Session 9: Objects in Teaching

Overview

This session explores the use of objects in learning experiences in informal environments, and encourages educators to think about the role of the objects in conversations and interactions. Participants explore how different types of objects that are commonly found in informal environments can be used to support learning. Educators participate in a challenge to create and implement an activity or program to teach one idea using four types of objects. This challenge provides them with a common experience to think about and compare the talking and doing that may occur with different types of objects.

Background Information for the Presenter

Informal science education institutions are places where objects are displayed for their authenticity, immediacy, interactivity, and cultural capital (Gurian, 1999). They include, but are not limited to, artifacts, specimens, artworks, live organisms, and interactive exhibits. They are what make these places different from other learning environments. These objects are the physical representations of the scientific knowledge – information, history, aesthetic, and significance (Tran & King, 2007). Traditionally, this information has been defined by curators and communicated by labels (Gurian, 1999); though increasingly, visitors are invited and encouraged to make their own interpretations and meaning from the objects (Roberts, 1997). The recognition of the constructivist perspective on learning is attributed to this shift (Rowe, 2001). "One important implication of constructivism is that the meanings people make as a result of the negotiation of different knowledges and ways of knowing cannot be judged according to authoritative standards of what is "correct" or "incorrect" as is often the case in more formal learning settings" (Rowe, 2001, p. 21).

This shift draws attention to how learners connect with the objects and how educators facilitate engagement with the objects. The multiple representations and interpretations of objects provoke affective connections among learners (Macdonald, 2004). Leinhardt and Crowley (2002) suggest that objects offer a degree of information unavailable in a two-dimensional image. They emphasize that it is often the smallness or largeness of an object, or its connection to real events or people, which makes it, and thus the wider learning experience in informal environments, truly memorable. Consequently, educators are challenged to use objects as the primary vehicle for communicating scientific knowledge, while also inviting and encouraging learners to make personal connections and meanings with the objects and the knowledge they represent. To mediate a visitor's experience of an environment, educators need to unravel the complexities inherent in the objects and, at

the same time, help individuals find points of personal connection and relevance. Thus educators must select from a range of interpretations to best suit their understanding of learners' needs. In so doing, they may address the provenance of the object, its social history or scientific significance, or they may simply encourage learners to observe an object and appreciate it for its own sake or aesthetic value.

Types and Characteristics of Objects

In this course, the term "objects" is used broadly to include all the "special things" in informal science education institutions, such as specimens, live organisms, artifacts, artwork, and interactive exhibits. We identify at least five different types of objects:

Natural object (e.g., live and preserved plants and animals)
Representational object (e.g., model, replica)
Virtual/Digital object (e.g., video, simulation, SEM, x-rays, photographs)
Artifactual objects (e.g., Darwin's microscope, rice bowl that survived the atomic bomb in Hiroshima)
Interactive object (e.g., Bernoulli blower, tornado exhibit)

There are at least four features of these objects in informal environments that are starting points of ideas for conversations and elaborations that make them unique from other sources of experiences and information, such as books, televisions, and the Internet (Leinhardt & Crowley, 2002). An object may have more than one of these features.

- **Resolution.** The minute and subtle details of objects, such as bumpy scales of a snake or the stench of the corpse flower when it blooms.
- **Scale.** The smallness and largeness of objects, such as a steam engine from the Industrial Revolution the size of a room or the femur bone of a dinosaur that stands the height of the room.
- **Authenticity.** The realness of objects, such as the first underwater glider to traverse across the Atlantic Ocean autonomously, or a first edition of *On the Origins of Species*.
- **Value.** The uniqueness of objects, such as the only live white shark in captivity or a rock from the moon.

Conversing about Objects

Different types of objects promote different types of talk from learners (Ash, 2003; Eberbach & Crowley, 2005; Hohenstein & Tran, 2007). For example, Eberbach and Crowley (2005) compared how families explained pollination in their conversations at three different types of objects—natural, representational, and virtual. Explanations, in particular, are viewed as a higher-level thinking process (Keil, 2006); they result from human activities, and serve to generate knowledge and increase our understanding of phenomena (Wilson & Keil, 1998). Explanations are the core of theories, and so explanations can be viewed as a useful tool to assess learners' current theories (Crowley, et al., 2002). Explanations that arise in everyday conversation present excellent opportunities for children

to articulate and revise their theories of scientific phenomena, with guidance from parents and other adults (Crowley, et al., 2002, p. 714). Eberbach and Crowley (2005) found that learners made more process explanations when exploring representational and virtual objects than with natural objects. Process explanations were accounts of what was happening and how it was happening, such as bees landing on flowers to drink nectar (what) and bees using their proboscis to drink the nectar (how). Children made more connections to school when exploring representational objects; and learners made more connections to everyday experiences when exploring natural objects than virtual objects.

