TEXAS TECH UNIVERSITY™

Preparing Informal Science Educators

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Epistomology and Pedagogy

Epistomology:
Your beliefs about knowledge and how to acquire knowledge.

Pedagogy:
How you teach—the art of teaching.

Defining informal science education (ISE)

Turn to someone next to you and describe your ideas about informal science education. How do you define ISE?

Defining informal science education

Student definitions:

- “taking students outside of the traditional classroom and teaching/learning scientific concepts in a real world environment in order to better help students experience that correlation”
- “hands-on, experience, and visually based as opposed to textbook based”
- “it is science where science is actually happening; real time, in 3-D!”

Defining informal science education

Dierking, Falk, Rennie, Anderson, & Ellenbogen, 2003

> "rarely if ever occurs and develops from a single experience…it is cumulative, emerging over time…what people come to know about the world, including the world of science content and process, [ISE] derives from real-world experiences within a diversity of appropriate physical and social contexts, motivated by an intrinsic desire to learn…"

Defining informal science education

National Science Teachers Association (2012)

> "…delivered by parents, friends, and educators in informal environments can spark student interest in science and provide opportunities to broaden and deepen students' engagement; reinforce scientific concepts and practices introduced during the school day; and promote an appreciation for and interest in the pursuit of science in school and in daily life."

Defining informal science education

Bell, Lewenstein, Shouse, & Feder (2009)

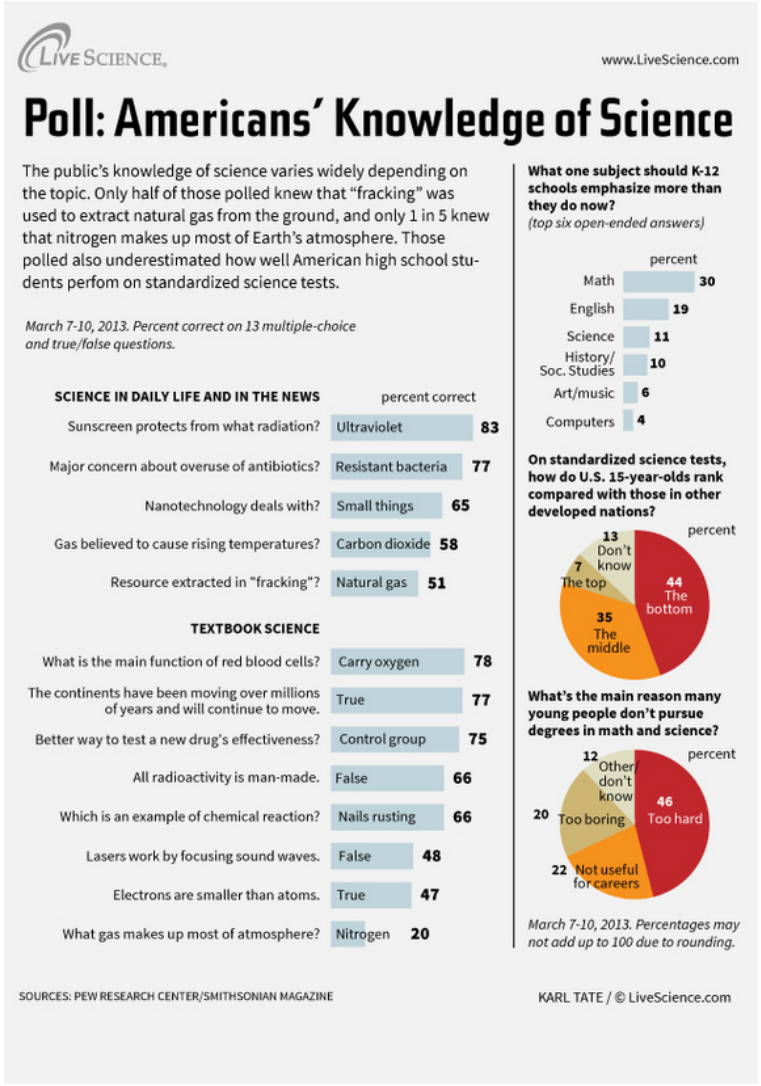
> "Experiences in informal environments…typically characterized as learner-motivated, guided by learner interests, voluntary, personal, ongoing, contextually relevant, collaborative, nonlinear, and openended [sic]."

