Communicating With Your Audience: Tips to Presenting Live, Interactive Programming
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BIOGRAPHIES
Dayna Thompson has been Assistant Planetarium Director at Ball State University since 2012. With a M.S. in Physics she has over 10 years’ experience in STEM outreach.

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ABSTRACT
There are many characteristics and abilities that are associated with scientists today, all of which can be learned. As planetarians, how can we go further in our presentations to help better prepare the next generation of scientists and, in turn, foster a questioning public? During this workshop, you will team up and actively explore the characteristics of a scientist. As a group, we will come up with creative activities and methods that teach planetarium learners how to be a scientist. We will also take a few minutes to hear from participants about the state of science education (formal and informal) in their home countries in order to stress the importance of promoting scientific literacy.

INTRODUCTION
Not to be confused with a trait, which is a genetically determined quality, a characteristic can be taught and refined over time. Certain characteristics are said to be associated with various professions. When you think of a scientist, for instance, a list of characteristics can come to mind. When asking various audiences what they think of, they sometimes answer: brainy, careful, creative, critical thinker, flexible, focused, insightful, knowledgeable, logical, objective, observant, open-minded, patient, persistent, resourceful, risk taker, skeptical, and even white lab coat.

We teach some of these characteristics to planetarium guests – whether it is apparent or not. Before discussing how, let’s refine this list and focus on the following characteristics of a scientist:

- Careful
- Creative
- Curious
- Critical thinker (also: Logical, Objective, and Skeptical)
- Observant
- Open minded (also: Resourceful)
- Persistent (also: Patient)
- Risk taker
Note: We should not forget that these characteristics build off of a good foundation of knowledge. Information and facts are vital to each planetarium lesson. However, it is worth going beyond in presentations to help encourage other facets of the mind.

**Tips to Fostering these Characteristics**

Below are some characteristics associated with scientists and some tips to teaching them:

**Careful**
- Ask if there is anything else to consider before moving on to an answer/solution.
- Let learners realize on their own if they missed some important information that would have helped them with something.
- Ask learners what they could have done differently – and let them try a task/question again if possible.

**Creative**
- Allow time for divergent or off topic questions.
- Spend time imagining. For example: what it would be like to travel into space, live on another planet, see an alien, etc.
- Create/find new pictures in the sky or in other objects in space.
- Come up with names for exoplanets based on their characteristics.

**Curious**
- Encourage questions and revisit old questions when able.
- Model and promote ambition.
- Develop game-based learning exercises.
- Use diverse and unpredictable content.

**Critical thinker/Logical/Objective/Skeptical**
- Give reasons behind some discussion points – explain why learners are doing something.
- Talk about bias and the way emotions or motives can influence judgements.
- Present bad vs. good arguments with concrete examples.
- Create categories and classify objects.
- Ask a question and give relevant as well as irrelevant information to help them find the answer. Have learners sift through the provided information to obtain the answer.
- Ask learners to consider alternative explanations or solutions for issues.
- Ask questions that allow learners to explore ethical, moral, or public policy dilemmas.
- Provide examples of fake news/images and break them down to figure out why they are misleading or incorrect.

**Observant**
- Define what an observation is and point out when someone makes one.
- Emphasize that observations can be made with senses other than sight. “What do you hear?” or “How does that feel?” etc.
- Demonstrate how to measure or watch with good technique.
- Use compare and contrast exercises.
- Give learners a chance to observe or find something before showing it to them.
- Have learners list all the features they see in an object.
Open minded/Resourceful

- Be open with what the learning goals of activities are – if it’s to learn how to be open minded or resourceful, explain that.
- Focus on possibilities and not constraints.
- Challenge learners to think broadly.
- Have learners draw on past experiences.
- Provide examples of scientists or people thinking “outside the box.”
- Support rule-bending (Galileo).
- Teach collaboration (more minds contributing to the same task).
- Encourage interdisciplinary thinking.
- Use cross-cultural examples or stories.
- Urge learners to publicize and praise one another’s accomplishments and ideas.

Persistent/Patient

- Model it. Tell a story of how you failed at something but kept trying.
- Give feedback such as: “I know you can do it if you keep at it.” or “If you’re really stuck, ask for help.” or “Think of how good you will feel once…”
- Teach how the brain works through plasticity so learners understand that it is natural and okay if they do not succeed at something the first time.

Risk taker

- Encourage learners to take, as well as create, opportunities.
- Build learners’ trust and encourage them so they will respond, speak-up, and feel like their input is valued.
- Encourage alternative solutions to problems (team work or pairs work well with this as it can sometimes be daunting for learners to give new or untested answers).
- Consider asking a question with no definite answer so learners are forced to provide original perspectives.
- Show risk taking in your own answers to issues/questions in an effort to minimize the pain of making an error.
- Let learners work and talk on their own.
- If learners are going down the wrong path, let them learn from the experience.

Sample Presentation Outline for “General Sky” Show

During planetarium programs, we often inspire future artists, writers, and various other non-STEM dreams. In addition, many of us have a mission to teach science. Although not everyone move on to get a STEM career, we know that they will benefit from these lessons as science is always around us. It’s unavoidable in our day-to-day lives. Therefore, it is a good idea to start presentations with an introduction on what doing science means.