Hohenstein and Tran (2007) explored learners' conversations at three artifactual objects that differed in their *resolution*, more specifically, the physical complexity and self-explanatory nature. They found the *resolution* of the objects might influence the types and quantities of questions and explanations learners made. Physical complexity is the intricate details of the object, and self-explanatory is the extent to which learners can explain the idea or concept the object represents simply by observing or moving the object itself. Hohenstein and Tran noted that visitors engaged in more explanations and asked more questions about objects that had greater physical complexity, and were more self-explanatory in nature. For instance, at one object, the intricate details and movable machinery prompted visitors to explain the mechanism, as they observed the machine move right in front of them. In comparison at another object, visitors were asked to reflect on the historical, social, and scientific significance of the object, though it possessed little context or detail of the event. In this case, explanations and questions from the visitors did not often occur.

Finally, Ash (2003) examined how families talked about life science topics at a variety of objects—natural, interactive, and virtual/digital—in an exhibition about frogs. She reported that families used biological themes, such as the life cycle of frogs and coloration for protection, as conversational points. The families used features of the objects, for instance the resolution of detail from a frog skeleton compared to a human skeleton and authenticity of live swimming frogs and tadpoles, to make process explanations about change from tadpole to adult frog and functional reasoning about the use of tadpole's tail and frog's legs. She found that children talked about the essence of animals (e.g., that they reproduce themselves and that they have life cycles); and adults used personification and mapped human characteristics to other species.

Across the various conversations around the objects examined in these studies, what learners and educators talked about could be organized into three categories (Hohenstein & Tran, 2007):

- **Identification.** Calling out or naming objects, or parts of objects.
- **Description.** Elaborating upon elements or details of the object.
- **Explanation**. Reasoning causal relations, processes, scientific principles, and analogies.

Engaging with Objects

Hands-on activities in science education are highly valued for promoting learning, though they have been highly criticized also. Additionally, "hands-on" exploration does not require learners to manipulate the materials physically, as long as they are actively engaged in the learning experience (Klahr, Triona, & Siler, 2008; Klahr, Triona, & Williams, 2007; Zacharia & Constantinou, 2008).

First, advocates for hands-on science argue that it promotes learning because (Flick, 1993): it is consistent with the concrete-to-abstract nature of cognitive development; it provides additional sources of brain activation via kinesthetic involvement; and its intrinsic interest increases motivation and engagement. Critics of hands-on activities argue that they make learning less efficient and effective by (Hodson, 1996): producing confusing and inconsistent feedback; allowing learners to engage in off-task activities that produce irrelevant information; and providing inadequate mappings between the behavior of physical materials and their abstract representation in formal diagrams and equations. Second, whether virtual or physical materials were used had no effect on children's ability to learn from their own hands-on attempts to discover the causal factors in the distance traveled by mousetrap cars that they designed (Klahr, et al., 2007). Using another example, physical and virtual manipulatives can provide equally interactive experiences that enhance students' understanding of concepts related to temperature and changes in temperature (Zacharia & Constantinou, 2008).

The informal science education field is a proponent of hands-on activities for science learning, thus the more important discussion for us focuses on how we encourage learners to engage in hands-on activities and how we facilitate those experiences.

While it is well recognized that the only effective way to learn to do science is by doing science, it is also important for educators to understand that it is most effective for learners to do science alongside someone who is skilled and experienced, and thus can provide on-the-task support, critique, and advice, and is able to model the processes involved and invite criticism from the learner (Hodson, 1996). There is significant evidence to suggest that pure self-discovery learning does not support science learning (Mayer, 2004). When students learn science in classrooms with pure discovery methods and minimal feedback, they often become lost and frustrated, and their confusion can lead to misunderstandings (Brown & Campione, 1994). In informal environments, at exhibits that demonstrate counterintuitive phenomena, visitors are often left to ponder, "why did that outcome occur," which may be too challenging for most visitors to answer through self-experimentation at the exhibit. As a result, they either leave the exhibit or turn to an explanatory label for the answer (Gutwill, 2008). In a comparison study between direct instruction and discovery learning, researchers found that many more children learned from direct instruction than from discovery learning, and also when asked to make broader, richer scientific judgments, the many children who

learned about experimental design from direct instruction performed as well as those few children who discovered the method on their own (Klahr & Nigam, 2004). Thus, while learners need enough freedom to become cognitively active in the process of sense making, learners also need enough guidance so that their cognitive activity results in the construction of useful knowledge (Mayer, 2004).

