Level 2: Discovering Skills

Reflecting and Processing STEM

Professional Development Situation: Face to Face (level 2)
Skill Focus: Discovering skills for reflecting and processing Time Required: 120 minutes

Purpose:

Frontline staff and volunteers will deepen understanding and personal meaning for youth by facilitating opportunities for reflecting on and processing of STEM learning experiences.

Time Required:

Pre-session preparation by participants: 15
minutes Workshop session length: 120 minutes
Post-session follow-up by participants: 15 minutes
Post-session follow-up by trainer: 30 minutes

Objectives:

As a result of ongoing, consistent professional development efforts, frontline staff and volunteers will be able to:

- Facilitate STEM activities that develop understanding of STEM concepts and develop science and engineering process skills.
- Develop strategies and questions that encourage youth to reflect on what they have learned and develop a personal understanding of STEM concepts.
- Guide discussions that help youth make sense of what is happening during STEM activities and understand the science and engineering process skills being developed.

Session Outline:

Welcome—5 minutes
Introduction—20 minutes
See the Skill in Action—20 minutes
Hands-on Learning and Practice—60 minutes
Conclusions—15 minutes

Materials & Supplies:

Trainer Supplies—

- Computer with Internet connection
- LCD Projector
- Flip Chart Paper (if it doesn't have self-adhesive, tape will be needed)
- Markers (to be used with Flip Chart Paper)
- 3-4 pieces of paper for each participant (for name tent, notes)
- Newspapers (Paper Structures Activity)
- Masking Tape (Paper Structures Activity)
- Photos of Famous Structures (Eiffel Tower, St. Louis Arch, etc.) (Paper Structures Activity)
- Objects of different weight—books, paper, etc. (Paper Structures Activity)

- Training Resources:
  - Training Resource A: Sample pre and post-workshop emails to participants
  - Training Resource B: Reflecting and Processing STEM Self-Reflection
  - Training Resource C: Reflecting and Processing STEM Checklist for Understanding
  - Training Resource D: Reflecting and Processing STEM Goal Setting & Action Plan Handout
  - Training Resource E: Paper Structures Activity
  - Training Resource F: Reflecting and Processing STEM Reflective Process
  - Training Resource G: Reflecting and Processing STEM Reflective Process During an Experience
  - Training Resource H: Reflecting and Processing STEM Background Information and Additional Research Articles for Trainers

Participant Supplies—

- Reflecting and Processing STEM Self-Reflection (Training Resource B) OR Checklist for Understanding (Training Resource C) ***if participants have already done a level 1 training or completed a Self-Reflection as part of a meeting or coaching session, use the Checklist for Understanding to review/refresh all of the elements and give a better understanding of how this skill related to the learner***
- Reflecting and Processing STEM Goal Setting and Action Plan Handout (Training Resource C)
- Reflecting and Processing STEM Paper Structures Activity (Training Resource E)
- Reflecting and Processing STEM Reflective Process (Training Resource F)
- Reflecting and Processing STEM Reflective Process During an Experience (Training Resource G)

Before the Session

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

Step Two: Prior to the training, send an email with the Reflecting and Processing STEM 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

- Develop a list of possible questions participants might have during the training. Create potential responses to be explored through informal conversation.
- Review any key terms or ideas that may be unclear.
- Develop a list of personal examples or ideas to further explore each of the key objectives for the session.
- 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 Reflecting and Processing STEM experiences. We will be working together to apply strategies and "skills" to support reflecting and processing STEM experiences. Can we all do a lot of reflecting together today? Let's discover strategies we each can use in our current setting to reflect on STEM experiences. Please let me know if at any time you have questions. The more we can share questions and thoughts about what we are learning today, the more we will all gain from today's training.	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 they completed the Reflecting and Processing STEM Self-Reflection (Training Resource B). If they have not, distribute blank copies for them to complete during the opening. OR, if they have completed the Self-Reflection as part of another training/coaching/meeting, distribute a Checklist for Understanding (Training Resource C) to have them review the elements to help better understand how this skill relates to the learner.

