Learning to Develop Effective K-12 Outreach

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Want a Copy of the Slides? Help Yourself!

You bet! It’s gonna be great!
What Does Outreach Mean to You?

- Who is the audience?
- What should you do?
- What is the outcome?
• Kids!
• Hands-on experiments! Cool demos!
• Neat facts! Make it fun!
• They will get excited about _______________!
• They will learn about _______________!
Learning ... Not a Simple Goal

- How can you tell if someone has learned?
- How long will learning last? How do you know?
- What are the best ways to help kids learn an idea or concept?

Jot down your answers to these questions.
Quick Example: Levels of Learning

Pull out any digital device with network access and a web browser.
(Laptop OK too.)
First peoples of Utah: **Utes**

- By 1500, Utes had spread through eastern and central Utah
  - Also parts of CO, WY, and NM
- Two distinct groups of Utes in Utah
  - Northern Utes
  - White Mesa Utes

Info from Utah.gov, Utah Division of State History: [http://ilovehistory.utah.gov/people/first_peoples/tribes/ute.html](http://ilovehistory.utah.gov/people/first_peoples/tribes/ute.html)
Northern Utes: Central UT to Western CO

- Lived in small family groups. After they got horses, the groups became larger bands.
- Had leaders, but not what we call “chiefs.” Some were spiritual leaders, some helped direct specific activities, and some just offered suggestions.
- Traveled through larger regions hunting, fishing, and gathering plants throughout the seasons.
- Gathered cactus, seeds, and roots to store for winter in buried baskets. Also hunted and dried meat for winter.
- Lived in brush shelters or tipis.
- Wore clothes made from shredded bark or animal hides, used rabbit-fur robes in winter.
- Acquired horses, which let them travel more widely. They could go to the Great Plains to hunt buffalo. Some also became skilled at stealing horses from California and elsewhere.
- Knew the mountains well, used them for refuge.

Info from Utah.gov, Utah Division of State History: http://ilovehistory.utah.gov/people/first_peoples/tribes/ute.html
White Mesa Utes: Four Corners Area

• Were related to Ute groups in Colorado and New Mexico.
• Lived in close association with Paiute bands in the Four Corners area.
• Lived in bands of 1-10 families.
• Migrated through the seasons to harvest plants and animals.
• Spent winters at low elevations and summers at high elevations.
• Hunted deer to use for food, leather, and tools.
• Also hunted desert bighorn sheep, wild turkeys, badgers, beaver, rabbits, fish, and more.
• Lived in tepees made from elk or deer hides in the winter.
• Lived in wikiups in the summer.
• Sometimes grew small gardens near springs.
• Ate plants such as yucca fruit, ricegrass, pinenuts, chokecherries, and wild onions.

Info from Utah.gov, Utah Division of State History: http://ilovehistory.utah.gov/people/first_peoples/tribes/ute.html
Quiz time! Let’s Play!

1. Open a web browser on your device.

2. Go to: kahoot.it

2. Type in the code given by presenter.
   
   We’ll do two different quizzes, one at a time

3. Enter your nickname
   
   This will be displayed to everyone – please keep this in mind.

4. Get ready!!
How Did You Decide on Your Answers?

**Quiz 1**

Q2 In the summer, White Mesa Ute families lived in homes made of poles covered in brush called:

- 11 Longhouses
- 0 Tepees (Tipis)
- 0 Wattle houses
- 0 Wikiups

**Quiz 2**

Q2 Group size of Northern Ute bands grew with the introduction of horses, likely because:

- 77 Horses made it easier to hunt and gather resources
- 0 Horses were valuable and could be traded for supplies
- 0 Horses needed more people to care for them
- 0 Larger groups were needed to guard the horses against theft
Learning is not a unitary concept.

Learning occurs at different levels.
Memory vs. Understanding

Theory of comprehension: Construction-Integration Theory

Surface Level = Exact Representation

Textbase = Key ideas from materials

Situation Model = Deep understanding

Kintsch, 1998
Memory vs. Understanding

Theory of comprehension: Construction-Integration Theory

Surface Level = Exact Representation

Can recall or reproduce. Understanding isn’t necessary.

