Supplemental Materials

for

Self-Driven Service Learning: Community-Student-Faculty Collaboratives Outside of the Classroom

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Table of Contents
(Total pages 14)

Appendix 1: Call for volunteers
Appendix 2: Supplemental Table 1: List and descriptions of stations at Cell Day
Appendix 3: Supplemental Table 2: Museum staff feedback on station activities
Appendix 4: Supplemental Figure 1: Pages in the Cell Passport booklet
Appendix 5: Supplemental Table 3: Representative museum guest responses to KWL questions
Appendix 6: Supplemental Table 4: Student responses to reflection questions
Appendix 7: Supplemental Table 5: Constructive feedback to improve event in the future

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Appendix 1: Call for volunteers.

The following text was sent in an e-mail (at the beginning of October 2014) by the Center for Leadership and Community Engagement at Rollins College with the purpose of recruiting students interested in engaging in self-driven service learning leading to a Cell Day event in the spring of 2015.

Dear student community,

We are writing to invite you to participate in an exciting opportunity to combine your interests in the biological sciences and community outreach. Every year the National Institute of General Medical Sciences hosts Cell Day, an online event that is meant to highlight cell science to a varied audience (http://publications.nigms.nih.gov/cellday2014/). We have been invited to help the Orlando Science Center (http://www.osc.org) hold a LIVE Cell Day event in the spring of 2015.

Join a few of us in the Department of Biology that are planning this event! We will start meeting mid-October. Only two hours a week of your time will be required. Send an e-mail of interest to vsegarra@rollins.edu.
Appendix 2: Supplemental Table 1: List and descriptions of stations at Cell Day.

<table>
<thead>
<tr>
<th>Station number and title</th>
<th>Concepts it highlights</th>
<th>Description of activities/experiments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cells are everywhere!</td>
<td>Cell theory</td>
<td>Examine methylene blue-stained cheek cells under a microscope</td>
</tr>
<tr>
<td>2. Do it Yourself DNA</td>
<td>Learn the double helix structure of DNA</td>
<td>Construct a DNA double helix from candy <a href="http://www.theguardian.com/science/blog/2013/apr/25/dna-double-helix-jelly-babies-liquorice">http://www.theguardian.com/science/blog/2013/apr/25/dna-double-helix-jelly-babies-liquorice</a></td>
</tr>
<tr>
<td>4. Proteins are awesome!</td>
<td>Protein function and structure</td>
<td>Track lactase-mediated production of glucose from lactose (milk sugar) using milk, resuspended Lactaid tablets, and glucose urinalysis strips</td>
</tr>
<tr>
<td>5. Know Your Cells</td>
<td>Cell organelles and their functions</td>
<td>Cell Puzzle</td>
</tr>
<tr>
<td>6. You are what you bleed!</td>
<td>Serology and antigens</td>
<td>Blood typing in the context of forensics (pretend crime scene)</td>
</tr>
<tr>
<td>7. Disease Station: Funnyitis</td>
<td>Disease contraction and prevention</td>
<td>Neon lotion and black light disease simulation (pretend disease= Funnyitis) <a href="http://www.edvotek.com/166.021008.pdf">http://www.edvotek.com/166.021008.pdf</a></td>
</tr>
</tbody>
</table>
### Appendix 3: Supplemental Table 2: Museum staff feedback on station activities.

<table>
<thead>
<tr>
<th>Station/Activity</th>
<th>Museum staff feedback Round 1 (before the event)</th>
<th>Museum staff feedback Round 2 (after the event)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cells are everywhere!</td>
<td>-We generally encourage guests to wear goggles when they work with a chemical.</td>
<td>-The microscope/cheek cell activity went really well. We typically refrain from putting microscopes out because we find most people don’t know how to use them and therefore need constant supervision. The student at that station did great job guiding guests through the activity, which offered a unique opportunity for kids to experience working with a microscope in a controlled environment. The microscope cameras were a great tool as well.</td>
</tr>
<tr>
<td>2. Do it Yourself DNA</td>
<td>-Rather than explaining the procedure, we recommend using pictures</td>
<td>-Do it yourself DNA was one of our favorites and guests loved it, however a lot of the pictures were overlapping the instructions and the font was relatively small.</td>
</tr>
</tbody>
</table>
| 3. What's really inside a strawberry? | -You may want to clarify a few directions: How many strawberries should be put into a baggie? How long should we crush the strawberries…(until they are pulp)? Is the DNA extraction liquid soap? Are 2 teaspoons what is needed for 1 strawberry, 2 strawberries?  
  -In slide #6 we would have them cut a slit in the corner of the bag.  
  -We would recommend pictures for Slide #6 and 7 | -Use disposable bulb pipettes instead of toothpicks to make it easier to collect strawberry DNA |

