Discovering Skills

Reflecting and Processing STEM Experiences

Professional Development Situation: Face to Face (level 1)
Skill Focus: Reflecting and Processing STEM Experiences
Time Required: 90 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: 90 minutes
Post-session follow-up by participants: 15 minutes
Post-session follow-up by trainer: 15 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
Hands-on Learning and Practice—30 minutes
See the Skill in Action—20 minutes
Conclusions—15 minutes

Materials & Supplies:

Trainer Supplies—

- Computer with Internet connection
- LCD Projector
- Post-It notes (1 per participant)
- Flip Chart Paper (if it isn't 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)
- Video of Skill in Action (Paper Structures)
- 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 Goal Setting & Action Plan Handout
    - Training Resource D: Reflecting and Processing STEM Silhouette Activity
    - Training Resource E: Reflecting and Processing STEM Optical Illusion Activity
    - Training Resource F: Reflecting and Processing STEM Observation and Reflection Sheet
    - Training Resource G: Reflecting and Processing STEM Learner Journal
    - Training Resource H: Reflecting and Processing STEM Reflective Process
    - Training Resource I: Reflecting and Processing STEM Background Information and Additional Research Articles for Trainers

Participant Supplies—

- Reflecting and Processing STEM Self-Reflection (if it wasn't completed ahead of time—Training Resource B)
- Reflecting and Processing STEM Goal Setting and Action Plan Handout (Training Resource C)
- Reflecting and Processing STEM Optical Illusion Activity (Training Resource E)
- Reflecting and Processing STEM Observation and Reflection Sheet (Training Resource F)
- Reflecting and Processing STEM Learner Journal (Training Resource G)
- Reflecting and Processing STEM Reflective Process (Training Resource H)

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. Review all videos and informational materials (Trainer Resources A-I).

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

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 understand the importance of reflecting and processing STEM experience. We will identify "skills" necessary to reflect alone, with others, and to help learners reflect and process STEM experiences. We will also share with one another strategies we currently use to reflect on STEM experiences in our settings.*	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.

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 so to be ready to use it at the end of the session.
 	
To introduce ourselves we are going to do two things:
1) Fold a piece of paper into 3 sections to make a " name tent"—please write your name on one side and on the other side, look at the image I've displayed (Silhouette Activity Image 1)—describe what you see in the image.
 	
After you have completed your tent and written down what you saw in the image, please place the tent in front of you.
 	
Introduce yourself to your 'elbow partner' (person sitting next to you) and share with them what you saw in the image.
 	
• *Did you both see the same thing?*
  ○ *If so, is there anything else you can find in the image?*
  ○ *If not, what did the other person see?*
	Distribute 3-4 pieces of paper to each participant (for creating a 'name tent' and taking notes).
	
	Attach a piece of chart paper to a wall (with tape) that can easily been seen by all participants.
	
	Explain directions to participants and demonstrate how to fold the paper to make a name "tent." Ask participants to put their "tent" in front of them so you and others at their table can easily see their name.
	
	Display Image 1 from the Silhouette Activity (Training Resource D). Have Image 2 ready to display.
	
	As you notice individuals no longer writing, prompt participants to share what they 'see' in the image with their partner.
	
	Move about the room to listen in to what people are sharing at the tables
	
	Allow approximately 5 minutes to share and then ask the groups to share what they saw in