Intro

- Introduce yourself and science
  - “My name is ____, I work here at the ____.”
  - “When I went to school I studied ___science____.” OR “I am going to school and studying ___science____.”
    - “Raise your hand if you do science at your school.”
    - “Can someone explain what it means when we say we do science?”
Science can be defined most simply as: “The study of the world around us in order to improve our understanding of how it works.” OR “Science is a means of improving our knowledge and understanding of the universe based on the collection of observation-based evidence.”

- Model and promote ambition during introduction and throughout presentation to encourage curiosity in learners.

  Room full of observant scientists
  - “We are all scientists today in the planetarium because we are going to be making a lot of observations.”
  - “Do you know what an observation is?”
    - If no one knows, define: “When you make an observation, you are taking a patient look at something and noticing things about it: facts or occurrences.”
  - “We are all going to be scientists today because we are going to observe the world around us, ask questions based on those observations, and try to find the answers to those questions using more observations.”
    - Note: A positive response is a good idea when someone makes an observation (even if it is off topic).

- Technology and scientific tools
  - “Scientists need tools to do science, so we have some technology that we use as tools in the planetarium to help us. They will be able to recreate the sky and show us things that happen in real life.”
    - Introduce any technology or tools you will use: star projector, computers, etc.

Planetarium guests can benefit from an introduction like this because it gives them the words that define their activities/actions. They may have also thought they didn’t like science based on an incorrect view of what it entails. After discussion, they may find that they enjoy science and would even like to do more. Beyond the introduction, one can cultivate the characteristics of a scientist throughout the presentation. These characteristics are beneficial to all learners, not just future scientists. For example, the ability to ask questions stems from the many different characteristics a scientist has. It is important for everyone to formulate questions. This gives them the ability to better navigate various obstacles. Today, this includes the rise in fake news. Given the proper abilities, everyone can more readily sort out credible news articles from fake or biased one. Having a questioning public like this can lead to a well-informed community – a community in which we aspire to live.

“GENERAL SKY” PRESENTATION OUTLINE

**EXAMPLE**

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<thead>
<tr>
<th>Activity/Method</th>
<th>Characteristic</th>
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<tr>
<td><strong>1.</strong> Bring up daytime sky with Sun above horizon in the East, Moon in waning</td>
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<td>crescent phase, and clouds/birds/directions/etc. up in the sky.</td>
<td>Observant</td>
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<td>Ask learners to make observations out loud or to their friends next to them.</td>
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<td>Repeat as many as you can while facilitating more observations. For example:</td>
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<td>“Can you tell me if the birds are closer than the clouds? How do you know? Are</td>
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<td>the Moon/Sun are closer than the clouds?”</td>
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<td>Observant</td>
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<td>Page</td>
<td>Briefly compare and contrast the Moon and Sun based on age level of learners. (You can come back to this more later when taking “trips” to Sun/Moon.)</td>
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| 3    | **Sunrise vs. Sunset/directions:**  
**Presenter:** “Can you tell me if the Sun is rising (going up) or setting (going down)? How do you know?”  
**Go forward in time a few hours using your technology/tools to see if the Sun is rising or setting.**  
Explain that the Sun will always rise in the same direction each day. **Presenter:** “The Sun will always rise in the ____.” (Have learners fill the blank together out loud.) |
| 4    | **Presenter:** “I wonder why the Sun and the Moon appeared to change their location in the sky. Does anyone have any ideas?”  
Answers may vary but often result in the following discussion:  
**Learner:** “The Sun and the Moon appear to move across the sky because the Earth is going around the Sun and the Moon is going around the Earth.”  
**Presenter:** “YES, it is true that the Earth goes around or orbits the Sun, and the Moon orbits the Earth; AND how long does it take for the Earth to go all the way around the Sun?”  
**Learner:** “A year/≈365 days.”  
**Presenter:** “Yes, it takes a year for the Earth to orbit the Sun. Let’s think about this carefully. Remember that we only went a few hours ahead in time and the Sun and Moon moved a large distance on the sky. Is there something else that the Earth is doing that takes less time that would cause this motion?”  
**Learner:** “The Earth is spinning!”  
**Presenter:** “Yes, the Earth is spinning or rotating as it orbits, or goes around, the Sun. How long does it take to rotate one time?”  
**Learner:** “A day/24 hours.”  
**Presenter:** “Exactly, the Earth rotates once every 24 hours and it makes it so the Sun and Moon appear to move across the sky during the day and night.” |
| 5    | **Speed up time and go to Sunset.**  
After teaching what a constellation is: Instead of showing learners where constellations are, have them try to find them on their own by either explaining what one looks like or giving them a star chart. An alternative for this, especially for young learners, is to bring up constellation overlays and have them find certain animals or objects in the sky. Have them explain where they are to their friends using the directions they learned (up/down, high/low, NWSE, by the horizon, etc.).
“I wonder what it would be like to: go into space, visit another planet, see the sky from somewhere far away and name new constellations, etc.” Then take a trip to somewhere in the solar system or beyond. You can also have them try and name or rename new things they see together.

**Presentation Outline by Workshop Participants**

During this workshop, participants worked in groups to come up with various activities specifically designed to facilitate one of the characteristics associated with a scientist (that was their creative constraint – see below). For instance, people whose show topic was “Moon Phases” had to focus on teaching students to be “careful.” EM Spectrum: Creative, Intro to SS: open minded, Jupiter and Juno: Persistent, and eclipses: risk taker.

**SHOW TOPIC(S): __________________ CREATIV**

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