From his review of 40 years of research literature on discovery learning and constructivist teaching, Mayer concluded that while "activity may help promote meaningful learning, instead of behavioral activity per se (e.g., hands-on activity, discussion, and free exploration), the kind of activity that really promotes meaningful learning is cognitive activity (e.g., selecting, organizing, and integrating knowledge)" (Mayer, 2004, p. 17). He argued that rather than depending solely on learning by doing or learning by discussion, the most genuine approach to constructivist learning is learning by thinking. Thus instructional methods that rely on doing or discussing should be judged not on how much doing or discussing is involved, but rather on the degree to which they promote thinking and making connections. Guidance, structure, and focused goals should not be ignored.

When we consider how learners engage with the objects, we examine the ways in which they participate in, become involved with, and connect with the objects, and also what the educator does to guide, structure, and focus this engagement. We found that learners in informal environments may actively engage with objects in several ways (Tran, Werner-Avidon, & Randol, 2008), and that educators may facilitate this engagement using a variety of methods. We describe them here.

Engagement

- **Sense.** Sensory experiences of objects singularly, such as look, smell, touch, taste, and listen.
- **Compare.** Sensory experiences across multiple objects.
- **Experiment.** Manipulate, control, or handle objects to test ideas and assumptions.
- **Discuss.** Talk with others (peers or educators) about what happens, what they see, what they do.

Facilitation

- **Model.** Educator engages with the object(s) to demonstrate for learner(s) how to engage
- **Social.** Educator encourages learners to engage with objects with other learners
- **Prompt.** Educator invites and suggests ways for learner(s) to engage with objects

Session Objectives

— Discuss role and use of objects in learning and teaching

— Discuss features of objects in learning conversations
— Reflect on how and why educators use objects in their interactions

Session Activities at a Glance

Quick Write. 10 minutes

Objects refer to the special things in informal institutions—artifacts, exhibits, specimens, etc.

1. How and why do you use objects when you teach?
2. What do you talk with learners about while focusing on or using these objects?

Engaging with Cephalopod Objects Activity. 60 minutes

This activity encourages participants to think about the various types of objects in informal environments, and how they can be used in different ways to promote learning. The types of objects are explored in an activity where groups of participants design a program using specific objects. Groups "teach" a small part of the program they design, and the audience (remaining participants) considers the different ways in which they may talk about the science concepts with the different types of objects.

— How are the objects being used?
— What are the participants doing with the objects?
— What worked and didn't work for each of the objects?
— What are the conversations like?

Research Discussion. 25 minutes

Participants consider the types of objects and different types of conversations that the objects promote, as described in the literature, and begin to consider how these relate to their teaching practice. In groups of four, each person is responsible for quickly reading and taking turns presenting to their group the information from one research card on the topic of conversing about objects. They include their own reactions to the information and questions they have about it, leading a discussion on the topic within their group.

Science Presentation on Cephalopods. 25 minutes

Science content about cephalopods is introduced through discussions, demonstrations and PowerPoint presentations to provide background information for the participants and to demonstrate how objects can be used in an interactive content presentation.

Note: *If you're interested in using this or other science content presentations, please see the Science Content Index on the website.*

Work with Partner. 30 minutes

Students work with their partners to determine how they use objects in their activity to promote learners to talk about the scientific ideas.

Housekeeping. 15 minutes

Online discussion

Monterey Bay Aquarium

- carpooling

Presentations

- @ LHS once during March 27 – April 11
- @ farmers market once, April 6, 8, 27 or 29
- Get ready to present activity at Cal Day, April 17.

Homework. 5 minutes

(Note – this homework is assigned as part of the UC Berkeley course; other institutions may decide to use these assignments or develop different assignments.)

Reading

— Eberbach, C., & Crowley, K. (2005). From living to virtual: Learning from museum objects. Curator, 48(3), 317–338.

— Falk, J.H. & Dierking, D.L. (2000). Chapter 6. Communities of learners. In *Learning from Museums: Visitor experiences and the making of meaning* (pp. 91–112). Walnut Creek, CA: AltaMira Press. Online discussion.

