Swimming into Science: Sharks and Minnows Summer Camp

Victor Perez and Kent Crippen
Summer Camp Overview

• Who?
  Elementary-aged students
  (Grades 3-4)

• Where?
  Florida Museum of Natural History

• How long?
  Five half days (June 2018)

• Theme?
  STEM careers and Fish
Primary Goals

1. Increase interest and awareness of STEM careers

2. Identify and address misconceptions about STEM careers

3. Identify and address misconceptions about fish

REPORT TO THE PRESIDENT
ENGAGE TO EXCEL: PRODUCING ONE MILLION ADDITIONAL COLLEGE GRADUATES WITH DEGREES IN SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS

PCAST (2012)
# Theoretical Framework

<table>
<thead>
<tr>
<th>Dorsen’s Factors</th>
<th>Brief Description</th>
<th>Intervention Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Career Awareness and Decision to pursue a</td>
<td>STEM careers cannot be pursued if students are not aware of them and how they are</td>
<td>Participants were introduced to five STEM careers.</td>
</tr>
<tr>
<td>STEM career</td>
<td>introduced to those careers will influence their decision to pursue those careers.</td>
<td></td>
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<tr>
<td>Academic Preparation and Achievement</td>
<td>Academic preparation should be augmented with informal extracurricular STEM</td>
<td>Camp activities were aligned to Florida’s K-12 teaching standards (NGSSS) to augment</td>
</tr>
<tr>
<td></td>
<td>experiences, which will in turn enhance interest and performance in formal classrooms.</td>
<td>formal education.</td>
</tr>
<tr>
<td>Identification with STEM Careers</td>
<td>Students must envision themselves in STEM careers, which can be facilitated by role</td>
<td>Participants experienced authentic STEM practice and met early career professionals</td>
</tr>
<tr>
<td></td>
<td>models and/or real-world experiences.</td>
<td>(role models).</td>
</tr>
<tr>
<td>Self-efficacy</td>
<td>Students must feel confident in their ability to succeed in STEM careers.</td>
<td>Implemented a validated survey to measure attitudes towards STEM careers.</td>
</tr>
<tr>
<td>External Environmental Factors (Barriers and</td>
<td>Life experiences, both positive and negative, dictate a student’s perception of STEM.</td>
<td>The summer camp is a STEM-related life experience.</td>
</tr>
<tr>
<td>Supports)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interest, Enjoyment, and Motivation</td>
<td>Positive childhood experiences have a strong impact on STEM career pathways.</td>
<td>Participants’ responses indicate an overall positive experience.</td>
</tr>
</tbody>
</table>

Summary of the six factors that influence students’ pursuit of STEM careers from Dorsen et al. (2006).
**Evaluation Plan**

<table>
<thead>
<tr>
<th>Front-end (Needs Assessment)</th>
<th>Formative</th>
<th>Summative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prior to implementation</td>
<td>During implementation</td>
<td>After implementation</td>
</tr>
<tr>
<td>Compromise between my interests and the museum’s needs</td>
<td>Students filled out scientific notebooks throughout the week (formative assessment tasks)</td>
<td>Pre/Post validated survey on attitudes towards STEM careers</td>
</tr>
</tbody>
</table>
A Day in the Life of a Camper...

1. Introduce topic
2. Draw a Scientist Activity
3. Role Model Visit
4. Inquiry Activity 1
5. Museum excursion
6. Snack Break
7. Inquiry Activity 2
8. Inquiry Activity 3
9. Reflection
Day 1: Fish Anatomy and Classification

• **Driving Question:** What are fish skeletons made of?

• **Learning Objectives:** After day one, campers will be able to:
  • explain how living bony fish, sharks, and rays are classified.
  • relate body shape to locomotion.
  • understand the compositional differences between bone, cartilage, and teeth.

• **Words to Know:** Vertebrate, Chondrichthyes, Osteichthyes, Cartilage, Phosphate, Enamel, Dentine, Crown, Root

• **Career Highlight:** Biologist – someone that studies living organisms
Day 1: Fish Anatomy & Classification

Today we will:
• explain how living bony fish, sharks, and rays are classified.
• relate body shape to locomotion.
• understand the differences between bone, cartilage, and teeth.

