Developing an Active STEM Learning Environment - I

Professional Development Situation: Face to Face
Skill Focus: Embracing Active STEM Learning
Time Required: 90 minutes

Purpose: Afterschool staff and volunteers will be able to identify skills needed for Active STEM learning and their role in developing an active learning environment.

Time Required:

Pre-session preparation by participants: 15 minutes
Workshop session length: 90 minutes
Post-session follow-up by participants: 15 minutes
Post-session follow-up by trainer: 15 minutes

Objectives:

As a result of this training, frontline staff and volunteers will be able to:

- Recognize an appropriate level of messiness needed for Active STEM Learning and understand this is part of the learning experience.
- Recognize children's curiosities and the importance of being flexible with time or the direction of the exploration.
- Understand the importance of encouraging youth to use their creativity, curiosity, or imagination.
- Understand the importance of engaging learners in authentic inquiry and supporting children in their own explorations and discoveries.

Session Outline:

Welcome—5 minutes
Introduction—20 minutes
Hands-on Learning and Practice—30 minutes
See the Skill in Action—25 minutes
Conclusions—10 minutes

Materials & Supplies:

Trainer Supplies—
- o Computer with Internet connection
- o LCD projector
- o Post-it notes
- o Flip chart paper (if it isn't self-adhesive, tape will be needed)
  - o Fold one sheet into 4 sections for a KWLN chart (see Training Resource E)
- o Markers (to be used with flip chart paper)
- o 3-4 pieces of paper for each participant (for name tent, KWLN chart, notes)
- o Video of Glurch vs Oobleck
- o Training Resources:
  - o Training Resource A: Sample pre and post-workshop emails to participants
  - o Training Resource B: Active STEM Learning Self-Reflection
  - o Training Resource C: Active STEM Learning Goal Setting & Action Plan Handout
  - o Training Resource D: Active STEM Learning Open-ended Questions Handout
  - o Training Resource E: Active STEM Learning KWLN Example
  - o Training Resource F: Active STEM Learning Reflective Practice Handout
  - o Training Resource G: Active STEM Background Information and Additional Research Articles for Trainers

Participant Supplies—
- o Active STEM Learning Goal-Setting and Action Plan Handout (Training Resource C)
- o Examples of Open-ended Questions Handout (Training Resource D)
- o Active STEM Learning Self-Reflection (if it wasn't completed ahead of time—Training Resource B)

Before the Session

Step One: Read through this training guide to familiarize yourself with the content; allow time to personalize the activities to best suit your presentation style and review all videos and informational materials (Trainer Resources A-G).

Step Two: Prior to the training, send an email to participants with the Active STEM Learning Self-Reflection attached. Ask participants to fill it out ahead of time and bring it with them to the training (Trainer Resources A and B).

Step Three: Gather all materials needed for the training

- o   Develop a list of possible questions participants might have during the training. Create potential responses to be explored through informal conversation.
- o   Review any key terms or ideas that may be unclear.
- o   Develop a list of personal examples or ideas to further explore each of the key objectives for the session.
- o   Develop a list of open-ended questions to ask during the session to support each of the objectives.

Training Outline

Welcome/Context - 5 minutes

What I Say	What I Do
Welcome. I'm happy to be here with you today. The focus of our session will be on Active STEM Learning. We will be working together to identify skills necessary to promote Active STEM Learning and sharing with one another ways we currently promote Active STEM Learning in our programs.	Greet participants as they arrive. Make sure everyone feels welcomed and comfortable in the learning environment. Determine if there are any accommodations necessary for participants (viewing video; hearing; etc.). Ensure participants are aware of the locations of restrooms facilities, refreshments, etc. As people arrive, confirm whether they completed the Active Learning Self-Reflection (Training Resource B). If they have not, distribute blank copies for them to complete during the opening.

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Introduction Activity - 20 minutes

What I Say	What I Do
Earlier, I emailed you a copy of the Active STEM Learning Self-Reflection. We will be using this later in our session. If you did not complete it prior to coming, please do so now and be ready to use it at the end of the session.

To introduce ourselves we are going to do two things:

1) On the Post-it note, write:
• What Active STEM Learning means to you
• One thing you would like to learn today
• One question you have about Active STEM Learning.

Save the Post-it to use in the next activity and at the end of today's session.

2) Fold a piece of paper into 3 sections to make a " name tent"—please write your name on one side and on the other write about a favorite activity you did with an important adult in your life as a child—what did you do and who did you do it with?

Share your name and favorite childhood activity with others at your table. | Distribute (1) Post-it note to each participant and 3-4 pieces of paper.

Explain directions to participants and demonstrate how to fold the paper to make a name "tent."