	the image.
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.	Use a marker to record what people saw on a piece of chart paper. Emphasize the bolded words as reasons and purposes for Reflecting and Processing STEM experiences.
Did you see any variations in the pictures? (Such as faces vs. vase) *Can I see a show of hands to see how many saw the faces? How about the vase?*	After discussion of Image 1 slows, ask for a show of hands of how many saw the picture one way and then the other. Reveal Image 2, which gives the detail of both images together. Ask participants if the level of information they wrote down is more, less, or about the same as the level of information given in the second image. Typically, the amount will be less.
(Reveal the 2nd image which gives more detail) *Did anyone write more or less information than what is shown in this 2nd image?* *What does this activity show us about the importance of reflecting (sharing information) with others?*	On the chart paper, write down people's responses to the question: *What does this activity show us about the importance of reflecting (sharing information) with others?*
(This activity is designed to show that each person's perspective can bring something of value to the discussion.)	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.
Next, we will do an activity. At the end, we will practice reflecting skills alone, with a partner and the whole group to demonstrate how this might be done with the learners. *We will first explore with materials, take notes/sketches, and then do a 'reflective session.' As we do this, think about the amount of time, space and materials (journal, scratch*	

paper, etc.) used. Think about how you could do something similar in your setting. *Later, we will view a video of the Skill in Action to better understand how Reflecting and Processing looks in the classroom setting.* *At any time, please ask questions as we move through the various activities.*	

Hands-On Learning and Skill Practice—30 minutes

What I Say	What I Do
We are now going to practice the skill of Reflecting and Processing STEM by simulating an activity you might do with learners in your setting. *Please divide yourselves into groups of 4. Once you are divided into groups, identify one person to be the 'adult' and the other three to be the children. It is not necessary to role play parts; rather, the purpose is to gain an understanding of* ***what the adult can do*** *during an activity/experience and* ***what children can do*** *to enable them* ***to reflect and process information*** *about materials and experiences.* *The 'facilitator' should use the Observation/Reflection sheet to* ***take notes*** *about what is happening and areas of learning*	Participants take a few minutes to divide into groups of 4 at the most. (More than 4 will make it more difficult for each participant to be engaged) Distribute materials to each group for the Optical Illusion Activity (Training Resource E): 3 copies of the Child's Journal (Training Resource G); one copy of the Observation and Reflection Sheet (Training Resource F); and one copy of the Reflective Process (Training Resource H). Ask participants to identify one person to be the adult for the simulation and the other three to be the children in the simulation. Again, emphasize the bolded words in the *What I Say* column as important pieces in Reflecting and Processing about STEM experiences.

*(STEM) taking place. The learners should use the Learner journal to **take notes and sketches** while exploring the materials.* *The 'learners' should first read through the instructions and make initial predictions to the question: "What do you think will happen when the funnel is filled with sand?" or another question the group finds interesting to explore with the materials provided. The important part is to have the group focused on the same question.* *Once predictions are made, follow the directions on the Optical Illusion Activity. We will spend approximately 10 minutes **exploring materials** and then the 'facilitator' in the group should initiate the Reflective Process using the handout to **guide the discussion**.* *I will be moving about, so please ask questions if they arise.* *The steps we take during this process: question, predict, explore materials, make observations, questions, share information, etc. are all part of the scientific process. The more we practice and incorporate these steps into our routines with learner, the more natural they become to our interactions in our settings.*	Ask participants to read through the instructions and make their initial predictions to the question: What do you think will happen when the funnel is filled with sand? (The question can be changed if group members would like to develop their own question to explore with the materials. The main purpose of having an initial question is to focus the attention of the group to an aspect of the experiment. This will allow the group to share similarities and differences—reflecting and processing what actually happened compared to what they thought would happen.) The 'facilitator' should use the Observation/Reflection sheet to take notes as the 'learner' explores the materials. The 'learner' should use the Learner Journal as they explore with the materials. Allow approximately 10 minutes to explore so the reflection and processing can begin. The bulk of time should be given to the reflection participation. **The trainer should move about the groups to see how they are exploring with materials, looking to see that everyone is participating, and answer any questions from participants.**

	As groups have explored and filled out at least some of the learner journal, ask the 'facilitator' to facilitate a reflective 'session' using the Reflective Process handout with the other 3 'learner members' of the group. Group members should take note of: • Differences in what they noticed • Similarities in what they noticed • Discuss how they could use a similar process (handouts, time, space, etc.) with learners in their setting