Mersidotes and dosidotes
And little lamsey divey
Diddley-divey do
Wouldn’t you?

Example adapted from Kintsch (1998)
Rote Learning ≠ Understanding

Mersidotes and dosidotes
And little lamsey divey
Diddley-divey do
Wouldn’t you?

Mares eat oats and does eat oats
And little lambs eat ivy
A kid’ll eat ivy too
Wouldn’t you?
Memory vs. Understanding

Theory of comprehension: Construction-Integration Theory

Surface Level = Exact Representation

Textbase = Key ideas from materials

- Formed by *encoding* content from learning materials
- Fails to go beyond the learning materials, fades quickly
- Tested by assessments targeting *recall* or *recognition*
  - Multiple choice, fill-in-the-blank, True/False, etc.
  - Exhibited as *memory* of the learning materials

Situation Model = Deep understanding
Textbase Questions

As the blood flows through the capillaries in the body, carrying its supply of oxygen, it also collects carbon dioxide. The blood that empties into the right atrium is dark colored. It has picked up carbon dioxide from the body cells. It has left most of its oxygen with the cells.

- What does the blood collect as it flows through the capillaries of the body?
- What color is the blood that empties into the right atrium?
Memory vs. Understanding

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Kintsch, 1998
Memory vs. Understanding
Theory of comprehension: Construction-Integration Theory

Surface Level = Exact Representation

Textbase = Key ideas from materials

Situation Model = Deep understanding
- Formed by integration of current & prior knowledge
- Tested by assessments targeting high-level cognition
  - Inference, application, comparison, analysis
  - Exhibited as understanding of learning materials
- Flexible, robust, and long-lasting representation = transfer
Situation Model Questions

As the blood flows through the capillaries in the body, carrying its supply of oxygen, it also collects carbon dioxide. The blood that empties into the right atrium is dark colored. It has picked up carbon dioxide from the body cells. It has left most of its oxygen with the cells.

• What color would the blood in the right atrium be if, for some reason, it failed to pick up carbon dioxide or to distribute oxygen in the body?

• What might be the difference between blood in the right and left sides of the heart?
Following a single learning session, how much is retained after 4 days???

Kintsch et al., 1990

- **Surface Level**: ~ 0%
- **Textbase Level**: 50%
- **Situation Model**: 100%
What to Remember about Depth of Learning

Remembering what has been shown/told = shallow, short term learning

Reasoning about information, generating explanations, making inferences = deep, long term learning
When to Use Memory (Rote) Questions

- Ensure learners encode foundational content
- Trigger background knowledge for application
- Throw the kids a few “easy” questions to build up success
- Facilitate long-term retention through spaced recall
Engagement is necessary, but not sufficient for learning.

Hands-on activity does not ensure deep cognitive processing.
Technology is fun! You can use it to engage students – but depth of learning is determined by you!

Free to create interactive, quiz game activities
Fun way to get students excited and active
Deep questions ensure depth of learning
Device agnostic (iPads, Chrombooks, Laptops)

Create a free account and create quizzes here:
https://getkahoot.com/
What activities require students to engage in one or more of these deep processes?
Structuring Your Outreach Session

- Who you are, what you do
- Student role in the session
- Set up a key question or goal
- Lead activities for deep learning
- Scaffold and assess thinking/reasoning
- Help students reflect on learning
- Leave class with extension Qs or activities
Hi, I’m Brad. I’m a grad student in Chemistry at the University of Utah. I’m here today to teach you about …

Just a different teacher with another lesson.
Who Are You? An Outreach Introduction

- Your name (the way you want them to address you ... ask about norms)

- The exciting thing you study at the University of Utah
  - You’re telling a kid, or your grandma!

- Why that exciting thing is important to the world

- What you love about your work

Jot down your answers to these questions. Share them with your table.

5 minutes
What is Student Role?