Move about the room to listen in to what people are sharing at the tables

As you notice individuals no longer writing, prompt the group to share with each other their childhood activity. *A useful strategy:* Ask participants to raise their hand if they need more time and to hold up the number of fingers to indicate how many minutes (1-5) they might need to finish. This allows individuals to finish, but takes the guessing out of how much longer everyone will need to wait.

Have participants put their tents in front of them so others at their table (and you) can easily see their names.

Allow approximately 5 minutes to share and then ask the groups to share the childhood |

activities with the whole group.

Ask:
Why do you think this memory was special to you?
What was it about the activity you liked so much?
What did the adult do that made this memory special to you?

Thank you all for sharing these important childhood memories. It's important for us to realize how adults in our lives supported our curiosity and learning and how we can do the same for the children in our care each day.

Today we are going to explore more about Active STEM Learning and how as adults in children's lives you can help create memories for them – just like the ones you shared here – and in the process also promote learning!

Using a piece of flip chart paper taped to the wall, list skills for Active STEM Learning that come from the participants' childhood activities.

Look for and emphasize:
Examples of hands-on learning
Adults who supported their ideas
Time allowed to explore
Messiness
Other skills for Active STEM Learning

Emphasize by adding more content information—
Why are hands-on experiences important for children? Hands-on materials allow children to explore with all of their senses and give them opportunities to discover properties of the materials.

How do the materials support their investigation and learning? Matching appropriate materials to what the child is trying to understand helps them understand the material and why the material is important to the concept being learned. For example: using a real kite to explore properties of wind.

Hands-On Learning and Skill Practice—30 minutes

What I Say	What I Do
We are now going to create a KWLN chart <u>(See Training Resource E)</u> that may help you think about Active STEM Learning and the skills adults use to promote active learning with children. This activity is commonly used to help organize children's ideas around topics to explore in the classroom. Using what you put on the Post-it note about What Active STEM Learning means to you, fill in something you KNOW about Active STEM learning under the "K" on each of your individual KWLN charts and then share with everyone at your table. Use the following questions to guide the discussion about Active STEM Learning (K): • What types of materials are used for Active STEM Learning? • What considerations should be made in regard to time and space? • What do children's expressions and questions tell the adult about whether or not they are interested in the materials? • How might adults support children's inquiry and/or creativity, imagination and curiosity?	Ask each participant to create a KWLN chart on a piece of paper. This will be used throughout the remainder of the training session. Move about the room to discover what participants identify as Active STEM Learning, listening to their conversations. Brainstorm ideas with smaller groups if they are having difficulty with the prompt. As the groups finish discussing the "K" on their charts, record some of the responses on the Whole Group Flip Chart Paper (taped on a wall to be easily seen by all participants). After several responses have been recorded, move to the "W" for individuals and then the group, repeating

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Now that you've had time to discuss the "K" column at your table, we'll make a Whole Group KWLN chart to share different perspectives about Active STEM Learning. We'll also use this to develop questions and to create individual goals at the end of the session.

Following the same process used to develop the "K" column, we'll begin the "W" – or WHAT – column individually. Think of at least one question you have regarding Active STEM Learning, something you wonder about Active STEM Learning, or something you want to learn about Active STEM Learning.

Maybe this was a question you put on the Post-it note at the beginning or another question you've thought of as we listed what we "Know" about Active STEM Learning.

(To further prompt—if needed)
Also, consider the following:

- *What is the purpose of Active STEM Learning for children? For adults?*
- *What does the classroom "need" for Active STEM Learning to take place?*
- *What does Active STEM Learning look like?*
- *What might the adult need to know/do for Active STEM learning to take place?*

the process for the Whole Group.

**Pace yourself with each of the steps in the process based on individual writing and the discussions going on at the tables. Use the same strategy described earlier to have participants indicate how much time they need to complete a step.

After the "K" and "W" have been recorded for the Whole Group, review the Oobleck vs. Glurch video as a whole group. (See Trainer Resource E).

Link:
http://www.click2sciencepd.org/active-engagement-youth

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See the Skill in Action - 15 minutes

What I Say	What I Do
Considering what you have put in the K and W columns as individuals and at your table, we will now view a short video of Active Stem Learning in action. We can always view the video more than one time, but if at any point in the video you would like me to pause it or have questions, please let me know.

The video will show an adult with several children experimenting with Oobleck and Glurch. The focus of the experiment is to explore the scientific concept of colloids through a hands-on experience. Imagine that the adult and children have already filled in the K and W columns on their KWLN charts prior to the experience we are about to see. They would have probably added some predictions in their "W" column to test as | Ensure that each participant has a blank piece of paper to take notes on. Distribute more paper, if needed.