Time Frame

Total Workshop: 2 hours, 50 minutes

Quick Write (10 minutes)
Engaging with Cephalopod Objects Activity (60 minutes)
Research Discussion (25 minutes)
Science Presentation on Cephalopods (25 minutes)
Work with Partner (30 minutes)
Housekeeping (15 minutes)
Homework (5 minutes)

Materials Needed

For the session

- ❑ PowerPoint slides for Session 9, Objects
- ❑ Data projector
- ❑ Observation Questions poster (see Getting Ready)
- ❑ Debriefing the Activity chart (see Getting Ready)

For Cephalopod Objects Activity (4 groups of 4-5 participants per group)

- ❑ Group One: 1 to 2 real whole squid or octopus—frozen and thawed or fresh (or other organisms)
- ❑ Group Two: 3 to 4 videos of squid or octopus—especially capturing prey (or other organisms)
- ❑ Group Three: 1 model of squid or octopus (or other organisms)
- ❑ Group Four: 5 to 6 photographs of different species of cephalopods, including some capturing prey (or other organisms)

- ❑ All groups: Arts and crafts materials—scissors, colored paper, glue, tape, pipe cleaners, etc

Note to Facilitator: *Cephalopods, and specifically squid, are used in this session because they are intriguing organisms, and the four types of objects featured in this session are fairly easily attainable. If your institution has another organism, feel free to substitute as long as you can gather materials for all four types of objects.*

For Research Discussion: Ideas from Research Jigsaw Cards (small groups will need one copy of each card)

Research Card #1: Promoting Meaningful Learning
Research Card #2: Effect of Different Types of Objects
Research Card #3: Family Interactions around Objects
Research Card #4: Objects that Promote Conversations
Research Card #5: Importance of Visitors Engaging in Conversations

For each participant

- ❑ 1 copy of "Ideas from Research – Conversing about objects" take home handout
- ❑ 1 copy of "Ideas to consider when teaching with objects"

Preparation of Materials

Note to Facilitator: *For large groups where there will be more than four or five individuals per group, consider having more than four groups, with a couple of groups working with another set of objects that are easily acquired, such as having two groups use the video or the real squid.*

1. Decide if you will use cephalopods (squid and/or octopus) as your focus or some other organism. The specific organism does not matter as long as you can obtain living or once-living specimens, video, models, and photographs of the organism.

2. Cephalopods

a. Whole squids can be purchased frozen in many grocery stores or fresh from seafood or bait stores. Preserved squid can be purchased from biological supply houses such as Carolina Biological.
b. Models of squid can be purchased or made from simple, inexpensive materials. Here is a link to a squid toy for purchase, and below are photographs for making your own models out of felt.
http://www.amazon.com/Safari-LTD-Monterey-Giant-Squid/dp/B0009JK9SA
http://anwo.com/store/squid.html
c. Videos can be found on free online video sites, such as YouTube. Here are some examples of squid videos.

http://www.youtube.com/watch?v=vT9fJLlFeKU
http://www.youtube.com/watch?v=OBg0k9GbHiw&feature=related
http://www.youtube.com/watch?v=URrXDJy1SGk&feature=related
http://www.youtube.com/watch?v=yTaEzlnw-LM&feature=related

d. Photographs can also be found online. We recommend images at least 500 dpi in resolution so the image prints fully on a piece of paper. Color printing is most ideal.

3. Write out Observations Questions on a poster paper, and have them ready to post where everyone can see them during the sharing of the Activity: Cephalopods.

— What are the learners and educator talking about?
— How are the objects used in the conversations?
— What are the participants doing with the objects?

4. Make copies of the "Ideas from Research–Conversing about Objects" research cards. Cut apart into separate cards. Each small group will need one copy of each card, and each group member will need a different card.

5. Make copies of handouts "Ideas from Research–Conversing about Objects" and "Ideas to Consider when Teaching with Objects" handouts.

6. Make the Debriefing the Activity chart.

Debriefing the Activity chart				
	video	photo	real-thing	model
engagement				
conversation				

Instructor's Guide–Session Details

Quick Write.

1. Participants do Quick Write. Participants write for three minutes on the following questions:

Objects refer to special things in informal institutions—artifacts, exhibits, specimens, etc.

— How and why do you use objects when you teach?
— What do you talk about with learners while focusing on or using these objects?

2. Whole group share. Facilitate a brief discussion of the participant's ideas about objects using the Discussion Map below:

- Ask participants to share their ideas.
- Listen to their responses.
- Ask for agreements, disagreements, and alternative opinions & views.

Engaging with Cephalopod Objects Activity.

1. Introduce the task. Let participants know that they will work in four groups for 15 minutes to prepare a way to teach something about **cephalopod behavior or adaptations such as *how cephalopods catch their food*** to visitors. The group needs to decide what type of interaction and audience: classroom-based, floor activity, exhibit, or auditorium show for general public, school group, family, etc. Each group will design a whole program, but will teach only a 3 to 5-minute clip of the whole program. Each group will designate one person as the "educator" and the rest of the group (and if necessary, the rest of the participants) will serve as the learners.

2. Explain and distribute materials. Let participants know that each group will have one of following types of objects and a collection of other materials (paper, markers, scissors, tape). The interaction must feature the object, but they may use any, all, or none of the other materials available at their table.