Introduction Activity - 20 minutes

What I Say	What I Do
Before you came today, I emailed you a copy of the Self-Reflection for Reflecting and Processing STEM experiences. We will be using this later in our session. If you did not complete it prior to coming, please do it now to be ready to use it at the end of the session. If you have already completed Level 1 Training or other coaching/meeting with the Self-Reflection, please review the Checklist for Understanding.	
	Distribute 3-4 pieces of paper to each participant (for creating a 'name tent' and taking notes).
	Explain directions to participants and demonstrate how to fold the paper to make a name "tent." Ask participants put their "tent" in front of them so others at their table (and you) can easily see their name.
To introduce ourselves we are going to do two things: 1) Fold piece of paper into 3 sections to make a " name tent". Write your name on one side 2) On the other side, answer the following questions: a) What is reflection? b) Do you reflect in your setting (alone; with other colleagues; with children)? c) If you do reflect, what is one strategy you use to reflect? If you do not reflect, why?	Attach a piece of Chart paper to a wall (with tape) that can easily been seen by all participants. Make categories on the Chart Paper: • What is reflection? • Strategies used to Reflect • Reasons not to Reflect
After you have completed your tent and answered the questions, introduce yourself to your 'elbow partner' (person sitting next to you) and share with them your responses to the questions about reflection.	As you notice individuals no longer writing, prompt participants to share what they wrote about reflection and strategies they currently use with someone sitting near them. Move about the room to listen in to what people are sharing at the tables – only listening!

It sounds like many of you have good ideas about what reflection is and how to incorporate strategies for reflecting in your settings. It also sounds like there are some of you having difficulty in incorporating reflection in your settings.	Allow approximately 5 minutes and then ask the groups to share their responses to the reflection question. Write their responses in the appropriate categories on the Chart Paper.
I'd like to use the Chart Paper to record the great ideas you've shared. During the workshop today, we'll use the Chart Paper to organize ourselves; to take note of how people are reflecting and keep track of the problems people may be facing trying to reflect in their setting. Throughout the training today, we'll pause and review the chart to see if any of the experiences we have can help us identify solutions to issues or create ideas for new ways to incorporate reflection into our settings.	Use this time to identify participants' ideas about what reflection is; how to use reflection in their settings; and barriers to reflection. Remain focused on having individuals share without becoming too focused on why they cannot reflect (time, spaces, materials, don't know how, etc.). *There may be one or more participants who will struggle to stay positive about the process (they see many barriers in their setting). Assure them today is about exploring strategies to try to reduce their frustration. Take the time to visit with them to schedule a time to meet and discuss any other issues.*
Purposes of Reflecting and Processing An important aspect of reflecting and processing includes **listening** and understanding **other people's viewpoints**. Often times, we have a better picture or **deeper understanding** of a situation when we hear what other people saw and how they interpreted the information. Next, we will view a video of the Skill in Action to better understand what Reflecting and Processing looks like with youth. Later, we will do an activity to practice using the Reflective Process during an STEM learning experience. At any time in the workshop today, please ask questions as they come up.	Review the responses of the group and proceed with the information about the purpose of the activity and the reflective process, which is the focus of the training.

See the Skill in Action - 20 minutes

What I Say	What I Do
We've set the state by talking about reflection, its purposes, how some of us are using it why others aren't. Now we'll see what it looks like with actual children in a real setting *during an activity*.	
In the video you will see staff in a Making and Tinkering Space leading youth through an engineering design challenge. One strategy the staff use is called 'Plussing' where youth give constructive feedback to each other. Watch for this strategy	Ensure that each participant has a blank piece of paper to take notes on. Distribute more paper, if needed.
As you watch the video take note of: • How the space and supplies are organized • How the staff support 'Plussing' and keep it positive • Watch for other strategies for reflecting and processing Watch for strategies or ideas in the video that you can use.	View Group Collaboration Skill Video - Link: http://click2sciencepd.org/learning-modules/design-a-grape-smasher Watch for signs of questions or interest by the group. *Pause the video, if needed.* *Repeat the video, if requested.*
Share with your 'elbow partner' one thing you saw in the video you could incorporate into your setting. What stood out to you the most in the video? What strategies did you see in the video that you could incorporate into your own setting?	Take notice of people's responses to what they could incorporate into their setting.