Link: http://www.click2sciencepd.org/active-engagement-youth |

they experiment with real materials. Please take notes on things that you notice— • What surprised you? • What did you like or dislike? • What did the adult do? • What are the children are saying and doing? • What does the classroom look like? • What materials are used? Now that we've seen Active STEM Learning in action, please write one thing under the "L" of your individual chart to note what you LEARNED. Share this with your table and then we will share as a Whole Group.	*Watch for signs of questions or interest by the group.* *Pause the video, if needed.* *Repeat the video, if requested.* Record responses for the "L" column from the tables to the Whole Group KWLN Chart.

Closure: 10 minutes

What I Say	What I Do
To conclude our time together today, we will review the Active STEM Learning skills we have discussed and help you identify the next step you'll take in developing an Action Plan around a goal you have for yourself. This would be the "N" – for NEXT STEP – on the KWLN chart. In a classroom setting, we would gather the students together and review all parts of the chart and then decide what to put in the "N" column. For our purposes, please take out your Active	Distribute Active Learning Goal Setting and Action Plan (Trainer Resource C) to each participant. Move about the group to help those who might be having difficulty developing goals. Review the Active Learning Self-Reflection to help identify 1, 2, or 3s on the reflection.

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Learning Self-Reflection. All the statements on the Self-Reflection relate to skills needed for Active STEM Learning. Review your reflection. For any items on which you circled a 1, 2, or 3, consider developing 1-3 goals and write them on the Active Learning Goal Setting Action Plan. Focus on this throughout the next few weeks.	If time permits, share these goals at the table and as a whole group.
Thank you for your time today. Before you leave, please write on the back of the Post-it note you started with: • Yes or No if the question you listed at the beginning of the session was answered through our work together. • One goal you made for yourself around Active STEM Learning Look for an email in a few weeks with a reminder of your goal!	Collect the Post-it notes from participants.

After the Session:

Step One: Review the Post-it notes from participants for questions that weren't answered and goals participants listed. Compile a question/answer list to be attached to a follow-up email to participants.

Step Two: Within 2-3 weeks of the training, use the post-email sample (Trainer Resource A) to send an email to all participants. Attach the question/answer list from Step One as well as the Active Learning Reflective Practice Handout (Trainer Resource F).

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Training Resource A

Active STEM Learning Pre and Post-session Sample Emails

Pre-session Email **to Participants (Sample)**
- **Send 10-14 days prior to the session**

The next professional development opportunity to enhance our STEM skills will be on DATE at TIME at LOCATION. Our focus for this session will be "Embracing Active STEM Learning."

Please complete the following to prepare for the session:

- Fill out the Active STEM Learning Self-Reflection attached to this email. This sheet will take 5-10 minutes to complete.
- Bring it with you to the training session.

I am happy to answer any questions you have and look forward to seeing you at the workshop. I can be reached at CONTACT INFO.

Post-session Email **to Participants (Sample)**
- **Send 10-14 days after the session**

Thank you for your participation in the recent "Embracing Active STEM Learning" session. I hope you found some value in the information explored and have implemented 1 or more of the goals you developed in the session. I am including a Reflective Practice Handout to be used as part of your goal implementation. Please find the attached:
- Question/Answer from participants
- Active STEM Learning Reflective Practice Handout

I look forward to continuing our learning at the next session on SKILL/FOCUS on DATE at TIME at LOCATION. Please don't hesitate to ask if you have any questions. I can be reached at CONTACT INFO.

Training Resource B

Embracing Active Learning
Self-Reflection

Consider each of the statements below. Circle the number that best describes yourself.
There are no right or wrong/good or bad responses.

1= almost never true 2=usually not true 3=sometimes true 4=usually true 5=almost always true

1	2	3	4	5	I am comfortable with an appropriate level of messiness
1	2	3	4	5	I am flexible with time (do not pressure children to hurry or follow my timeline)
1	2	3	4	5	I know how to recognize children's expressions of curiosity and how to support them
1	2	3	4	5	I know how to recognize the ways children make sense of things
1	2	3	4	5	I believe messiness is part of learning
1	2	3	4	5	I think children should be able to explore materials and directions of learning based on phenomena they encounter
1	2	3	4	5	I believe adults and children together should determine the direction of the exploration
1	2	3	4	5	I think children should have a lot of different resources to explore ideas
1	2	3	4	5	I think adults should cover specific content so children will learn
1	2	3	4	5	I think children should be free to explore without pressure to cover particular content
1	2	3	4	5	I believe staff should be ready to support children in their own explorations and discoveries
1	2	3	4	5	I believe staff and volunteers should predict the next steps youth may take in order to be prepared
1	2	3	4	5	I believe staff and volunteers should be willing to adapt to children's curiosities and interests
1	2	3	4	5	I provide lots of opportunities for learners to engage in authentic inquiry
1	2	3	4	5	I encourage learning as productive and signal this value to learners
1	2	3	4	5	I encourage youth in using their creativity, curiosity, or imagination
1	2	3	4	5	I provide sufficient time and an appropriate environment for thorough learning

Training Resource C

Active Learning
Goal Setting and Action Plan

Review the Active Learning Self-Reflection. For items you scored 1-3, consider focusing on them for future growth.

