educator who has expertise in science, technology, engineering, art, or math. Based on children's proposals, they will explore their topics deeper and build their skills and knowledge to bring their imagined idea to life. The STEAM educators act as facilitators and help children with advice or encouragement to keep going.



### STEP 4: Creation

STEP 4 is creation. Based on the knowledge and skills gathered, children express their ideas, hopes, and dreams so they can share their passion with others. Any form of expression is accepted, including constructing, designing, drawing, movements, or creating sculptures. We also have a creative incubation room in which various materials are freely available for the children's use. In this free room, the children can work on something other than their current projects to refresh their minds, especially if they get stuck in their current work. We emphasize process rather than product, which allows the children the courage to try new things. Even if their proposed projects do not turn out the way students expect, they will have learned approaches or perspectives that did not work, and these will be integrated into their overall knowledge.

## Afterschool Program Model

### STEP 5 : Exposition

The last stage is exposition. During this phase, the students construct exhibits to share their results and outcomes with the public. We use our school building for the exhibition and also install the students' creations outside the beach near the school. The students become curators of the exhibit, from selecting exhibition design, developing materials and advertisements/flyers, planning lighting effects, conducting tours, and overseeing the whole show. During the exhibition, the students represent themselves at their own exhibits; they articulate the purpose and aim of their work and answer questions that visitors may have. It is an excellent opportunity to receive feedback and reflect on themselves. Besides the skills the students gain in organizing this event, it also provides an opportunity for them to share their innovative ideas with the public. This may catch the attention of an organization or individual who aims to save the ocean. The exhibition also serves as a fundraising event to increase our supporters. After a cycle is done, we record it in each student's portfolio, so they have documentation of what they have accomplished from their inspiration.



Picture from Washedashore and 'Trashion' designer Marina DeBris.  
<https://www.washedashore.org/galleries/>

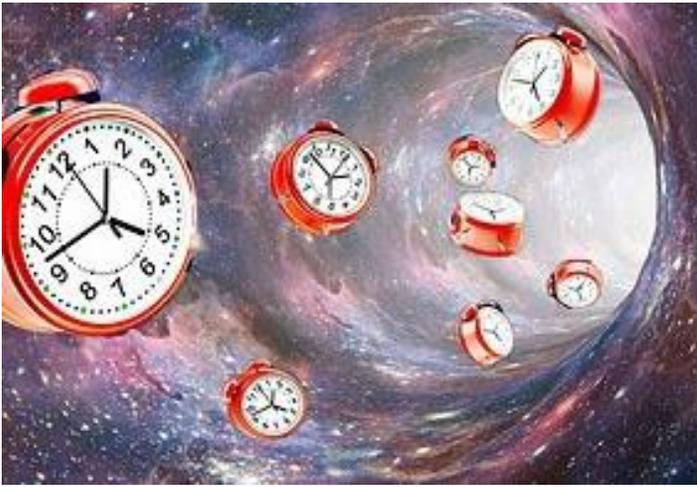
## Afterschool Program Model

# Exhibition Example: Ocean -Trash Fashion Show

The students conduct fashion show for clothes made from ocean-trash materials. The purpose of this show is to: (1) understand what waste does to the environment; (2) find ways to use the materials around them to create something new (even if they would normally be recognized as trash); (3) learn to listen to a client's needs by designing and producing clothes for a particular client (in this case, a classmate), just as if they were working as a designer; (4) enhance the students' abilities through producing the entire show, including creating the clothes and the visual stage setting, choosing the background music, and advertising for the show; and (5) convey messages of kindness to the earth and to encourage the audience to consider the matter as a group throughout the show.



Source: The Guardian. Photograph: Deepak Nath Gupta



# Tips for Lesson Plan

## Big Ideas

Big ideas are the core of students' interests and curiosity. They can be explored through specific themes and sub-themes that can be revealed through an artist's chosen expressive perspective, which is a reflection of their culture and era (Sandell, 2006). One use of big ideas is to define a clear goal before creating lessons. Massey (2017) calls this strategy a backward design as it begins with the intention rather than the activity itself. "The curriculum goes to the heart of the big idea that the classroom community is exploring. It assists teachers in avoiding activity-focused teaching" (p.10).

## Inquiry Based

Inquiry-based teaching and learning asks students to contemplate big questions. While many of these questions may never be answered, through the process of inquiry, our classroom communities become research laboratories—exciting places of wonder and discovery (Massey, 2017). Creative thinking opens the door to a variety of perspectives, and it should be integrated into students' daily lives.

## Invite Experts

You're not an expert in a STEAM subject? That's ok. You can build connections with people who have expertise in specific STEAM areas and invite them to talk to the children. We learn along with our students. Children should be showered in knowledge and inspiration.

## Educators as Facilitators

Instead of giving step-by-step instructions, educators can act as facilitators. Be resourceful when considering how we can encourage children's learning. Children thrive with minimal intervention when they are provided opportunities to pursue their own learning.