The objects are:
— Real, once-alive squid
— Model of squid
— Video of squid
— Photographs of squids and other cephalopods

Let participants know that it is understandable that 15 minutes is not enough time to create a stellar program. The goal is to consider different ways these types of objects are used in our practice, and what the conversations that ensue as a result of using the objects may be about.

3. Circulate. While participants are designing their interaction, circulate around the room to offer supplies and answer questions pertaining to the task.

4. Teach it. Each group teaches 3 to 5 minutes of their designed program. Remind the group to inform everyone about the context of their interaction. Participants not presenting will play the role of audience, and will need to adjust according to the needs of the presenting group. For example, everyone can pretend to be the general public in an auditorium interaction, but five or six volunteers will be needed to pretend to be a small school group.

5. Observation questions. Post the Observation Questions on the board. Let participants know that while they are observing, they will need to gather observation data to answer the following questions for each group:

— What are the learners and educator talking about?
— How are the objects used in the conversations?
— What are the participants doing with the objects?

Note to Facilitator: (1) After each group presents, give everyone a few minutes to gather their notes and prepare for the next group. (2) Keeping to time can be challenging, as participants are excited to share the idea they designed. Give them at least five minutes to present—after that, cut them off based on whether it appears they have done enough in their presentation to give observers the chance to record their observations. (3) If necessary, remind participants to refrain from placing value judgments on one type of object over another, or effectiveness of one group over others. The task is to pay attention to how people use the objects and what they talk about.

6. Clean up. After all the groups have finished, ask them to place their materials back on their trays, and move the tray to the side of the room out of the way.

7. Review notes. Let participants know that the debrief discussion will focus on answering the Observation Questions according to the type of objects rather than the individuals leading the activity. Give everyone a chance to review their notes, and allow them to confer with a partner if they choose.

8. Display Debriefing the Activity charts. Display the Debriefing the Activity Charts you made in Getting Ready comprised of four columns on

the board, or four separate sheets of chart paper, one for each of the types of objects, with each column divided into two rows labeled "engagement" and "conversation" respectively.

Debriefing the Activity chart				
	video	photo	real-thing	model
engagement				
conversation				

9. Participants share observation data with whole group. Ask participants to share the observation data for each of the observation questions, and record their ideas in the respective section of the Debriefing the Activity charts.

— What are the learners and educator talking about?
— How are the objects used in the conversations?
— What are the participants doing with the objects?
— How did people engage with the models? Video? Photo? Real thing?
— What kind of conversation happened?
— Why do you think that is?

Encourage the group to ask questions of each other by explicitly asking individuals to respond to other people's comments. Use the Discussion Map below as a guide to help you facilitate the discussion.

Discussion Map:

— Listen to their responses.
— Ask for evidence, explanation, or clarification.
— Ask for agreements, disagreements, and alternative opinions & views.
— Encourage questions.
— Synthesize their ideas as you reference their comments.
— Restate/summarize the participants' viewpoints. Ask them about points they have not mentioned.
— Pose new questions that build on what the participants are talking about.

Research Discussion.

1. Focus of discussion: Objects for memories and conversations. Do a think-pair-share with the following two statements to segue the discussion to focus on the conversations that objects promote. Ask participants to think a moment about the meaning of the statement and their reaction to it—do they agree, disagree, why, and then ask them to pair up to share their reactions with a partner.

— People visit informal environments for the memories and experiences that they create when they see, touch, smell, and interact with these objects (Gurian, 1999).

— The genius of informal environments exists somewhere in an analysis of how unique and powerful objects support learning in the form of conversations, which get elaborated as small clusters of individuals engage with objects (Leinhardt & Crowley, 2002).

Use the Discussion Map as a guide to facilitate the sharing out of these paired conversations.

Discussion Map:
— Listen to their responses.
— Ask for evidence, explanation, or clarification.
— Ask for agreements, disagreements, and alternative opinions & views with the ideas put forth.
— Encourage questions.
— Synthesize their ideas as you refer to their comments.
— Restate/summarize the participants' viewpoints. Ask them about points they have not mentioned.

2. Focus of discussion: Starting points of conversations. Share with participants that there are four features of objects in informal environments that are argued to be starting points of ideas for conversations and elaborations that make them unique from images in books, televisions, and the Internet (Leinhardt & Crowley, 2002). Objects may have more than one of these features.

- **Resolution.** The minute and subtle details of objects, such as bumpy scales of a snake or the stench of the corpse flower when it blooms.
- **Scale.** The smallness and largeness of objects, such as steam engines from the Industrial Revolution the size of a room or the femur bone of a dinosaur that stands the height of the room.
- **Authenticity.** The realness of objects, such as a Mars rover or a first edition of *On the Origin of Species.*
- **Value.** The uniqueness of objects, such as the only live white shark in captivity or a rock from the Moon.