Why is informal science education important?

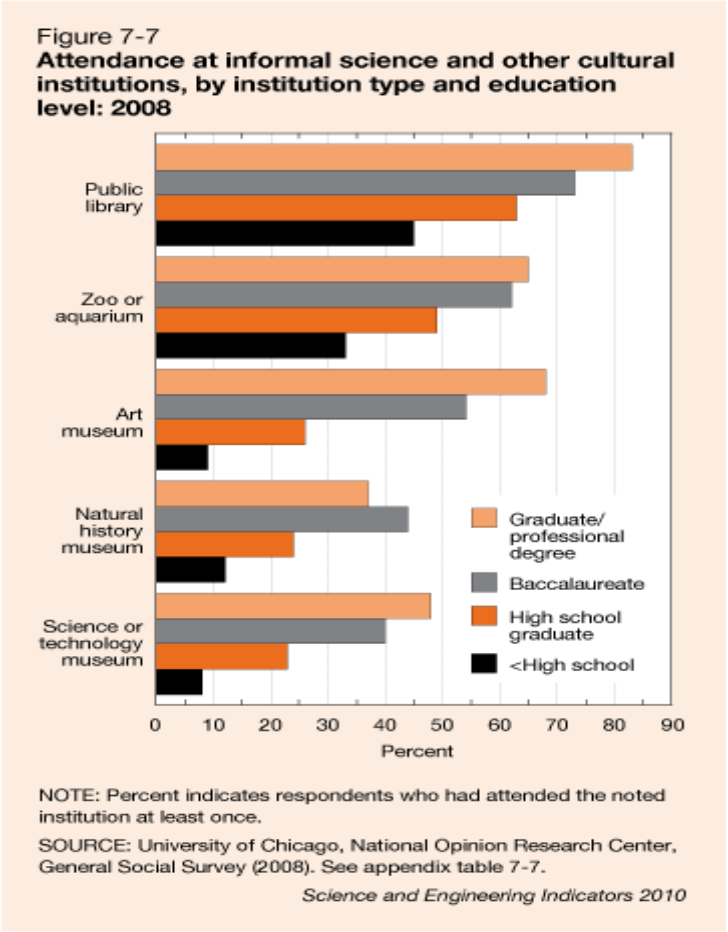
Turn to someone next to you and describe why you believe ISE is important?

Sir Ken Robinson—Changing Education Paradigms

Why is informal science education important?



"School is not where most Americans learn most of their science" (Falk & Dierking, 2010)



Why should we prepare informal science educators?

- If informal educators do not take control of informal educator preparation and teaching standards someone else might. Committee on Science, Space, and Technology: http://www.youtube.com/watch?v=uD2Y3IU-ywg

- Informal science institutions are requiring educators have Master's Degrees.

Why should we prepare informal science educators?

- Grants—more funding is being required to keep informal learning centers open.

- Evaluation/Assessment—agencies are being expected to show learning occurs and their programs make a difference in behavior (Blackfish). Evaluation/Assessment is also a requirement for most grants.

If we are tasked with making sure we have good informal educators, should we define the characteristics of good informal science teaching?

While you watch these videos think about the following:

- What are the learning objectives?
- What is the intended outcome?
- How does the keeper know learning is taking place?
- Do you think the intended learning outcomes were met?
- Did the keeper engage the audience? What did the keeper do well?
- What would you change about the presentation?