• Related to the field

• Authentic, but reasonable for level
  • Research assistant or scientist-in-training
  • Not expert scientist, not famous geologist

• Contextualizes their activities

• Brings meaning to the activity. Not “just another lesson”

Why am I doing this? I don’t know what to do.
How to Prep: 8 Steps to a Great Outreach Session

1. Select skill or concept
2. Find a real question or goal
3. Figure out process
4. Customize for audience
5. Choose activities & scaffolds
6. Monitoring & assessment
7. Create a meaningful ending
8. Post-session reflection

Can we break this down? Seems overwhelming!
Step 1: Identify Target Skill, Idea, or Concept

• What is interesting or exciting in your field?

• What can be investigated or demonstrated with little time or equipment?

• What are core skills or concepts for that grade level?

If you already have a specific topic or goal, think about how it translates to your specific audience. You may need to simplify and make more concrete.
Grade Level Standards

Explore standards for target grade in your area. Connect to your skills and knowledge.

http://www.uen.org/core/

K-12 teachers can more easily give you time if you are helping them meet a standard in their classrooms.
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Select a grade level. Explore standards relevant to your area and jot down a possible topic related to your work. (Likely more specific than the standard ... that’s OK!).

You may want to target skills that are prerequisite to knowledge (e.g., making observations).

http://www.uen.org/core/
Now that you have a topic, how will you engage students?

Students need a **guiding question or goal**

Works best if it is a **real question** that someone in your area actually would address.

Seems fake. Just tell me the answer.
Step 3: Figure out the Process / Reasoning

- How would YOU answer that question?

- Think out loud for someone not in your field

- Break down your thinking into concrete steps

- At every step, ask yourself: How do I know that?
What do you mean, how do I know? It’s obvious. There’s no way they can miss it.

Hint: Examine your work flow. How do you collect data? How do you document findings? How do you decide between ideas?
Begin to flesh out your outreach session:

1. What is a real question or goal relevant to your target concept or skill? (Make it concrete.)

2. How would you figure out the answer to that question or solve the problem?

3. Write down the process you would use (adjust to your target grade)?
Modeling Your Thinking for Students

• Demonstrate how you figured out the answer.

• Break it down. Be simple and straightforward. Connect to their ideas.

• Think about what student is likely to know to get started

• Invite students to compare their thinking to yours

Modeling your thinking focuses students on the process of learning, not just getting the right answer.
Practice Modeling Your Thinking

1. Find another workshop attendee who is not in your area of specialization.

2. Tell them your question/goal.

3. Model how to answer one aspect of that question (make it simple). This may be how to analyze a piece of evidence, to solve a problem related to the question, etc. (Partner: Be a helpful critic.)

15 minutes
Step 4: Customizing for your Audience

• When you model your thinking, what are things that you “just know”?
• That tells you what **background knowledge** is needed for your topic.

• Is there **specialized vocabulary**? Can you say it another way or do you need to teach those words?
Speak Their Language

- Elementary
  - Can you talk about the topic without using big words?

- Middle and High School
  - Gauge familiarity with vocab. “Remind” students what it means.

- Start with the question and its importance. Introduce vocab if required.

- If learning new vocab, do a quick recall several times during lesson (“What’s that called again?”)
The Role of Background Knowledge

Expert Knowledge
- Highly structured
- New concepts readily integrated
- Connections between relevant concepts easily activated
- Inferences generated easily
- Importance of information easy to understand

Novice Learner
- Lacks foundational ideas
- Little if any structured organization
- Relevant prior knowledge must be specifically activated
- Connections need to be made between relevant concepts
- Inferences difficult to make
- Importance hard to see
Science Topic? Check out Literacy Maps

http://strandmaps.dls.ucar.edu/
Nodes show educational concepts and how they build over time.
• **Smile!** Use gestures. Be animated.
• Show your **excitement and enthusiasm**
• Emphasize the **process**
• Praise specific **effort (not results)**
  • Sustains activity & reduces frustration
  • “Good work on looking for new evidence.”
  • “I like that I can hear you thinking through your ideas! That’s great!”
Step 5: Choose Activities & Scaffolding

• **How long** do you have? Account for:
  • Setup time
  • Instructions
  • Clean up time
  • Recess times? They might need this!!