3. Whole group discussion. Ask participants to consider and respond to this question:

— How can these features be useful when thinking about the design and interactions in your activities?

4. Introduce Research Card Jigsaw. Let participants know that researchers have taken an even closer look at how learners talk about science ideas at different types of objects, and found that different types of

objects may promote different types of talk. Tell the participants each small group will receive a few research cards focusing on "Conversing about Objects". Each card features a piece of information that research has found out about teaching with objects. Each member of their group is responsible for carefully reading one of the cards. Then they will take turns explaining the information from their card to their small group. Like a jigsaw puzzle, each member of the team is in charge of one of the "pieces."

Research Card #1: Promoting Meaningful Learning
Research Card #2: Effect of Different Types of Objects
Research Card #3: Family Interactions around Objects
Research Card #4: Objects that Promote Conversations
Research Card #5: Importance of Visitors Engaging in Conversations

5. Each member leads a brief discussion about one research card. After each group member shares the information from a research card, they should tell the group their thoughts on the card. They should also invite group members to discuss the topic on the card, including:

- anything they find confusing about it.
- questions or issues they have about the topic on the card.
- how teaching might be structured to take this piece of information into account.

During this discussion, each member should hold onto, and be in charge of their research card. They should continue the sharing and discussing process until you tell them to stop.

6. Large group share. After about 15 minutes of discussion, ask each group to share out any issues, ideas or questions that came up during their small group discussion. Also ask participants to consider how these ideas about the ways in which learners talk about objects are similar and/or different from the conversations they had at the Cephalopod Activity.

Note to Facilitator: Remember to encourage participants to:

- Share multiple viewpoints
- Agree and disagree
- Provide evidence and clarifications for their viewpoints and dis/agreements
- Respond to one another's comments.

Note to Facilitator: An overview of the content of the research cards is described here.

— Learners make more process explanations when exploring representational and virtual objects than with natural objects (Eberbach & Crowley, 2005).

- Learners make more connections to school when exploring representational objects; learners make more connections to everyday experiences when exploring natural objects than virtual objects (Eberbach & Crowley, 2005).
- The *resolution* of objects (e.g., the physical complexity and self-explanatory nature of objects) may affect the types and quantities of questions and explanations learners make (Hohenstein & Tran, 2007).
- The resolution in the details of objects, for instance, tools and moving parts in a Victorian workshop compared to a rice bowl from post-atomic bomb at Hiroshima, may prompt learners to make explanations about the mechanism at the former object, while be more terse at the latter object (Hohenstein & Tran, 2007).
- Families use biological themes, such as life cycle and protection, as entry points to learning conversations about life science topics at various types of objects (Ash, 2003).
- Families used features of the objects, for instance the resolution of detail from a frog skeleton compared to human skeleton and authenticity of live swimming frogs and tadpoles, to make process explanations about change from tadpole to adult frog and functional reasoning about the use of tadpole's tail and frog's legs (Ash, 2003).

Content explanation. ***Process explanations*** are accounts of what is happening and how it is happening, such as bees landing on flowers to drink nectar (what) and bees using their proboscis to drink the nectar (how). ***Physical complexity*** is the intricate details of the object, and ***self-explanatory*** is the extent to which learners can explain the idea or concept the object represents simply by observing or moving the object itself.

Explanations. Explanations, in particular, are viewed as a higher-level thinking process (Keil, 2006). They result from human activities, and serve to generate knowledge and increase our understanding of phenomena (Wilson & Keil, 1998). Explanations are the core of theories, and so explanations can be viewed as a useful tool to assess learners' current theories (Crowley, et al., 2002). Explanation episodes that arise in everyday conversation present excellent opportunities for children to articulate and revise their theories of scientific phenomena, with guidance from parents and other adults (Crowley, et al., 2002, p. 714).

7. Distribute "Ideas from Research-Conversing about Objects" take-home handout. Distribute the take-home handout for participants to use as a reference.

Work with partner.

1. Distribute "Ideas to consider when teaching with objects." Distribute the handout to each participant and give them a few minutes to review it as you provide an overview of the content of the handout.

2. Participants pairs discuss handout. Participants work with their partner to think about how they use, talk about, and encourage engagement with objects in their activity to promote learners to talk about the scientific ideas, using the handout as a guide.

3. Lead whole group debrief. Lead a whole group debrief while encouraging participants to share their partner discussions about the use of objects.