## Limit Materials

To promote creativity and divergent thinking, you can ensure that activities include limitations. Limited resources force learners to find more creative solutions (Needles, 2020). The limitation-based approach can also help in real-world situations when only specific resources are available.

# EXAMPLES OF INVENTORS

## DAVE HAKKENS : ONE ARMY

working to find a solution to plastic pollution.



Sources: **DIY Machines Allow You To Recycle At Home**  
<https://www.youtube.com/watch?v=F2E5n5alCtc>

**Dave Hakkens**  
Creator

Dave Hakkens began his career as a designer, developing DIY plastic recycling machines.

He shares the blueprints of his DIY plastic recycling machines as well as offering suggestions for other ways to turn plastic into other creations for use locally or at home.

Precious Plastic <https://www.onearmy.earth/project/precious-plastic>

One Army Homepage <https://www.onearmy.earth/>

# THEO JANSEN



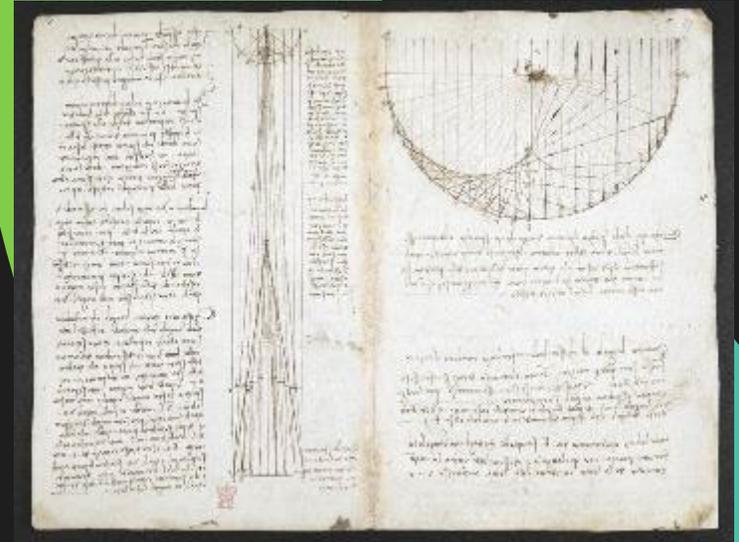
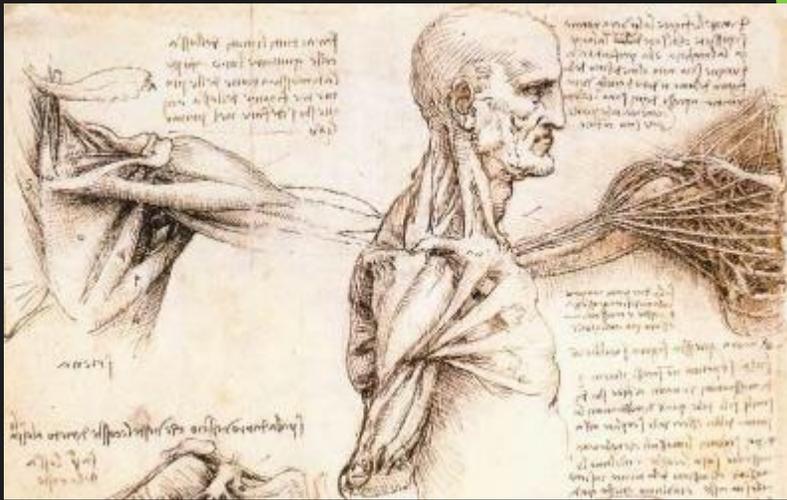
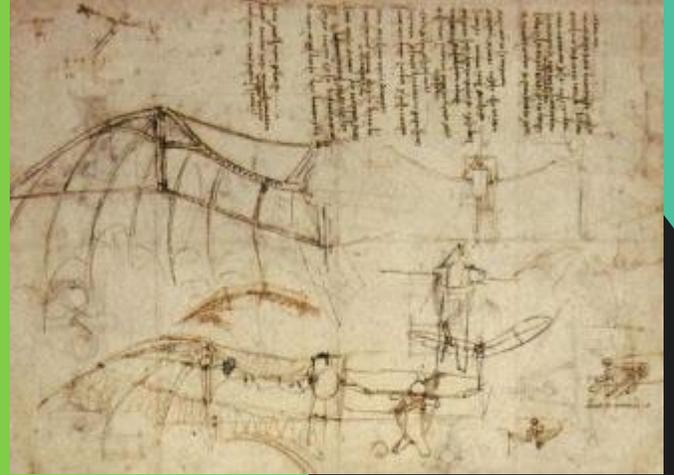
Theo Jansen is a Dutch physicist-turned-artist. He creates kinetic sculptures called "Strandbeests." These works, which are constructed from PVC tubes, plastic bottles, and recycled materials, walk by themselves using the force of the wind. His works are a fusion of art and engineering. Jansen has said that "the walls between art and engineering exist only in our minds."