Armadillo Talk at the Houston Zoo

Tiger Training Window Houston Zoo

Teaching rubric that addresses the 6 strands of informal science learning (Bell, Lewenstein, Shouse, & Feder, 2009)

Strand	5 points	3 points	1 point
Strand 1: Strand 1: Experience excitement, interest, and motivation to learn about phenomena in the natural and physical world.	Educator begins by getting audience excited and introduces the topic. Educator has immersed themselves in learning about the topic they are discussing. They are able to candidly discuss the topic to keep the audience interested. Educator uses multiple stimuli such as physical, audiovisual and three-dimensional to excite learners and keep them interested. Educator keeps the audience/students interested by asking open-ended questions and asking for responses. Ex. "Who know what kind of food beluga whales eat?" Educator lets students work in peer groups and discuss concepts to stay interested. Educator/presenter offers handouts that get the audience/student interested in doing further research on the concept.	Educator introduces the topic. Educator does not read directly from presentation slides but recites only what is memorized. Educator uses one form of stimuli to excite learners and keep them interested. Educator keeps the audience/students interested by asking close-ended questions and asking for responses. Ex. "How many of you guys have ever seen a beluga whale in the wild?" Educator/presenter stays on one topic on a decent amount of time; does not jump around from topic to topic. Ex. "The dolphin fish are changing colors. Now the turtle target is in the water, and the keeper is trying to get the turtle interested. So, as I mentioned before the dolphin fish is changing colors…"	Educator does not introduce topic and just begins their presentation. Educator reads off cue cards or reads from presentation slides. Educator does not use any stimuli to excite learners and keep them interested. Educator/presenter does not ask questions during presentation, but allows students/audience to come up after presentation for questions. Ex. "I will stick around after the show for questions." Educator does not stay on topic, making it difficult for the students to grasp and follow.
Strand 2: Come to generate, understand, remember, and use concepts, explanations, arguments, models, and facts related to science.	a) Educator provided ample opportunity for the audience to ask questions relevant to presentation. b) Educator facilitated understanding of the information so the audience can apply to new and existing schema. c) Additional information was provided to further the audience members' interest during the presentation. d) Educator allows opportunities for participants to discuss scientific phenomena and interacts directly in the conversations. e) Educator provokes participant reflection and encourages further learning. f) Educator is able to assess background knowledge and interest level of group and modify program accordingly	a) Educator allowed two or three audience members to ask questions relevant to presentation b) Educator facilitated enough understanding of the information presented to allow for the audience to develop some new schema. c) No additional information was provided to further the audience members' interest during the presentation. d) Educator allows opportunities for participants to discuss scientific phenomena. e) Educator allows for participant reflection. f) Educator does present age appropriate material.	a) Educator did not allow audience members to ask questions relevant to presentation. b) Educator facilitated some understanding of the information presented, however, the audience did not appear to develop any new schema. c) The educator just gave the bare facts regarding the exhibit/presentation. d) Educator does not allow opportunities for participants to discuss scientific phenomena. e) Educator does not allow for participant reflection. f) Educator does not present age appropriate material
Strand 3: Manipulate, test, explore, predict, question, observe, and make sense of the natural and physical world.	a) Lesson must contain hands on components, and must test participant knowledge through questioning. b) A good educator should ask questions to gauge the knowledge of the crowd and to predict any possible questions they may have.	a) Lesson has some hands on activities but does not gauge the participant's acquisition of knowledge. b) Educator is facilitating hands on activities but not linking the activity to the lesson and answering limited questions asked by the audience.	a) Lesson includes no hands on activities, bad transitions, and no closure. b) A subpar educator does not have any background knowledge, lectures to the group without pausing for questions.