Hands-On Learning and Skill Practice—60 minutes

What I Say	What I Do
We are going to practice the skill of Reflecting and Processing STEM with an activity you might do with youth. There are several scientific concepts that could be explored with these materials however, for the purposes of the training, **our goal is to focus on how to reflect and process information during the experience.**	
Please divide yourselves into groups of 3 or 4. In your group, select one person to be the facilitator. Everyone else gets to be learners today. We'll be thinking about **what the facilitator can do** during the activity and **what learners can do** to enable them **to reflect and process information** about materials and experiences.	Divide participants into groups of 3 or 4. (More than 4 will make it more difficult to have each participant share their perspectives about the experiment.) Distribute materials to each group for the Paper Structures Activity (Training Resource E); 1 piece of Chart Paper and a marker; 1 copy of the Reflective Process During an Experience (Training Resource G); and 1 copy of the Reflective Process (Training Resource F). Emphasize the **bolded words** as important pieces to Reflecting and Processing STEM experiences.
We are going to use newspapers and masking tape to build a table. We will test the 'strength' of the table using various objects (books, water bottles, whatever is available). Let's see what this activity looks like. Are you ready to begin?	View STEM Stuctures Paper Table Activity From Design Squad Overview Video: http://click2sciencepd.org/learning-modules/creating-opportunities-for-youth-to-reflect

Facilitators, take a moment to review the handouts – focus on the handouts on the reflective process while the rest of your team gathers the supplies you will need.

(As groups bring supplies back to their tables.)

You will start by brainstorming some questions about the materials and ideas about how to build your table.

Then we will spend about 10 minutes **exploring materials**. When I give the signal, your facilitator will lead you though the Reflective Process using their handout to **guide the discussion**.

Then you will have 10 minutes to Re-design and test you table before we pause for more reflection. Facilitators, be sure to refer back to your group's Chart Paper to see if any question, theories/ideas were correct or not. You may add new questions, theories/ideas to the chart paper as you go.

A you work, I will be moving about, so please ask questions as they arise.

Give these prompts at the appropriate time through the activity.

1) Start by brainstorming. What will you're your structure the 'strongest.'
2) By now, your groups should be getting started explore you materials and starting

Have supplies ready for participants to collect for their group.

Photos of famous structures (Eiffel Tower etc.) can be examined to gain inspiration for building the table.

Once the facilitators have reviewed the handouts and has an understanding of the Test-Reflect-Re-Test process and some questions or strategies to use, you will introduce the structure of the activity to the whole group.

1) Groups brainstorm ideas, questions, theories, plan for building tables and record them on their chart paper. (5 minutes) Start time: _____
2) Explore materials (10 minutes). Start time: _____
3) Reflection and discussion (5 minutes) Start time: _____
4) Redesign and test tables (10 minutes). Start time: _____
5) Reflection and discussion (5 minutes) Start time: _____
6) Wrap up

The facilitator should use the Chart Paper to record their groups' ideas before beginning to explore or build.

The trainer should move about the groups to see how they are exploring with materials and

to design your table. 3) Take a few minutes to reflect and process how things are going so far. 4) It is time to begin redesigning and testing your tables. 5) Take a few minutes to reflect and process how things are going so far. 6) Let's wrap this up and think about how the process went. I'm going to give you a couple of minutes to reflect on your own about how things went. Get out a blank piece of paper and think about the process. Was it helpful for your group? In what ways? If it wasn't helpful, what made it challenging? What would you change to make it more helpful?	*answer any questions from participants.* Be sure the facilitators are referring to their Chart paper as their group reflects to help 'answer' some questions and create new ones. Ask for a few participants to share their ideas. Add to their discussion about writing by sharing ideas (journaling, chart paper, making a simple book after an experience, photos, video, etc.).