• **What materials/equipment?**
  • Hands-on materials?
  • Technology?
  • Safety equipment?

• How will you **scaffold thinking** during the activity?!
Scaffolding for Facilitator Demos

- Be sure to set up a **key question**
- Ensure that students make **concrete predictions**
- Have students **compare their predictions to results**
- **Demonstrate failure**. Have students explain why it works vs. doesn’t work.

Interactive is best. But demos are OK when there is danger, materials are very expensive, or artifacts are very fragile.
Are there creative ways to get around fragile or expensive objects?

3D Prints and 3D virtual models of paleontology objects from Natural History Museum of Utah.
Brainstorming Activities

- Concrete, hands-on inquiry is best

- Little prep. Or prep can be done before arrival.

- How can you mimic real processes in your field?
  - Think about materials you use
  - Think about goals you set
  - Think about your favorite tasks

If you use models for abstract ideas (e.g., Legos to show molecular changes), discuss how the model does and does not represent reality
Scaffolds are question and materials that encourage deeper processing during your activity.
• Help students **organize and document ideas and findings**

• Try to **limit writing** (they won’t do as much as you’d like) but **maximize thinking**

• Confusion often precipitates learning. **Model it. Welcome it.** Full success = shallow thinking.

**SECTION 2 (continued)**

**STEP 10**

What type of dinosaur did these bones come from?

1. Key features of MYSTERY FOSSIL #2

<table>
<thead>
<tr>
<th>Ornithischian</th>
<th>Sauropod</th>
<th>Theropod</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. It has one knob on one end and two smaller knobs on the other end.

2.

3.

4.

5.

2. **Next**, analyze the data in the charts for Mystery Fossil #1 & #2 and discuss with your partner: **Which TYPE of dinosaur does your evidence point toward? (circle one)**

<table>
<thead>
<tr>
<th>Ornithischian</th>
<th>Sauropod</th>
<th>Theropod</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. **Now**, discuss with your partner: Mystery Fossils #1 & #2 provide strong evidence for the **TYPE** of dinosaur, but weak evidence for the **SPECIES** of dinosaur. Why might this be?
Drawing and Explaining Models
Explaining Examples and NonExamples

Correct

Incorrect
Scaffolding Deep Thinking

Deep Question Stems

• What would happen if .... ?
• Why does ...? What makes ... ?
• What is the difference between ... ?
• Why would you expect ... ?
• How can ... ? How do you know ...?
• Why is ______ an example of ... ?
• Why is ______ not an example of ...?

These work only if you didn’t already talk about the answers!
Scaffolding Deep Thinking

Process Prompts

• What are you thinking?
• Tell me about what you are finding.
• I’d like to hear your ideas. How did you come up with them?
• How did you figure that out?
• What other ideas did you consider? What made you reject them?
Outline Your Activities and Scaffolds

Brownies Activity: Friday, 3/24

- Random draw endangered animal groups as enter (5 min)
  - Black Footed Ferret
  - Red Wolf
  - Przewalski’s Horse
- Welcome & Introduction (5 min)
- Activity 1: Efficient Web Search and Fair Use Images (25 min)
  - Example endangered animal: Karner Blue Butterfly
  - Google Image Search (10 min)
    - What are usage rights? Why should we respect them?
    - How to refine by usage rights
    - How to refine by size (med to large for print)
    - How to save images to computer
    - Challenge: Find the best fair use pictures of your endangered animal
  - Google information search (15 min)
    - How do we know when online information is good?
    - What should we look for when doing online research?
    - Challenge: Find trustworthy, key information on your endangered animal
      - Description of your animal
      - Why is it endangered?
      - What zoos are trying to save it?
      - How can people help?
- Activity 2: Find your animal in U.S. Zoos .... Find closest place to visit (15 min)
  - Google Maps
    - Enter U1 address
Finding Hands-On Activities

1. Brainstorm activities with concrete and/or hands-on materials

2. Choose your best idea for an activity

3. What materials and questions will you use to encourage deeper thinking and learning?

10 minutes
Step 6. Monitoring and Assessment

Look and Listen: Engagement and Depth?!
Reasoning & Confusion
• I’m not sure. I was thinking that it could be …
• It’s _____ because …
• I wonder what would happen if …
• I think _____ since ____...
• But how could we tell if that’s right?