See the Skill in Action - 20 minutes

What I Say	What I Do
Now that you have experienced what a reflection 'session' might feel like after an activity/experience, let's see what it looks like with actual learners in a real setting during an activity. For a more in-depth training on how to support the reflective process during an activity, consider completing the level 2 training. *In the video you will see a facilitator facilitating a hands-on experience with learners using newspaper to build a structure and then testing the strength of the structure with various materials. As you watch the*	Begin the video: http://www.click2sciencepd.org/creating-opportunities-youth-reflect; Watch for signs of questions or interest by the group. Pause the video, if needed. Repeat the video, if requested.

video take note of: • *What the facilitator says/does* • *What the learners say/do* • *The space used* • *Could you see something like this happening in your setting?*	
What stood out to you the most? *How did the learners react to the questions?* *How did the facilitator support learners' theories about the structure?* *How did the learners react to being able to test their ideas?* *How did the learners build on one another's ideas?* *When we hear and see our own reactions to STEM learning, we want to offer many opportunities for learners to reflect with one another to process their understandings. It is also good for us, as facilitators, to reflect and process alone and with others in a similar manner.*	After the video, ask the prompter questions to gain a deeper understanding of what was happening in the video. You may record the responses on a piece of Chart paper or just have a conversation as a whole group.

Closure: 15 minutes

What I Say	What I Do
*Now let's use those skills of **reflecting alone, with a partner and the whole group** to demonstrate how this might be done in the classroom with learners. To conclude our time together today, we will do two things: 1) On the Post-it note, please write down 1 strategy you currently use (or think you could) to Reflect and Process STEM experiences in your setting. Share this with your elbow partner. 2) Review your Reflecting and Processing STEM Self-Reflection* *For any items you circled a 1, 2, or 3, consider developing 1-3 SMART (specific, measurable, achievable, relevant, and timely) goals to focus on throughout the next few weeks. Use the Reflecting and Processing STEM Goal Setting and Action Plan to record your goals.* *Consider beginning to journal about your experiences in your setting to give yourself time to reflect alone.* *Consider meeting with a co-worker, supervisor, or friend to review your action plan and progress you have made. If you want or need additional coaching, we can set something up to work on together.* *Are there any questions regarding our time today?* *Thank you for your time today.*	Distribute post-it notes to each participant. Distribute Reflecting and Processing STEM 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 Reflecting and Processing Self-Reflection (Trainer Resource B) to help identify 1, 2, or 3s on the reflection. For further Coaching – If someone is having difficulty developing goals, there are multiple Coaching resources, designed for one-on-one time with staff, available on the Click2Science website in this skill and others. If time permits, share these goals at the table and as a whole group. Collect Post-it notes as participants leave.

After the Session:

Step One: **Collect post-it notes from the training and compile a list of Reflecting and Processing STEM strategies participants wrote down.**

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**

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 Experiences."

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.
- 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 "Reflecting and Processing STEM Experiences" session. I hope you found some value in the information explored and have implemented one 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 add reflecting and processing STEM time 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 "List of strategies for Reflecting and Processing STEM" that you and your colleagues developed during the training. It might be helpful to review the "Reflecting and Processing STEM Goal Setting and Action Plan" distributed during the training. Please let me know if you need additional copies.

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.

Want to Earn Credit?

Frontline Staff can earn credit in a variety of training modules online. Go to:
http://extension.psu.edu/youth/betterkidcare/school-age- practitioners/click2science

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

1	2	3	4	5	I reflect on science and its processes
1	2	3	4	5	I help learner reflect on science and its processes to continue the work of a project or idea
1	2	3	4	5	I help learner make meaning of their experiences to give them personal significance
1	2	3	4	5	I help learner 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 learner make sense of and process what is happening during explorations
1	2	3	4	5	I encourage learner 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; learner (about our experiences together)
1	2	3	4	5	I offer meeting groups with learner 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 learner about how to write about their STEM learning experiences
1	2	3	4	5	I help learner 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 Goal Setting and Action Plan

Reflecting and Processing STEM Learning requires:
Time—for learner to reflect alone, with partners, in whole groups, with facilitators; to process what they have learned and develop deeper understanding; to make connections with relatable content; for facilitators to reflect alone and with other facilitators

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 learner 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 learner Reflect and Process STEM in your setting.