What are fish skeletons made of?
Camp Progression and Scaffolding

Day 1
- Topic: Fish Anatomy & Classification
- Career Highlight: Biologist

Day 2
- Topic: Fossil Preservation
- Career Highlight: Paleontologist

Day 3
- Topic: Stratigraphy
- Career Highlight: Geologist

Day 4
- Topic: Ecology & Diet
- Career Highlight: Ecologist

Day 5
- Topic: Biomimicry
- Career Highlight: Engineer
Formative Assessment Task: Draw-a-Scientist Test Checklist (DAST-C)

1. Lab Coat
2. Eyeglasses
3. Facial Hair
4. Symbols of Research
5. Symbols of Knowledge
6. Technology
7. Relevant Captions

________________________

1. Male Gender
2. Caucasian
3. Indications of Danger
4. Presence of Light Bulbs
5. Mythic Stereotypes
6. Indications of Secrecy
7. Working Indoors
8. Middle Age or Elderly
9. Open Comments

Preliminary Results

• Participants: N=18
  • 9 Male, 9 Female

• # of Drawings: N=80
  • Biologist: n=15
  • Paleontologist: n=18
  • Geologist: n=15
  • Ecologist: n=16
  • Engineer: n=16

<table>
<thead>
<tr>
<th>Stereotype</th>
<th>Frequency</th>
<th>Uncertain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lab Coat</td>
<td>15%</td>
<td>5%</td>
</tr>
<tr>
<td>Eyeglasses</td>
<td>2.5%</td>
<td>0%</td>
</tr>
<tr>
<td>Facial Hair</td>
<td>3.75%</td>
<td>0%</td>
</tr>
<tr>
<td>Symbol of Research</td>
<td>63.75%</td>
<td>0%</td>
</tr>
<tr>
<td>Symbol of Knowledge</td>
<td>11.25%</td>
<td>0%</td>
</tr>
<tr>
<td>Technology</td>
<td>83.75%</td>
<td>0%</td>
</tr>
<tr>
<td>Relevant Caption (ex. “Eureka!”)</td>
<td>16.25%</td>
<td>0%</td>
</tr>
<tr>
<td>Male Gender</td>
<td>48.75%</td>
<td>13.75%</td>
</tr>
<tr>
<td>Caucasian</td>
<td>87.5%</td>
<td>10%</td>
</tr>
<tr>
<td>Indications of Danger</td>
<td>6.25%</td>
<td>0%</td>
</tr>
<tr>
<td>Presence of Light Bulbs</td>
<td>2.5%</td>
<td>0%</td>
</tr>
<tr>
<td>Mythic Stereotypes (ex. Mad Scientist)</td>
<td>22.5%</td>
<td>0%</td>
</tr>
<tr>
<td>Indications of Secrecy</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Working Indoors</td>
<td>27.5%</td>
<td>3.75%</td>
</tr>
<tr>
<td>Middle aged or Elderly</td>
<td>2.5%</td>
<td>1.25%</td>
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</tbody>
</table>
Observations

- Does not self-identify
- Non-descript appearance
- Loss of lab coat
- Location varies with profession
- Biologist = Chemist
- Geologist is sensationalized
Observations

- Self-identifies with professions
- Depicts practice
- Change in appearance
- Location varies with profession
- Strong overlap between paleontologist and geologist
Biologist

Paleontologist

Geologist

Ecologist

Engineer

**Observations**

- Self-identifies with professions
- Depicts practice at high level
- Location varies with profession
- Strong differentiation between professions
Summary

DAST-C Results:
• Very few stereotypes about appearance, with the exception of ethnicity
  o Lab coat (15%), Eyeglasses (2.5%), Facial Hair (4%), Elderly (2.5%), Caucasian (87.5%)
• Many depictions of research and technology
• Gender largely reflected participant demographic
  o 49% male (n=39), 40% female (n=32)

Awareness of STEM careers:
• Biologist were often associated with chemistry and working indoors
• Ecology was often associated with animals and working outdoors
• Geology often sensationalized as rich, gem and mineral hunters
• Geology and paleontology were very similar and always depicted outdoors
• Engineers were typically associated with fixing/building
Next Steps

1. Validate DAST-C results with additional coders

2. Apply the Draw-an-Engineer Test (DAET)

3. Align observed trends in drawings to written responses in journals and results of validated survey

4. Analyze drawings of fish and written responses to identify misconceptions
Acknowledgements

Bruce MacFadden
Kent Crippen
FLMNH Education Staff
Junior Volunteers

NSF Grant No. DGE-1315138; DGE-1842473; DRL-1322725