Strand 4: Reflect on science as a way of knowing; on processes, concepts, and institutions of science; and on their own process of learning about phenomena.	Educator interacts with the audience through dialogue to assess the visitors' knowledge. Educator makes direct ties between science content and visitors' lives. Educator is able to address a variety of questions from the audience as a way to help visitors gain in-depth reflection of science.	Educator has limited interaction with audience through dialogue to assess visitors' knowledge. Educator makes weak ties between science content and visitors' lives. Educator is able to address some questions from the audience as a way to help visitors gain in-depth reflection of science.	Educator does not interact with audience through dialogue; educator only lectures. Educator does not tie content to visitors' lives. Educator is unable to address questions from the audience; educator is unable to facilitate in-depth reflection of science.
Strand 5: Participate in scientific activities and learning practices with others, using scientific language and tools.	1.) The educator introduces academic/scientific terms by connecting to prior knowledge and/or sensory stimuli. 2) The educator uses scientific vocabulary, explains concepts thoroughly, and encourages discussions that promote the usage of scientific language 3.) the educator utilizes, encourages, and assist learners in using materials, equipment, and manipulatives that promote scientific inquiry 4.) The educator frequently provides scientific activities or uses strategies that engage learners cognitively, physically and/or emotionally. 5.) The educator integrates collaborative group work activities where learners have the opportunity to interact and learn from one another	1.) The educator introduces academic/scientific terms without connecting the meaning of those terms for the learner 2.) The educator occasionally uses scientific vocabulary, explains concepts thoroughly, and encourages discussions that promote the usage of scientific language. 3) The educator occasionally utilizes, encourages, and assists students to use materials, equipment, and manipulatives that promote scientific inquiry 4.)The educator occasionally provides scientific activities or uses strategies that engage learners cognitively, physically and/or emotionally. 5.) The educator occasionally integrates collaborative group work activities where learners have the opportunity to interact and learn from one another.	1.) the educator does not use materials, equipment or manipulatives with learners. 2.) The educator does not use scientific vocabulary, explain concepts thoroughly and encourage discussions 3.) The educator does not utilize, encourage and assist learners in using materials, equipment, and manipulatives that promote scientific inquiry 4.) The educator does not provide scientific activities or use strategies that engage learners cognitively, physically and/or emotionally. 5.) The educator does not integrate collaborative group work activities where students have the opportunity to interact and learn from one another.
Strand 6: Think about themselves as science learners and develop an identity as someone who knows about, uses, and sometimes contributes to science.	Educator shows an extensive amount of knowledge regarding subject topic, has the hunger to learn more and is passionate about sharing knowledge with participants. Audience is often inspired to learn more about the subject. Educator has an engaging lesson plan that logically guides participants through the material and motivates those participants to think of themselves as science learners. Educator is able to assess through active engagement during the program whether participants are challenged to think of themselves as someone who can contribute to science. Educator changes lesson as necessary according to their assessment.	Educator shows a minimal level of knowledge regarding subject topic and exhibits little or no desire to further that knowledge. Educator has an average lesson plan or follows a script which they execute by "going through the motions." This sometimes leads to participants thinking of themselves as science learners. Audience may leave feeling confused about their role as science learners. Educator provides minimal information for participants to feel as though they can contribute to science.	Educator shows no knowledge and/or interest regarding subject topic. Educator has no lesson plan and does not encourage participants to think of themselves as science learners. Educator takes a passive role and does not lead the audience in science learning. Educator provides no information that leads to participants feeling like they contribute to science. Audience leaves haven gotten nothing out of the "lesson".