Closure - 15 minutes

What I Say	What I Do
The steps we took during this process: question, predict, explore/test materials, make observations, questions, reflect, re-test, debrief, etc. are all part of the scientific process. The more we practice and incorporate these steps into our routines with	

youth, the more natural these scientific processes will become Share with an elbow partner: • One idea you are taking away about how to incorporate more reflecting and processing into the experience when you are working with you. To conclude our time together today, we will do two things. We'll review our Chart from the beginning of the session and look over the self-assessment. *Refer back to the chart.* • Did we answer the questions from today's session? • Ideas/strategies shared you could use in your own setting? • New questions you have about Reflecting and Processing STEM? Now get our your self-assessment. Look it over and thinka bout whether there are any changes you'd like to make. Focus on the items where you selected a 1, 2 or 3. Select one or two of these items to focus on in the next few weeks. Use these items to create your action plan. As you finish share with your elbow partner one of your goals and how you plan to take action towards that goal.	Distribute the Reflecting and Processing STEM Goal Setting and Action Plan (Trainer Resource D) to each participant. *This an excellent tool that can help staff focus on specific, measurable goals while highlighting factors, such as time, space, etc., to ensure successful completion and attainment of those goals. Encourage everyone to take time to fill in their action plan before they leave the workshop. Move about to help those who might be having difficulty developing goals. Review the Reflecting and Processing Self-Reflection (Trainer Resource B) to help identify 1, 2, or 3 goals on the reflection. For those using the Checklist for Understanding (Trainer Resource C) help those who are having difficulty identify 1 or 2 items to focus on. If time permits, have participants share one of their goals with someone sitting next to them.
As you get back to work, consider ways you could reflect alone or with a co-worker. The	

same processes and strategies we've used today could also be used to guide your own reflection. Consider doing a follow-up coaching session or meeting focused on Reflecting and Processing STEM learning. I appreciate the time you spent sharing your ideas, reflecting and working to improve your practice. I hope you are leaving today with some strategies to incorporate into your work to encourage reflection and processing of STEM experiences. If not, please take some time to talk with me after today's session.	Collect the Chart Paper from each group.

After the Session:

Step One: **Collect Chart paper and compile strategies participants reported using to reflect in their settings. Save this list in a .pdf file to send to participants in an email.**

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 to the email the list of strategies used to Reflect and Process STEM (from the training) as a resource of ideas for participants.**

Training Resource A

Reflecting and Processing STEM Pre and Post-session Sample Emails

***Pre-session Email* to Participants (Sample)**

- **Send 10-14 days prior to the session**
- **Attach the Self-Reflection (Training Resource B) and the Checklist for Understanding (Training Resource C)**

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 "Reflecting and Processing STEM."

Please complete the following to prepare for the session:

- Fill out the Reflecting and Processing STEM Self-Reflection attached to this email. This sheet will take 5-10 minutes to complete. If you have already completed a Self-Reflection from a prior training, please use the Checklist for Understanding (also attached) to review the elements of Reflecting and Processing STEM. Identify 1 or 2 items on the Checklist you would like to focus on.
- Bring the Self-Reflection (or Checklist for Understanding) 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**
- **Attach the compiled list of reflection strategies from the training and the Goal Setting and Action Plan (Training Resource C).**

Thank you for your participation in the recent "Reflecting and Processing STEM" 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 list of strategies participants from the training identified as things they use or could use to Reflect and Process STEM learning in their settings. I hope it can be used as a resource to consider different ways to incorporate Reflection in your setting. I am also including a Goal Setting Handout to be used as part of your

goal implementation. Consider meeting with a co-worker, supervisor, or friend to share the goals you are working on. Please find the attached:

- Reflecting and Processing STEM Goal Setting and Action Plan
- List of strategies for Reflecting and Processing STEM

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.

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Training Resource B

Reflecting and Processing STEM Self-Reflection

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

1= not at all true 3=somewhat true 5= very true

1	2	3	4	5	I reflect on science and its processes
1	2	3	4	5	I help children reflect on science and its processes to continue the work of a project or idea
1	2	3	4	5	I help children make meaning of their experiences to give them personal significance
1	2	3	4	5	I help children gain purpose and deeper understandings about what they are doing by adding complexity to the experience
1	2	3	4	5	I ask guiding questions to help children make sense of and process what is happening during explorations
1	2	3	4	5	I encourage children to reflect on what they have learned at the end of each activity
1	2	3	4	5	I ask questions of myself; other colleagues; children (about our experiences together)
1	2	3	4	5	I offer meeting groups with children to encourage them to think forward
1	2	3	4	5	I provide time for individual as well as group reflection
1	2	3	4	5	I ask questions beyond the activity they did (helping to make connections to other experiences)
1	2	3	4	5	I offer ideas to children about how to write about their STEM learning experiences
1	2	3	4	5	I help children build upon knowledge in meaningful and relatable ways
1	2	3	4	5	I guide students through group reflection and or advisory panels.

