**STEM - High School**

**Leading Class Discussion on STEM Carbon Footprint**

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Avatar(s) &amp; Environment</th>
<th>Suggested Learner Audience</th>
</tr>
</thead>
</table>
| Simulations for Secondary Science Teachers Conference | Host Avatar(s)  
Nina/Michael | ● Pre-Service Teachers  
● Non-credentialed Teachers  
● Novice Teachers |
| Stacey Culleny  
Dr. Norm Herr  
Valecia Kelly  
Alicia Lane  
Dr. Michael McVey | Simulation Avatars  
Ciara, Angela, Jordan, James, Stephanie |                          |
| Mursion            | Environment [ML3z]  
11th Grade High School Classroom |                          |

**Delivery Mode(s) Available for Scheduling**

1:1, Facilitated Group

This scenario was created in partnership with AACTE and the convening, Enhancing Science Education through Virtual Reality: A Conference to Design Simulations that Enhance the Clinical Preparation of Secondary Science Teachers, is funded by the National Science Foundation (NSF) 20-572 Discovery Research PreK-12, award #2040747.

**Learner-Facing Vignette:**

You are the teacher of a high school STEM class. Today is the second day of your lesson exploring the engineering design process and carbon footprints. The students understand that a Carbon Footprint is the amount of carbon dioxide and other carbon compounds emitted due to the consumption of fossil fuels by a particular person. In preparation for today’s class discussion, the students have calculated their own carbon footprints and have them pre-loaded on their tablets. You intend to begin your discussion by asking the students to state their findings about their day-to-day energy consumption. You plan to encourage the students to discuss why some people’s footprints have more of an impact than others, and guide the students to brainstorm possible solutions they can employ in their day-to-day lives that can reduce their carbon footprints.

**Learner Outcome:**

Your goal is to lead a class discussion, encouraging the students to break a large-scale problem down into smaller more manageable problems that can be solved through engineering.

**Strategies/Best practices to consider:**

- Ask higher-order thinking questions to engage the students critically on the topic
- Promote the analysis and interpretation of data to problem-solve
- Encourage students to make assertions stemming from evidence
**Scenario Guide**

**Activation Date:**

**Intensity Level:** Low

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**Information about Intensity Level: Low**

- Low intensity sessions are meant to build confidence for the learner. This setting is recommended for first time learners.

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**Supplemental Materials:**

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**Students Prior Knowledge:**

The definition of a carbon footprint. The students understand that a Carbon Footprint is the amount of carbon dioxide and other carbon compounds emitted due to the consumption of fossil fuels by a particular person. Outside of this the students may have limited to no prior knowledge.

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This scenario is gearing toward practicing the following of the

**Next Generation Science Standards 8 Practices of Science & Engineering:**

1. **HS-ETS1-1 Engineering Design**

   Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

2. **HS-ETS1-2 Engineering Design**

   Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

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**Bloom's Taxonomy**

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Student Work:

Graphed data is reported in kgs.

**Ciara (she/her/hers)**

Household details:

Lives with her parents in military base lodging. Her mother is a military chaplain and her father is a translator. She has one sibling, but he does not live with them. She has a pet betta fish.

**Ciara’s Carbon Footprint**

<table>
<thead>
<tr>
<th>Category</th>
<th>Household</th>
<th>National Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home</td>
<td>6364</td>
<td>8451</td>
</tr>
<tr>
<td>Food</td>
<td>2912</td>
<td>4999</td>
</tr>
<tr>
<td>Purchases</td>
<td>1237</td>
<td>2680</td>
</tr>
<tr>
<td>Transportation</td>
<td>2563</td>
<td>5752</td>
</tr>
</tbody>
</table>

**Angela (she/her/hers)**

Household details:

Lives with her mother and step-father. Her mother is an attorney and her step-father is a stay-at-home dad. She has two siblings (one living at home & one in college) and a pet cat.

**Angela’s Carbon Footprint**

<table>
<thead>
<tr>
<th>Category</th>
<th>Household</th>
<th>National Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home</td>
<td>4160</td>
<td>8451</td>
</tr>
<tr>
<td>Food</td>
<td>2613</td>
<td>4999</td>
</tr>
<tr>
<td>Purchases</td>
<td>954</td>
<td>2680</td>
</tr>
<tr>
<td>Transportation</td>
<td>2917</td>
<td>5752</td>
</tr>
</tbody>
</table>
Scenario Guide
Activation Date: Low

### Jordan (they/them/their)

**Household details:**
Lives with their mother. Their mother is a case manager for a community service agency. They have two siblings and a pet guinea pig.

### James (he/him/his)

**Household details:**
Lives with his parents. His mother is a retail manager, and his father is a long-haul trucker. No siblings. No pets.