Identify 1-3 areas you want to focus on for future growth around Active Learning:

1. _____

    What's one thing you will do this week? _____

    _____

2._____

    What's one thing you will do this week? _____

    _____

3. _____

    What's one thing you will do this week? _____

Training Resource D - Write Notes Here

Training Resource E

Active Learning
KWLN Example

A KWL chart is often used to organize topics to be explored by teachers and children. Use the following example as a way to guide the conversation with participants about the parts and their importance in promoting Active STEM Learning. The "N" is an additional column to indicate "Next steps"—could be used for goal-planning for participants or next steps for an Active STEM experience with children.

Use the following example to have individual participants create an individual KW (on a blank regular piece of paper) and then group (3-4 participants) KW charts (the L and N will be filled out after the "Skill in Action." Following the individual/group work, then create a whole group KW chart with a piece of flip chart paper with all groups providing input from their group work. Complete the Group chart (adding L and N) after the "Skill in Action."

K	W	L	N
K=What do we "know" about the topic—what are our ideas about it? Pre-conceived ideas (can include misconceptions). For training purposes: Ask participants to share what they know about "Active Learning" Look for concepts: Hands-on exploration Children's inquiry/questions On-going	**W**=What questions do we have about the topic? What do we want to learn about the topic? For training purposes: Ask participants to share what they want to know more about regarding Active Learning Look for: Ways to find out what children want to know; how to support	**L**=What did we learn? (To be completed after an experience/project.) For training purposes: Use after the "Skill in Action" to discuss new understandings participants have about what skills are needed for Active STEM Learning. Emphasize sometimes our "learning" is a re-affirmation of what we do well. Look for: Time it took Messiness Materials	**N**=Next Steps What would you do next to continue the exploration of the topic? For training purposes: Use the "Goal Setting and Action Plan"— participants should focus on their own Self-Reflection (completed prior to the session) and develop 1-3 goals they want to focus on with

investigations—predictions, ways to explore misconceptions Time, space, materials, messiness	them; what the adult needs to be able to do, etc.	Children's expressions; curiosity Adult's role	Active Learning. Share with the whole group to fill in this column on the Group KWLN chart.

Trainer can offer suggestions based on the Active Learning "skills" if participants are having difficulty developing a focus area. |

Active STEM Learning
Reflective Practice

Identify someone to share your goals with (supervisor, co-worker, friend, etc.)

Share:

1. What goal did you focus on?

2. What did you do?

3. How you did it?

4. If you focused on an active learning experience with children, consider the following questions:

    a. What went well?

        1. Do you have ideas why it went well, if so, what are they?

    b. What you would consider changing (materials, time, space, questions, etc.)?

    c. How do you feel this experience helped you (or not) promote active learning?

    d. What did you discover about the children from this experience?

Training Resource G

Background Information for Trainers

For further reading:

Project-based/Activity-Based Approaches (inquiry):

O. Hazzan et al. (2011). *Guide to Teaching Computer Science: An Activity-Based Approach*, London: Springer-Verlag.

Jones, R. (2007). Project-based learning and early learning standards: making the connection. *Exchange*, March/April, pp. 8-12.

Pearce, C.R. (1999). *Nurturing inquiry: Real science for the elementary classroom*. Portsmouth, NH: Heinemann.

The importance of Questions:

Church, E. (2001). Building Language Through Asking Questions. *Early Childhood Today*, *15*(6), 50.

Danko-McGhee, K. & Slutsky, R. (2007). Floating Experiences: Empowering early childhood educators to encourage critical thinking in young children through the visual arts. *Art Education*, March, pp. 13-16.

Forman, G. (1989). Helping children ask good questions. *The Wonder of it: Exploring how the World Works*, Redmond, Washington: Exchange Press, pp. 21-24.

Following children's interests (child led vs. adult led; interactions):

Freeman, C. & Schiller, N.A. (2013). Case studies and the flipped classroom. *Journal of College Science* Teaching, 42(5), pp. 62-66.

Branch, J. J. (2012). *Scaffolding: A close examination of "support" in the inquiry process*, *The Constructivist, 21*(1), 1-26. (online journal: https://sites.google.com/site/assocforconstructteaching/)

Rushton, S. (2011). Neuroscience, early childhood education and play: we are doing it right! *Early Childhood Education Journal*, 39, pp. 89-94.

Classroom Set up:

Stuber, G.M. (2007). Centering your classroom: Setting the stage for engaged learners. *Young Children*, July, pp. 58-59.

Websites (credit to John D. Arango from *Technology and Children*, September 2009).

www.childrensengineering.com

www.engineeringk12.org

http://www.discovere.org/our-activities

www.explorelearning.com