- The students may also want to add a quick sidebar on the basics of using the microscope ex: which knobs to turn for course vs. fine focus.
| 4. Proteins are awesome!                                                                 | -You may want to move the informative slides (#2-6) about what proteins are to the end of the PowerPoint (we find it keeps the focus of our guests when they do the activity first and read the science after)  
-You might want to answer what a protein does first and then answer what it is.  
-This experiment is interesting for biochemists or biologists, but needs more interpretation to relate to and be interesting for guests. We recommend providing a ‘hook’ or a comparison that our guests can relate to. | -It was great that students were making alterations based on observations throughout the day, like learning that the 60 seconds of waiting time in the proteins experiment could be used to teach about proteins rather than just counting down. |
| 5. Know Your Cells                                                                        | -This is a great introduction to the parts of the cell  
-Make sure that you describe this as a puzzle  
-Walk the guests through solving the puzzle |  |
| 6. You are what you bleed!                                                                | ^                                                                                         | ^                                                                 |
| 7. Disease Station: Funnyitis                                                               | -Some pictures of examples of virus, bacteria and parasites might help break up slide #2 (perhaps you could incorporate the pictures from Slide #3).  
-Slide #6 has a lot of great information. We worry that our guests may not understand what they are reading. If there is a different way to visually represent the information, it may be easier for our guests to interpret  
-Slide #5 needs pictures.  
-Some things that might need clarification: What will the blacklight tell us? How will we know we have contracted funnyitis? What are we looking for? There’s a picture of a magnifying glass, are we using a magnifying glass? | -The funnyitis station has a good concept, but could probably use a little more developing before it would be ready to go out as a final experiment. |
- It may be easier to change the scope of the activity. Perhaps highlight how germs are transmitted. We do a similar activity, where a guest puts the solution on their hands and then shakes other’s hands or holds other objects. It helps show how germs can spread (and for little ones, it reiterates the importance of handwashing).

^ No recommendations for this station were provided. In fact, the museum allowed the student volunteers to use a previously designed serology activity and its PowerPoint presentation as the basis for designing this activity. The students used the model PowerPoint and activity as a guide to design all other station activities.
Appendix 4: Supplemental Figure 1: Pages in the Cell Passport booklet.

To give continuity to the different stations at Cell Day, a booklet was created to serve as an activity book, containing one page/activity per experiment station. Guests could get their passport stamped at each station. Additional pages had space for guests to draw their cheek cells (a cell-fie) and cell drawings for coloring. Museum staff commented on guests staying longer and participating in more experiments than they normally do during regular open lab activities. This can be attributed to guests wanting to get more stamps on their cell passports. It was also noticed that a lot of children enjoyed coloring the pictures on their passports while waiting for an experiment station to become available.
### Appendix 5: Supplemental Table 3: Representative museum guest responses to KWL questions.