### Stephanie (she/her/hers)

**Household details:**
Lives with her parents. Her father is a commercial airline pilot, and her mother manages a high-end clothing boutique. She has one sibling and a pet dog.
Background (Internal, not Learner-Facing)

<table>
<thead>
<tr>
<th>Review Time</th>
<th>Delivery Mode(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mursion Bank: Up to 15 minutes bill as “Trainee” directly to client</td>
<td>1:1, Facilitated Group</td>
</tr>
</tbody>
</table>

Scenario Specific Content

Intensity Level:
- **Low**: In a low intensity, the students exhibit mostly on task behavior with a few instances of off task behavior. Most students are engaged and off-task behavior is likely a result of over-participation or excitement over the subject matter. Off-task behavior can be redirected at the first attempt by the Learner.

Host Specific Inquiries:
- **N/A**

What is this scenario intended to address?

In this simulation, the learner will elicit student thinking related to the content. Specifically, they will pose questions that provoke students to share their thinking about the content in order to evaluate their understanding, guide instructional decisions, and surface ideas that will benefit other students.

Simulation Specialist Goal:
The goal of the Simulation Specialist is to follow the teacher’s lead and, if elicited, create an open dialogue about the content between students.

Avatar’s Perspective:
Initially, the students will only have a surface level understanding of the content; the Learner will have to elicit the differing interpretations of the content through higher-order questions and further checks for context.
- If asked close-ended questions - answer with “yes” or “no” only
- If questions are unrelated to text or surface level, do not volunteer additional responses

Carbon Footprint Bar Chart:
All of the student data is combined into one bar chart on the next page for ease of reference.
**Graphed data is reported in kgs.**

### Possible Student Responses & Questions

#### Ciara
- **Possible Student Responses**
  - I live at the military base, so even though my personal score isn’t that high, I know where I live has a really big carbon footprint.
  - Most everything we need is on the base, so we don’t really use transportation except for special occasions or when I come to school.

#### Angela
- **Possible Student Responses**
  - I’m vegan so I looked up what that means for my carbon footprint and found this University of Oxford study that said cutting meat and dairy from your diet could reduce your carbon footprint from food by up to 73 per cent!
  - I wonder what the school’s footprint is - we should get solar panels on all the roofs!

#### Possible Question
- **Would growing a garden help? Or composting?**
- **How do carbon footprints affect greenhouse gases?**
### Scenario Guide

**Activation Date:**

**Intensity Level:** Low

<table>
<thead>
<tr>
<th>Jordan they, them, theirs</th>
<th>Possible Student Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>We make sure to bring reusable bags to the grocery store.</td>
</tr>
<tr>
<td></td>
<td>I think our footprint is bigger in the home section because we use a lot of energy doing laundry - my mom helps local unhoused families wash their clothes. Also my dad lives a couple hours away, so I know my transportation is affected by that.</td>
</tr>
</tbody>
</table>

**Possible Question**

*The coffee shop I work at has a lot of imported beans - does that make a difference in my carbon footprint?*

<table>
<thead>
<tr>
<th>James he, him, his</th>
<th>Possible Student Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I think we are pretty average except in the transportation section because of my dad’s job.</td>
</tr>
<tr>
<td></td>
<td>I try to make sure to turn off the water when I brush my teeth but I always forget.</td>
</tr>
</tbody>
</table>

**Possible Question**

*If your job means you have to travel - like my dad does with driving trucks and Stephanie’s dad with being a pilot - how can you fix how big it makes your carbon footprint?*

<table>
<thead>
<tr>
<th>Stephanie she, her, hers</th>
<th>Possible Student Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I was really surprised at how high my carbon footprint is!</td>
</tr>
<tr>
<td></td>
<td>I guess I just didn’t think about how often we leave the lights on - also sometimes we’ll all be doing something in a different room that uses energy. Like I’ll be watching TV in one room and Mason will be playing some video game. And mom will be on the computer.</td>
</tr>
<tr>
<td></td>
<td>Also I don’t know why my food is so high. (They eat out/order in a lot, and they eat a lot of meat).</td>
</tr>
</tbody>
</table>

**Possible Question**

*The carbon footprint calculator asked how often we buy electronics, but why does it matter if we buy new TVs to replace our old ones every year or so? Don’t the new ones work more efficiently?*

### Pushback Techniques:

- If Learner never switches students, a student may ask “Why am I the only one getting asked anything?”

### Sim Specialist Information:

- **Carbon Footprint:** The amount of carbon dioxide and other carbon compounds emitted due to the consumption of fossil fuels by a particular person. This ranges from our direct energy consumption from personal household activities such as cooking or showering to our indirect energy consumption from the food we consume and how that industry operates.
- **Carbon Footprint Website:** [Basic Carbon Footprint Calculator](www.mursion.com)

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