Note: If you are continuing to add to the "Key Characteristics of Exemplar Activities" chart started in *Session 4: Designing an Activity*, add the following points that were addressed in this session:

__ Allow opportunities for visitors to engage in inquiry including exploration and investigation, but also in making explanations and application
__ Is "minds-on" (not just hands-on), interactive, fun, and contains a "hook"
__ Encourages questions from visitors and follows the interests of the learner
__ Uncovers/makes connections with visitors' current/prior understanding
__ Encourages and provides opportunities for discussion/discourse and other social interactions between visitors or family/group members
__ Includes opportunities to engage with and manipulate objects, experiences and conversations in a social setting
__Uses the specialness of objects to elicit conversations that support learning
__ Includes opportunities for learners to engage in various teaching approaches including some or all of the following: free exploration, guided and open inquiry and problem solving
__ Includes opportunities for visitors to make meaning individually, with peers and with someone more knowledgeable (e.g. facilitator/knowledgeable visitor)

Housekeeping.

Online discussion

Monterey Bay Aquarium

- carpooling

Presentations

- @ LHS once during March 27 – April 11
- @ farmers market once, April 6, 8, 27 or 29
- Get ready to present activity at Cal Day, April 17.

Homework.

Reading

— Eberbach, C., & Crowley, K. (2005). From living to virtual: Learning from museum objects. Curator, 48(3), 317-338.

— Falk, J.H. & Dierking, D.L. (2000). Chapter 6. Communities of learners. In *Learning from Museums: Visitor experiences and the making of meaning* (pp. 91–112). Walnut Creek, CA: AltaMira Press. Online discussion.

Ideas from Research – Conversing about Objects *Research Cards*

Research Card #1: Promoting Meaningful Learning

While "activity may help promote meaningful learning, instead of behavioral activity *per se* (e.g., hands-on activity, discussion, and free exploration), the kind of activity that really promotes meaningful learning is cognitive activity (e.g., selecting, organizing, and integrating knowledge)" (Mayer, 2004, p. 17). Rather than depending solely on learning by doing or learning by discussion, the most genuine approach to constructivist learning is learning by thinking. So instructional methods that rely on doing or discussing should be judged not on how much doing or discussing is involved, but on the degree to which they promote thinking and making connections. Guidance, structure, and focused goals should not be ignored.

Research Card #2: Effect of different types of objects

Eberbach and Crowley (2005) compared how families explained pollination in their conversations at three different types of objects—natural, representational, and virtual.

— Learners make more process explanations when exploring representational and virtual objects than with natural objects

— Learners make more connections to school when exploring representational objects; learners make more connections to everyday experiences when exploring natural objects than virtual objects

Process explanations are accounts of what is happening and how it is happening, such as bees landing on flowers to drink nectar (what) and bees using their proboscis to drink the nectar (how).

Research Card #3: Family Interactions around Objects

Ash (2003) examined how families talked about life science topics at a variety of objects—natural, interactive, and virtual/digital—in an exhibition about frogs.

— Families use biological themes, such as life cycle and protection, as entry points to learning conversations about life science topics at various types of objects

— Families used features of the objects, for instance the resolution of detail from a frog skeleton compared to human skeleton and authenticity of live swimming frogs and tadpoles, to make process explanations about change from tadpole to adult frog and functional reasoning about the use of tadpole's tail and frog's legs (Ash, 2003).

Process explanations are accounts of what is happening and how it is happening, such as bees landing on flowers to drink nectar (what) and bees using their proboscis to drink the nectar (how).

Research Card #4: Objects that Promote Conversations

Hohenstein and Tran (2007) explored learners' conversations at three artifactual objects that differed in their *resolution*, more specifically, the physical complexity and self-explanatory nature.

— The *resolution* of objects (e.g., the physical complexity and self-explanatory nature of objects) may affect the types and quantities of questions and explanations learners make

— The resolution in the details of objects, for instance, tools and moving parts in a Victorian workshop compared to a rice bowl from post-atomic bomb at Hiroshima, may prompt learners to make explanations about the mechanism at the former object, while be more terse at the latter object

Physical complexity refers to the intricate details of the object, and ***self-explanatory*** is the extent to which learners can explain the idea or concept the object represents simply by observing or moving the object itself.

Research Card #5: Importance of Visitors Engaging in Explanations

Explanations, in particular, are viewed as a higher-level thinking process (Keil, 2006). They result from human activities, and serve to generate knowledge and increase our understanding of phenomena (Wilson & Keil, 1998). Explanations are the core of theories, and so explanations can be viewed as a useful tool to assess learners' current theories (Crowley, et al., 2002). Explanation episodes that arise in everyday conversation present excellent opportunities for children to articulate and revise their theories of scientific phenomena, with guidance from parents and other adults (Crowley, et al., 2002, p. 714)

Ideas from Research – Conversing about Objects *Take-home handout*

While "activity may help promote meaningful learning, instead of behavioral activity *per se* (e.g., hands-on activity, discussion, and free exploration), the kind of activity that really promotes meaningful learning is cognitive activity (e.g., selecting, organizing, and integrating knowledge)" (Mayer, 2004, p. 17). Rather than depending solely on learning by doing or learning by discussion, the most genuine approach to constructivist learning is learning by thinking. So instructional methods that rely on doing or discussing should be judged not on how much doing or discussing is involved, but on the degree to which they promote thinking and making connections. Guidance, structure, and focused goals should not be ignored.