<table>
<thead>
<tr>
<th>K- What I Know</th>
<th>W- What I Want to Know</th>
<th>L- What I Learned</th>
</tr>
</thead>
<tbody>
<tr>
<td>cells are in living things</td>
<td>about DNA</td>
<td>parts of the cell</td>
</tr>
<tr>
<td>cells are in our bodies- white and red</td>
<td>wants to know what his cells look like</td>
<td>cells are important</td>
</tr>
<tr>
<td>cells are in our body</td>
<td>wants to see white blood cells</td>
<td>what’s inside of cells</td>
</tr>
<tr>
<td>2 types of cells- prokaryotic and eukaryotic</td>
<td></td>
<td>proteins</td>
</tr>
<tr>
<td>cells are building blocks of life</td>
<td></td>
<td>body made of proteins</td>
</tr>
<tr>
<td>cells make up the body</td>
<td></td>
<td>DNA</td>
</tr>
<tr>
<td>DNA and RNA exist in the cells</td>
<td></td>
<td>DNA is what makes up your bodies</td>
</tr>
<tr>
<td>use cells to make stuff</td>
<td></td>
<td>DNA is in the small part of the cell</td>
</tr>
<tr>
<td>DNA has nucleotides</td>
<td></td>
<td>looked at parts of my check cells</td>
</tr>
<tr>
<td>DNA is all living things</td>
<td></td>
<td>mitochondria gets longer and stronger when you eat healthy foods</td>
</tr>
<tr>
<td>cells have ribosome</td>
<td></td>
<td>special dyes are used to help see different parts of the cells</td>
</tr>
<tr>
<td>white and red blood cells</td>
<td></td>
<td>everybody has unique DNA</td>
</tr>
<tr>
<td>white blood cells fight off “the bad guys”</td>
<td></td>
<td>AT GC-&gt; parts of the DNA</td>
</tr>
<tr>
<td>cells can be in your body</td>
<td></td>
<td>body -&gt; healthy</td>
</tr>
<tr>
<td>cells blood cells that make your blood red</td>
<td></td>
<td>strawberry cells are cool can use extractor to see different parts</td>
</tr>
<tr>
<td>deoxyribonucleic acid (NDA)</td>
<td></td>
<td>what germs look like, can’t see them with naked eye</td>
</tr>
<tr>
<td>adenine, thymine, cytosine, guanine</td>
<td></td>
<td>cells are in our body</td>
</tr>
<tr>
<td>nucleus is the brain of cell</td>
<td></td>
<td>cells have lots of stuff in them</td>
</tr>
<tr>
<td>we’re made up of cells</td>
<td></td>
<td>strawberries have DNA</td>
</tr>
<tr>
<td>prokaryotic and eukaryotic</td>
<td></td>
<td>everything has DNA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>everyone has blood cells</td>
</tr>
</tbody>
</table>
DNA has backbone

strawberry separation

parts of the cell

milk has sugars in it

if the victim doesn’t have the same blood type, there are 2 different people

blood is in our bodies

strawberry extraction

cells make your blood red

your blood is actually clear

we have cells in our esophagus

extract DNA from strawberry after it separates

cheek cells are circular

DNA is like a ladder

safety first-> goggles

DNA shape

different types of blood

^ A KWL chart is used to assess what guests know before and after a given activity. What the participants said was recorded, despite any inaccuracies, to reflect what they knew before the event. After the event, any inaccuracies in their comments were corrected by student volunteers.
Reflecting on the experience

**Reflection Question 1. How would you describe your experience during Cell Day?**
Definitely a great experience. I was happily surprised by how busy Dr. Dare’s lab was. Cell day was a great opportunity to work with junior scientists and get them excited about biology. My experience was very fun and rewarding. Being able to teach the kids (and their parents) about cells and having them be genuinely interested in learning was gratifying. The day was slightly hectic for me because my station (Extracting Strawberry DNA) was popular, very hands-on, and messy, so I was constantly cleaning up for the next family in line. Overall, it was a great experience. It was good seeing something we all build from scratch come into its own and be so successful. I had fun planning for Cell Day and the actual event was also very fun.

**Reflection Question 2. What have you learned about our community?**
I realized how many opportunities there are to share knowledge with young students and get them interested in science. There are quite a few students interested in sharing their passion for science and many more children eager to learn. This could be the start of many more collaborations. I learned that kids could be genuinely interested in a subject if they are given an exciting, hands-on experience that encourages learning. I was surprised to see how curious the children and parents were about the science. To me this shows that people are interested in science topics but we as scientists need to become better in imparting our knowledge in ways that the knowledge is accurate but in layman terms.

**Reflection Question 3. What was hard about the experience?**
It took two or three times before I felt comfortable walking the kids through each experiment. Distilling complex biological process into simple experiments children could perform. The difficult part of the experience was being able to relate the information for the experiment on a level that is easy for the kids to understand, but without over-simplifying the information to the point of being useless. For example, I wanted to make it a point to discuss how the “DNA Extraction Liquid” worked with regards to lysing the cells, but it took a few tries to come up with an explanation that was succinct and easy for the kids to understand. Also, at some point I was helping at a station I was not familiar with (serology), so I was unable to provide excess information or examples for the kids. Since I am only a first year biochemistry major and was not enrolled in a general biology class until January, I could only be of limited assistance in the areas of the planning that required a more extensive knowledge of cells and biology experiments. For my PowerPoint on DNA structure, I had to teach myself the information. I did not find anything hard about it.