# ANTHONY HOWE



While Anthony Howe started as a painter, his part time occupation of producing steel shelving for storage resulted in his discovery of a new artistic medium: metal. Further exploration combined with a previous interest in wind and movement led him to invent kinetic wind sculptures.

# LEONARD DA VINCH



The famous painter, Leonardo da Vinci had many faces. He studied in the fields of engineering, chemistry, mathematics, anatomy, botany, astronomy, physics, and more. His best-known works are the Mona Lisa and The Last Supper. His notebooks are filled with inventions that could not be realized in his lifetime (White, 2020).

## “Inspiring Quotes Examples”

“I have not failed. I’ve just found 10,000 ways that won’t work.”

-Thomas Edison-

“Imagination is more important than knowledge.”

-Albert Einstein-

“We build too many walls and not enough bridges.”

-Issac Newton-

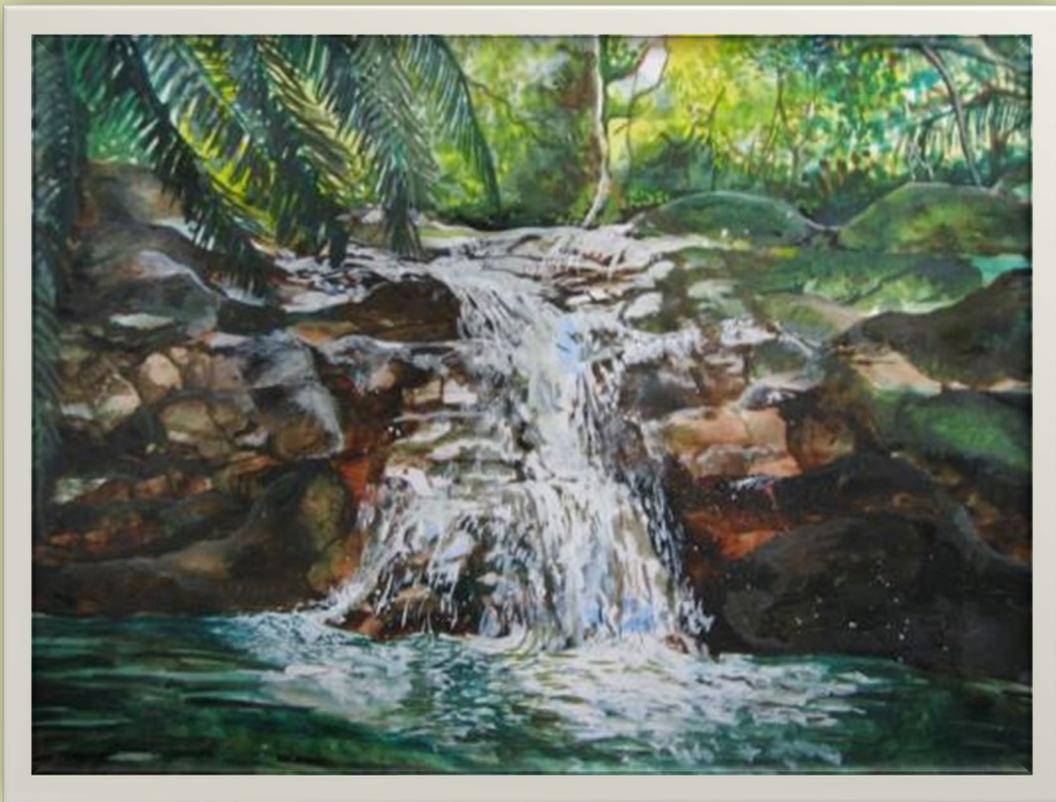
# Author Biography

Yuno Bounds holds a Bachelor of Arts in Liberal and Fine Arts from the Kyoto University of the Arts in Japan. This research was conducted as part of her Master of Arts in Art Education from the University of Florida. The full capstone project can be found at <http://yuzu.site/?p=4529>.

Yuno Bounds is an artist, art educator, and nature lover. Yuno grew up on Okinawa Island, the southernmost prefecture in Japan. Growing up on a subtropical island naturally led her to develop a love for the ocean and nature. She spent most of her childhood with her great-grandfather doing DIY projects that used materials around them. Inspired by nature and DIY and drawing, she became an art lover.

Yuno worked as an education technician in the Children, Youth, and Teen program on American military bases located in Okinawa, Japan, for a total of 8 years. Yuno was fortunate to work with children from a variety of backgrounds. She acknowledges that the experience made her more open-minded and made her realize that accepting diversity and differences is essential to building great relationships with others. While Yuno's job was to contribute to whole-child education, she specifically focused on art-infused projects.

During her master's study, Yuno developed a strong interest in STEAM education. She believes that STEAM education is a great way to support children's intrinsic motivation and learning through life experiences. Now, Yuno seeks to explore ways to foster students' intrinsic motivation through STEAM education and develop effective STEAM curriculums.



Yuno's Gallery and UF studies can be found at <http://yuzu.site/>

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