Informal science education teaching rubric

Topic	5 Exemplary	3 Proficient	1 Unsatisfactory
Motivating Visitors	• The content is well organized and is personally meaningful and relevant to visitors. • The educator consistently develops learning experiences where inquiry, curiosity and exploration are valued. • The educator regularly reinforces and rewards answers/interactions.	• The content is organized and is personally meaningful and relevant to visitors. • The educator sometimes develops learning experiences where inquiry, curiosity and exploration are valued. • The educator sometimes reinforces and rewards answers/interactions.	• The content is inconsistent and is not personally meaningful and relevant to visitors. • The educator rarely develops learning experiences where inquiry, curiosity and exploration are valued. • The educator rarely reinforces and rewards answers/interactions.
How Educator Presents Content	Educator is not speaking from a memorized script. Presentation of content always includes: • visuals that establish: the purpose of the presentation, organization of the presentation, and include internal summaries of the presentation. • examples, illustrations, analogies, and labels for concepts and ideas. • concise communication. • logical sequencing and segmenting. • all essential information. • no irrelevant, confusing, or non-essential information.	Educator seems to be speaking from a memorized script, but includes personal anecdotes. Presentation of content most of the time includes: • visuals that establish the purpose of the presentation, preview the organization of the presentation, and include internal summaries of the presentation. • examples, illustrations, analogies, and labels for concepts and ideas. • concise communication. • logical sequencing and segmenting. • all essential information. • no irrelevant, confusing, or non-essential information.	Educator is speaking from a memorized script and does not vary from the script. Presentation of content rarely includes: • visuals that establish the purpose of the presentation, preview the organization of the presentation, and include internal summaries of the presentation. • examples, illustrations, analogies, and labels for concepts and ideas. • concise communication. • logical sequencing and segmenting. • all essential information. • no irrelevant, confusing, or non-essential information.
Activities and Materials	Activities and materials include all of the following: • are challenging. • sustain visitors' attention. • elicit a variety of ways of thinking. • are relevant to visitors' lives. • induce visitor curiosity and suspense. • provide visitors with choices. • incorporate multimedia and technology. • incorporate resources beyond the ISI (e.g., educator designed materials, manipulatives, internet resources, etc).	Activities and materials include most of the following: • are challenging. • sustain visitors' attention. • elicit a variety of ways of thinking. • are relevant to visitors' lives. • induce visitor curiosity and suspense. • provide visitors with choices. • incorporate multimedia and technology. • incorporate resources beyond the ISI (e.g., educator designed materials, manipulatives, internet resources, etc).	Activities and materials include few of the following: • are challenging. • sustain visitors' attention. • elicit a variety of ways of thinking. • are relevant to visitors' lives. • induce visitor curiosity and suspense. • provide visitors with choices. • incorporate multimedia and technology. • incorporate resources beyond the ISI (e.g., educator designed materials, manipulatives, internet resources, etc).
Questioning	Educator questions are varied and high quality providing a balanced mix of question types: o knowledge and comprehension o application and analysis o evaluation • Questions are consistently purposeful and coherent. • Questions are well sequenced.	Educator questions are varied and high quality providing for some, but not all, question types: o knowledge and comprehension o application and analysis o evaluation • Questions are usually purposeful and coherent. • Questions are sometimes sequenced.	Educator questions are inconsistent in quality and include few question types: o knowledge and comprehension o application and analysis o evaluation • Questions are random and lack coherence. • Questions are rarely sequenced.
Educator Content Knowledge	• Educator displays extensive content knowledge of the topic. • Educator answers nearly all (reasonable) visitors' questions about the topic. • Educator regularly highlights key concepts and ideas, and uses them as bases to connect other powerful ideas. • Educator covers limited content in sufficient depth to allow for the development of understanding.	• Educator displays accurate content knowledge of all the subjects he or she teaches. • Educator sometimes answers visitors' questions (correctly). • Educator sometimes highlights key concepts and ideas, and uses them as bases to connect other powerful ideas. • Educator covers extensive content with little depth.	• Educators displays under-developed content knowledge in several subject areas. • Educator rarely answers visitors' questions (correctly). • Educator does not understand key concepts and ideas in the discipline, and therefore presents content in an unconnected way. • Educator covers extensive content with little depth.
Environment and Respectful Culture	The educator • welcomes all members and guests • is organized and understandable to all visitors. • supplies, equipment, and resources are easily and readily accessible. • interactions with visitors demonstrate caring and respect for visitors. • represents and communicates a positive image of the ISI and its mission (The mission of the ISI is clearly stated).	The classroom • welcomes most members and guests. • is organized and understandable to most visitors. • supplies, equipment, and resources are accessible. • interactions with visitors are generally friendly. • represents and communicates a positive image of the ISI and its mission (The mission of the ISI is clearly stated).	The classroom • is somewhat cold and uninviting. • is not well organized and understandable to visitors. • supplies, equipment, and resources are difficult to access. • interactions with visitors are sometimes authoritarian, negative, or inappropriate. • represents and communicates a positive image of the ISI and its mission (The mission of the ISI is clearly stated).

WE HAVE MORE TO DISCUSS!!!

Reform efforts in STEM education and formal education have embraced informal science education as an important part of developing cooperative learning, emphasizing communication skills, and aiding in facilitating science learning.

- How can we support these initiatives and still maintain our informal status?

- Will informal science educators be observed using formal teaching standards?

DISCUSSION/IMPLICATIONS

This is my own personal question/concern:

If we place formal boundaries such as those discussed in the previous slide are we still doing informal science education?

Facebook Discussion

Please continue this discussion on the Informal Science Education Facebook page at

https://www.facebook.com/pages/Informal-Science-Education/195637213954543

Contact information

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