Develop a 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 will offer_____to write about experiences.

Questions:

2 questions/statements I will use:

1. _____

2. _____

Training Resource D

Reflecting and Processing Silhouette Activity

(copy/paste Images 1 and 2 into a PowerPoint to project them)

IMAGE 1

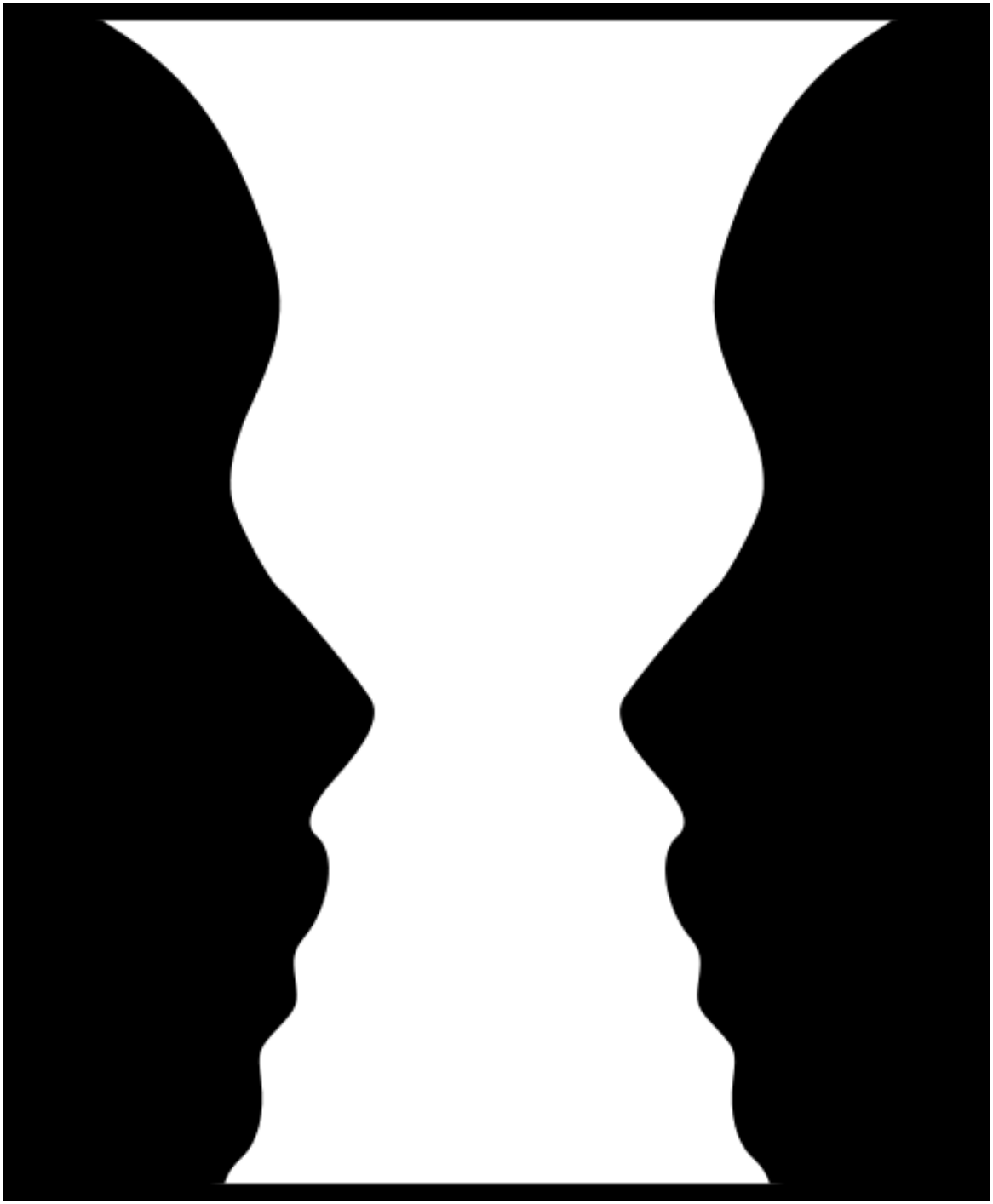
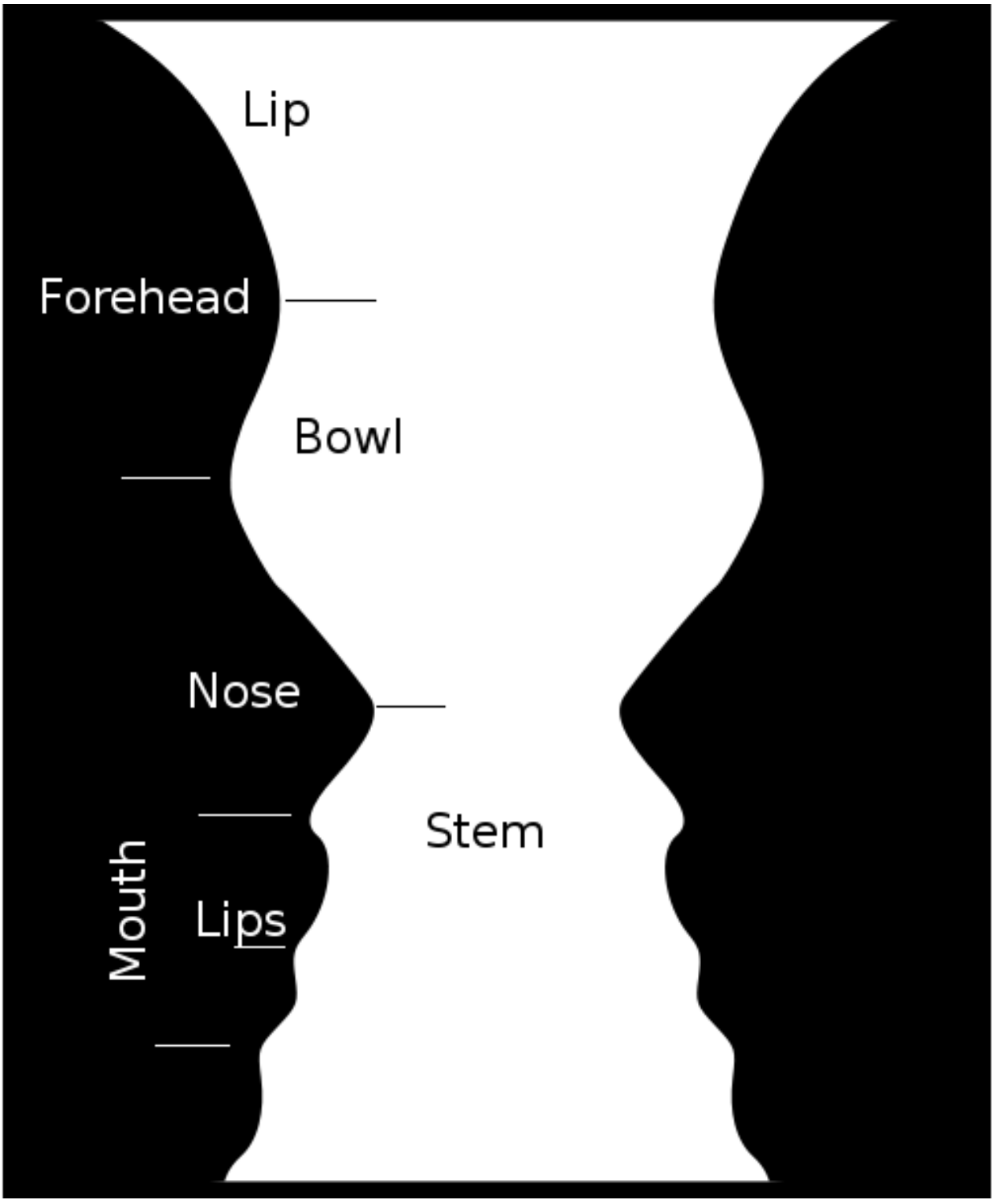