Training Resource C

Reflecting and Processing STEM Checklist for Understanding

Each statement below reflects skills or components of Reflecting and Processing STEM Learning. Review the list to ensure your understanding.

- ☐ Reflecting on science and its processes
- ☐ Helping children reflect on science and its processes to continue the work of a project or idea
- ☐ Helping children make meaning of their experiences to give them personal significance
- ☐ Helping children gain purpose and deeper understandings about what they are doing by adding complexity to the experience
- ☐ Asking guiding questions to help children make sense of and process what is happening during explorations
- ☐ Encouraging children to reflect on what they have learned at the end of each activity
- ☐ Asking questions of myself; other colleagues; children (about our experiences together)
- ☐ Offering meeting groups with children to encourage them to think forward
- ☐ Providing time for individual as well as group reflection
- ☐ Asking questions beyond the activity they did (helping to make connections to other experiences)
- ☐ Offering ideas to children about how to write about their STEM learning experiences
- ☐ Helping children build upon knowledge in meaningful and relatable ways
- ☐ Guiding students through group reflection and or advisory panels

Training Resource D

Reflecting and Processing STEM Goal Setting & Action Plan Handout

Reflecting and Processing STEM Learning requires:

Time—for children to reflect alone, with partners, in whole groups, with adults; to process what they have learned and develop deeper understandings; to make connections with relatable content; for adults to reflect alone and with other adults

Space—enough space to collaborate with others

Materials—to organize thoughts; to discover next steps in project work; to write about experiences

Questions—open-ended questions and statements that require children to consider other options and to 'push' thinking to a next level

Think of ways you can offer Time, Space, Materials, and Questions to help children Reflect and Process STEM in your setting.
Develop 1-2 goals to focus on within the areas of Reflecting and Processing STEM.

Time:

1. I want to focus on_____
   I will _____

Space:

1. I want to focus on_____
   I will _____

Materials:

1. I want to focus on_____
   I offer_____to write about STEM experiences.

Questions:

2 questions/statements I will use:

1. _____

2. _____

Training Resource E

Reflecting and Processing STEM Paper Structures Activity

Materials:
Newspapers (enough for building with)
Masking Tape
Photos of famous structures (Eiffel Tower; St. Louis Gateway Arch, etc.)
Objects (books, paper, etc.) to test strength of the structure

1) Group children in pairs or groups of 4.
2) Provide a set of materials to each group.
3) Ask children to examine the photos and use the newspaper to build a 'structure' or table
4) Use the objects (or find others in the setting) to test the strength of the structure/table
5) Have children reflect and discuss throughout the process using The Reflective Process

What is important about the following?

- Balance
- Symmetry
- Wide base
- Height
- Materials used to build

How do these things help support the strength of the structure?