Findings from three studies on un-facilitated conversations:

1. Eberbach and Crowley (2005) compared how families explained pollination in their conversations at three different types of objects—natural, representational, and virtual.

— Learners make more process explanations when exploring representational and virtual objects than with natural objects

— Learners make more connections to school when exploring representational objects; learners make more connections to everyday experiences when exploring natural objects than virtual objects

Process explanations are accounts of what is happening and how it is happening, such as bees landing on flowers to drink nectar (what) and bees using their proboscis to drink the nectar (how).

2. Hohenstein and Tran (2007) explored learners' conversations at three artifactual objects that differed in their *resolution*, more specifically, the physical complexity and self-explanatory nature.

— The *resolution* of objects (e.g., the physical complexity and self-explanatory nature of objects) may affect the types and quantities of questions and explanations learners make

— The resolution in the details of objects, for instance, tools and moving parts in a Victorian workshop compared to a rice bowl from post-atomic bomb at Hiroshima, may prompt learners to make explanations about the mechanism at the former object, while be more terse at the latter object

Physical complexity refers to the intricate details of the object, and ***self-explanatory*** is the extent to which learners can explain the idea or concept the object represents simply by observing or moving the object itself.

3. Ash (2003) examined how families talked about life science topics at a variety of objects—natural, interactive, and virtual/digital—in an exhibition about frogs.

— Families use biological themes, such as life cycle and protection, as entry points to learning conversations about life science topics at various types of objects

— Families used features of the objects, for instance the resolution of detail from a frog skeleton compared to human skeleton and authenticity of live swimming frogs and tadpoles, to make process explanations about change from tadpole to adult frog and functional reasoning about the use of tadpole's tail and frog's legs (Ash, 2003).

Explanations, in particular, are viewed as a higher-level thinking process (Keil, 2006). They result from human activities, and serve to generate knowledge and increase our understanding of phenomena (Wilson & Keil, 1998). Explanations are the core of theories, and so explanations can be viewed as a useful tool to assess learners' current theories (Crowley, et al., 2002). Explanation episodes that arise in everyday conversation present excellent opportunities for children to articulate and revise their theories of scientific phenomena, with guidance from parents and other adults (Crowley, et al., 2002, p. 714).

Ideas to Consider when Teaching with Objects

CONVERSATIONS: How are learners and facilitator talking about the objects?

	Description	Examples
Identification	Calling out or naming objects, or parts of objects.	- This is a fiddler crab. - There's the honeybee. - That is the operculum of a fish.
Description	Elaborating upon elements or details of the object.	- The whelk has a soft body and a hard shell. - The bee is taking nectar from the flowers.
Explanation	To make clear the cause, origin, or reason of; to account for. Reasoning causal relations, processes, scientific principles, and analogies.	- Dead zones means there is no oxygen in the water, and this is bad because animals cannot live without oxygen in the water. - Oh, see!? He [the bee] takes nectar and the pollen gets stuck on him, and then he goes to another flower and another flower. That's how pollen gets spread.

ENGAGEMENT: How are the learners engaging with the objects?

Sense	Examines object—listen, touch, smell, & look at (sensory).	- Learner touches, smells, looks at, or listens to object.
Manipulate	Manipulates, or makes changes to, objects in order to think about the topic from a new or different perspective—compare & contrast.	- Learner compares features or characteristics between objects.
Experiment	Makes a hypothesis about an observation and tests it out—"I wonder if …."	- Learner makes a hypothesis, controls variables, and tests ideas.
Discuss	Talks about the object.	- Learner converses about what she or he senses, does, or thinks about the objects.

FACILITATION: How is the educator facilitating learners' engagement with the objects?

Learner		
Learner-directed	Learner(s) engages with object(s) on their own	- Learner approaches the tank and touches a seastar
Educator		
Models	Educator engages with the object(s) to demonstrate for learner(s) how to engage	- Educator touches an otter pelt with two fingers, and urges learner to do the same
Social	Educator encourages learners to engage with objects together	- Educator asks learners to work together to sort a collection of shells
Prompt	Educator invites and suggests ways for learner(s) to engage with objects	- Educator proposes that learners compare the features of two skulls