IMAGE 2



Have participants choose a partner (or number them off by 2s in some fashion).

Beginning with Image 1, ask participants to write a description of what they see. Have participants introduce themselves to their partner and share what they saw in the photo.

Ask participants to share with the larger group what they saw. Typically, participants will vary in what they saw in the picture. If they don't, point out variations in the picture (two faces vs. a vase). Ask for a show of hands of how many saw the picture one way and then the other. Reveal the second image, which gives details of both images together. Ask participants if the level of information they wrote down was more, less, or about the same as the level of information given in the second image. Typically, the amount will be less.

Proceed with the following key information about the purpose of the activity and the reflective process, which is the focus of the training.

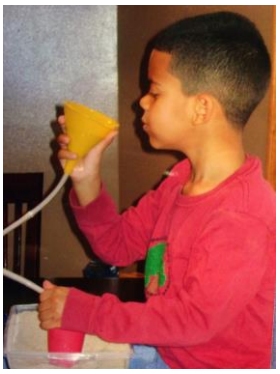
Reflecting

An important aspect of reflecting and processing includes listening and understanding other people's viewpoints. Often, we have a better picture of a situation when we hear what other people saw and how they interpreted the information.

This activity is designed to show that each person's perspective can bring something of value to the discussion.

Training Resource E – For the Facilitator to interact with Learner

Reflecting and Processing STEM Optical Illusion Experiment



Gather the necessary materials:

Small tub
Two Funnels (1) small (1) large
Plastic tubing (at least 12 inches and diameter should fit well with the funnels)
Fine Sand

1) Discuss questions about the materials. Decide on one question to explore. (*Ex. What do you think will happen when you fill the funnel with sand?*)

2) Record predictions using a journal or scratch paper.

3) Fill the tub at least half-full of sand.

4) Connect the tubing to one of the funnels. Fill the funnel with sand. Allow some of the sand to travel down the tube then put the open end of the tube into the sand (see pic). What happens?

5) Experiment and write down different observations and conclusions about the materials and what can be done with them.

   - What happened when the funnel was filled with sand?
   - Was this different than your prediction?
     - Why or why not?
   - Were these things different or the same as others in your group:
     - Prediction
     - Ways you manipulated the materials
     - Ideas about what happened and why
   - What would your group do next? (materials, research, resources, etc.

Training Resource F – For the Facilitator to Reflect on the Activity

Reflecting and Processing STEM Observation and Reflection Sheet

<table>
<tr><th>What happened? (what, how, when, why)</th><th>How does it relate to STEM?</th><th>What is something that could be done next? (time, space, materials—include ways to write about the experience)</th></tr>
<tr><td rowspan="2"></td><td rowspan="2">Science—

Technology—

Engineering—

Math—</td><td></td></tr>
<tr><td>Questions (Facilitator or Learner) to explore</td></tr>
</table>