Rote Actions, Lack of Processing
• The answer is _____. I just know.
• I don’t know why. Just do what she says.
• What’s it say to do next?
• What’s the right answer?
• [Silence]
Who is Doing More Talking? (Hopefully the kids!)
Whole class reflection ensures group progress
  • Not all students/groups may be getting same thing out of session

Every 10-15 minutes often is good balance between inquiry and reflection
  • 10 for elementary
  • 15 for middle/high school

Return to Deep Questions
  • What would happen if .... ?
  • Why does ...? What makes ... ?
  • What is the difference between ... ?
  • Why would you expect ... ?
  • How can ... ? How do you know ...?
  • Why is ______ an example of ... ?
  • Why is ______ not an example of ...?
Step 7: Create a Meaningful Ending

• What was important?

• What is the takeaway message? (Ask them first. Help them generate it.)

• How did their activities relate to the field? (As them first. Then compare to professional activities.)
Step 7: Create a Meaningful Ending

- What are **follow-up questions** that they could explore?
  - If you have time, helps to guide them to discover follow-up questions

- What is a **follow-up activity** they could try?

- How can they **find out more about this topic**?
Step 8: Post-Session Reflection & Changes

• What went well?

• What seemed problematic?

• Where did students fidget or go off-task?

• Did students know what you were asking?

Make notes immediately after your session! You will forget!
Step 8: Post-Session Reflection & Changes

- **Off-task behaviors?**
  - Students not engaged?
  - Students unsure what to do?
  - Single question or goal?

- **Time issues? Flow?**
  - What slowed down the students?
  - Fidgeting? Lack of depth? Balance between instruction and student work? Students need time to dig in.

- **Practice questions with non-domain peers.** Do they know what you are asking?
Feeling Overwhelmed? Totally normal!

- Doesn’t need to be perfect to be useful.

- **Processes** are as valuable as outcomes

- You will feel exhausted after a session – that’s normal!

- Kids love doing something different with someone new
Feeling Overwhelmed?

Brownies Activity: Friday, 3/24
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  - Challenge: Find trustworthy, key information on your endangered animal
    - Description of your animal
    - Why is it endangered?
    - What zoos are trying to save it?
    - How can people help?

- Activity 2: Find your animal in U.S. Zoos ... Find closest place to visit (15 min)
  - Google Maps
    - Enter U address
    - Directions to zoo address
    - Save map link

- Activity 3: Graphic Design (Infographic) --Piktochart.com (25 min)
  - What makes a poster look good? What catches your eye?
  - Discuss examples and nonexamples of good design.
  - Interactive guidance on Piktochart
    - Background [contrast with text]
    - Adding images
    - Adding text
  - Challenge: Create infographic on your endangered animal

- Activity 4: Share your design/Program Tweet via @[U] Program (10 min)
  - What is Twitter?
  - Internet safety
  - See results of our live Tweeting
Practical Tips

• Take your planned activities, cut them in half

• Do the activities as if you were a student. Time yourself.
  • Multiply by 4 for elementary school
  • Multiply by 3 for middle and high school

• Assign target times to each activity
  • Have an “emergency jettison” plan

• Quick finishers? Helpers!

• Expect the unexpected
  • Fire drills!
  • Terrorized by a bee!
• At the U? Media release form
• Many schools have signed media release from parents. Ask in advance.
KEEP CALM AND OUTREACH ON
Questions??

Download Slides?

http://bit.ly/2oaV0ts