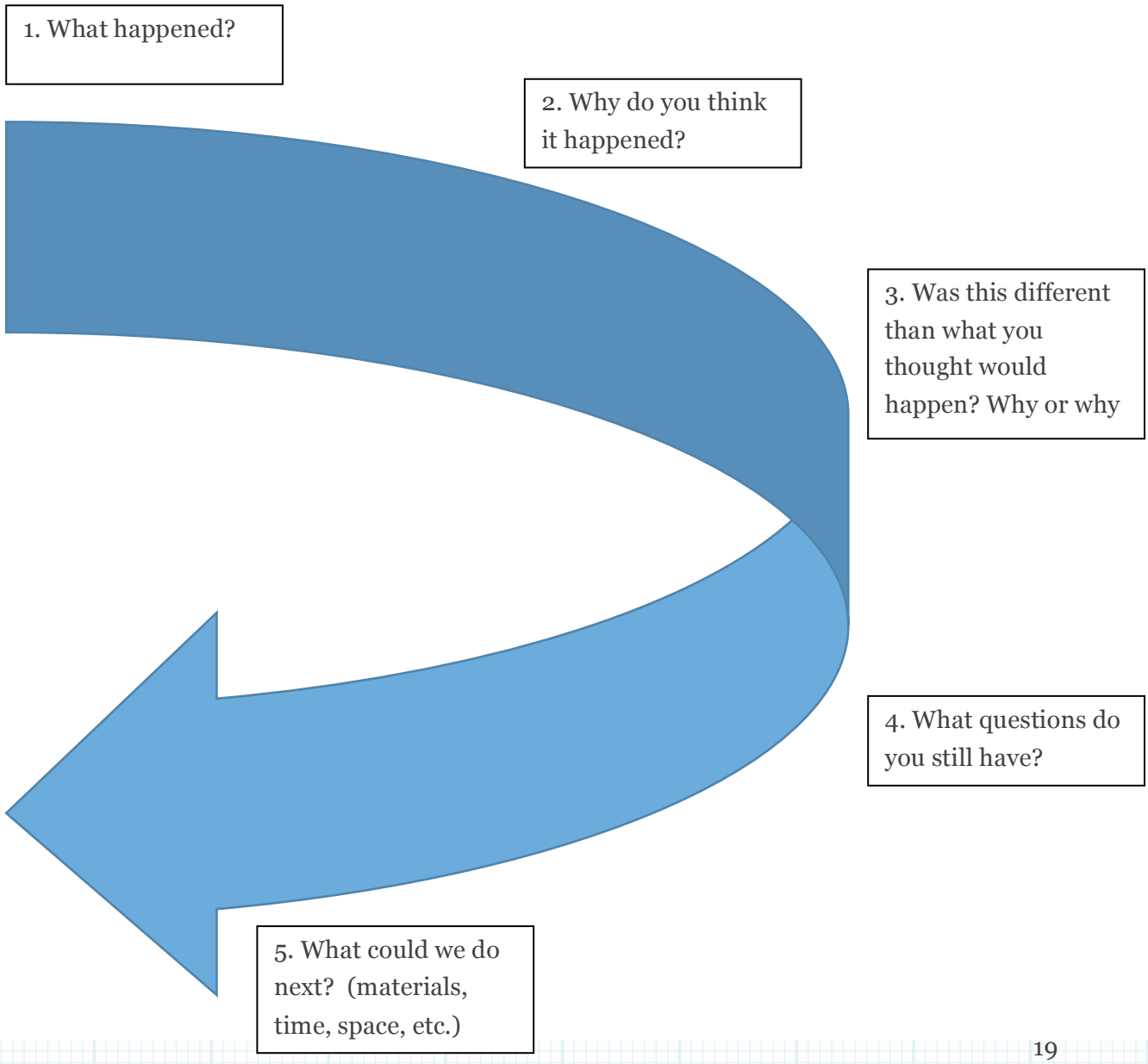
For more ideas about structures to use in your setting or with parents, try the following website:

http://peepandthebigwideworld.com/media/pdf/peep-event-structures.pdf

Training Resource F

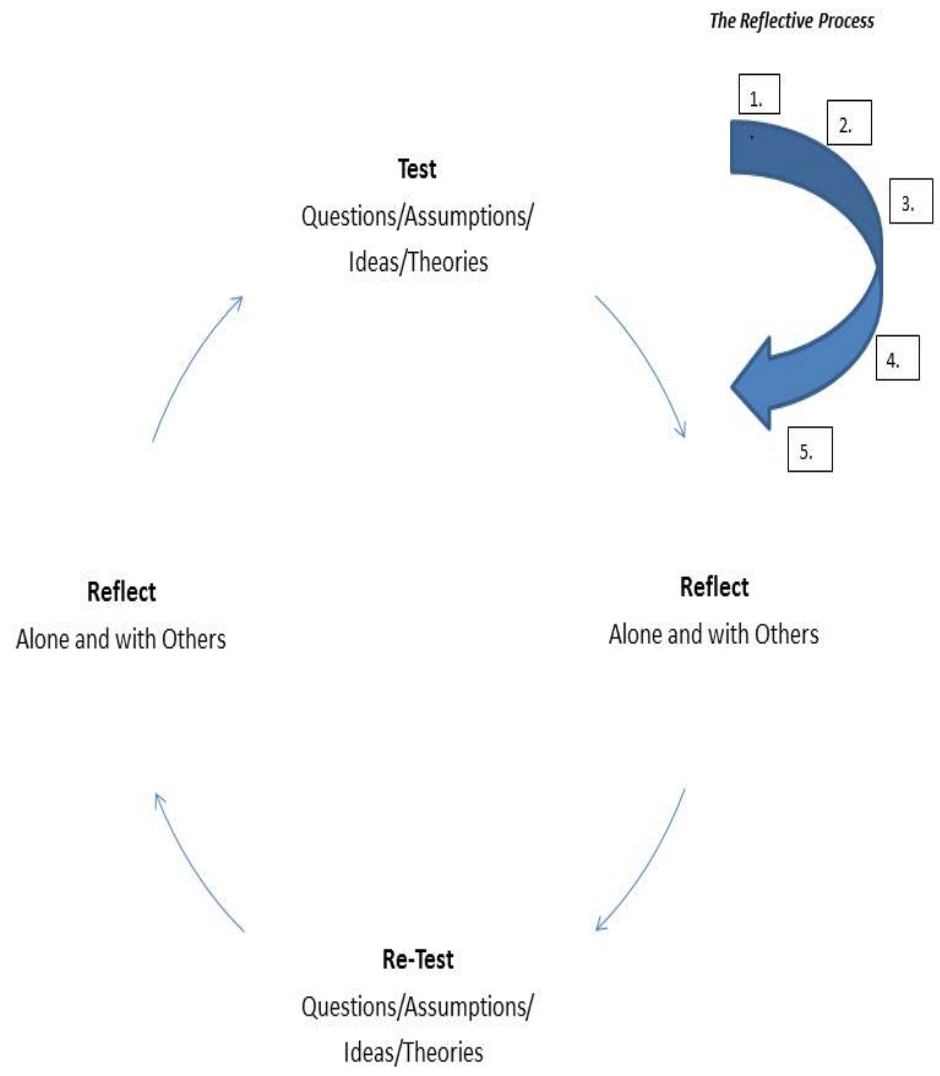
Reflecting and Processing STEM Reflective Process

When facilitating the Reflective Process (with children or adults), the following sequence is suggested as a way to create an expectation of participation and sharing among individuals. Each person should be asked to answer each question before the next question is asked of the group. This systematic approach allows the reflection and processing to 'build' on each person's experience and interpretation. As the group becomes more accustomed to sharing ideas, the structure can become more 'loose,' but initially, a similar process shown here should provide structure to the reflective process.



Training Resource G

Reflecting and Processing STEM Reflective Process During an Experience



Training Resource H

Reflecting and Processing STEM Background Information for Trainers

For further reading:

The importance of Reflection:

Bell, P. (2010). Scientific arguments as learning artifacts: designing for learning from the web with KIE. *International Journal of Science Education*, *22* (8), pp. 797-817.

Driver, R., Asoko, H., Leach, J., Scott, P., Mortimore, E. (1994). Constructing scientific knowledge in the classroom. *Educational Researcher*, *23* (7), pp. 5-12.

http://journal.naeyc.org/btj/vp/pdf/Voices_Abramson_Co-Inquiry.pdf

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.

Websites:

Asking questions:

http://teachingmahollitz.wordpress.com/2011/05/16/teaching-kids-how-to-ask-good-questions/

http://bd058.k12.sd.us/pagelinks/reflecting_with_children.htm

http://www.scilearn.com/blog/6-steps-to-help-students-ask-better-questions.php

http://www.ascd.org/publications/educational-leadership/nov99/vol57/num03/Helping-Students-Ask-the-Right-Questions.aspx

Experiments and Explanations:

http://kids.niehs.nih.gov/

- (Illusions) http://kids.niehs.nih.gov/games/illusions/illusion_06.htm