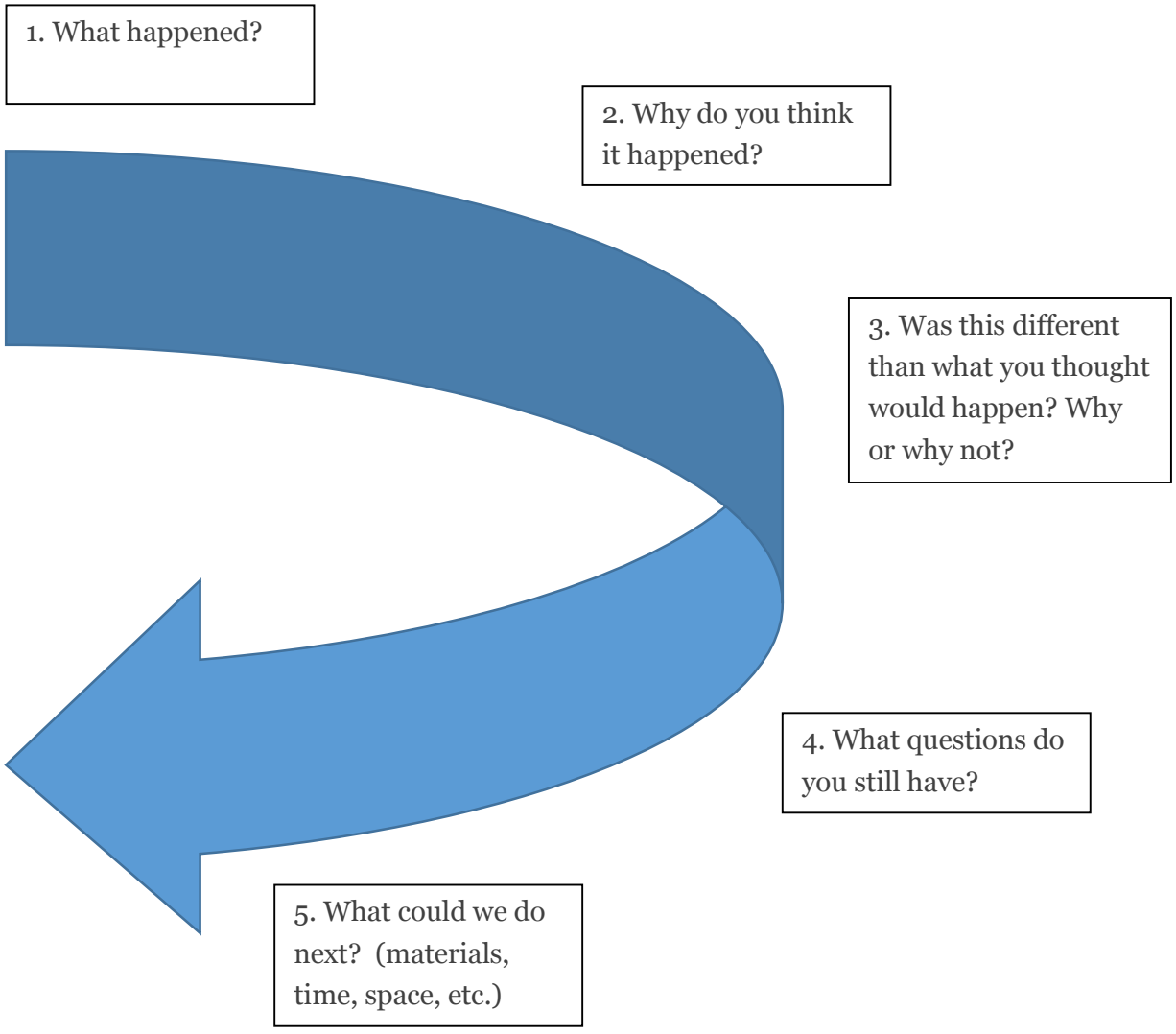
Training Resource G – For the Learner to record observations, notes, etc.

Learner Journal

Training Resource H

Reflecting and Processing STEM
The Reflective Process

When facilitating the Reflective Process (with learners or facilitators), 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 I

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 Learnerhood Today*, *15*(6), 50.

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

Forman, G. (1989). Helping learner 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_learner.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