**Reflection Question 4. What was easy about the experience?**
Event was really organized and made getting involved with the project very easy. Setting up the experiments and cleaning up was fast and easy. This project could be easily replicated. The easy part of the experience was getting the kids to participate, but that might have just been because my DNA station was messy, and the kids loved smashing the strawberries. The easy part of the experience was the initial brainstorming stage which involved simple research for possible experiments. It was very relaxed from day one. I never felt pressured to do anything I did not want to.

**Reflection Question 5. What was most rewarding about the experience?**
Helping the kids and listening to how much they already knew about biology was really fun. Getting children excited about science was the more rewarding event. Watching them come back to the microscope station to show their friends what they had learned was a great feeling, our project had an impact. The most rewarding part was seeing the parents doing the experiments with the kids, enforcing the learning. Also,
the kids were very excited to bring home their strawberry DNA.
Seeing the project come together and the great response it received from the museum, children, and parents.

**Reflection Question 6. What was least rewarding about the experience?**
Nothing- it was great.
The creation of PowerPoint presentations was one of the largest areas of focus before the event. The presentations, although well crafted, had very little utility for this event and that was disappointing.
I do not think there was an unrewarding part of the experience.

**Reflection Question 7. Do you feel your actions had any impact on our community?**
Yes! I loved hearing from the kids about how much they loved science, what they wanted to be when they grew up, and that they were excited for college.
Yes. Many of the parents were as excited about the experience as the children. They specifically mentioned interest in providing their children with microscopes.
I feel that Live Cell Day was a brilliant idea and that we should make it an annual or biannual event. In fact, a mother specifically inquired if we would be having this event again.
I felt it made the experiences of the people relating to science and the museum that came into our lab that day a very positive one. I hope it showed that science is not as daunting and intimidating as it looks and that it is actually very cool. At the very least I hope that our lab promoted people to take some interest in the science world.

**REFLECTING ON SELF**

**Reflection Question 1. What have you learned about yourself through this experience?**
I learned that I am better at working with young people than I thought.
Cell day reinforced my love for teaching and learning.
I learned that I really enjoy helping children learn. Also, I noticed that I myself am not as solid as I thought I was with cell information!
I really enjoy working with kids and teaching them what I know. It’s really cool watching them understand such complex topics and having fun doing so.

**Reflection Question 2. In what ways your sense of "community" and willingness to serve others have been impacted or altered through this experience?**
I have participated in a lot of service before while at Rollins, but this was unique and really connected to my major and discipline.
I have not spent much time volunteering with children or science related projects. I feel that this was more rewarding than I was expecting and want to incorporate science education into my volunteering.
My love of volunteering and working with children has been enforced through this experience.
I think scientific literacy is an important skill to have in this day and age. As someone who is being trained in the sciences, it is my responsibility to share what I know with people. I see myself as doing this a lot more in the future.

**Reflection Question 3. Will this experience change the way you act or think (perhaps as a scientist/physician) in the future?**
Yes- especially with regards to how to explain higher level concepts to young students or someone who does not have a background in science.
I don’t think this will change the way I act as a professional, but I will certainly be interested in sharing any knowledge I gain in professional studies with the next generation of scientists and physicians.
Yes, this experience has enforced my belief that being able to take a concept and break it down on a simpler level is something every physician should be able to do. Not every patient has extensive biology or anatomy knowledge; it is up to the physician to make sure a patient knows exactly what is going on with their health. Only through knowledge can patients truly be able to make healthy decisions for their body.
As important as it is to publish research to be peer reviewed and be known to the scientific world, it is just as important to make research be known to the actual world. No matter how important the finding, if the people don’t
hear of it and don’t understand it, they will not support it. Therefore, a big part of being a scientist or physician is being really good at explaining complex things accurately but simply.

**Reflection Question 4. How will this experience change your future behaviors/attitudes/and career in both our local and global communities?**

This has inspired me even more to pursue a career in science, and to help those who are younger than me do the same. It also taught me how vital hands-on learning is to education.

In a society that highly values scientific advances it seems like science literacy is fairly low. I hope my career will allow me the opportunity to help society gain a basic understanding of the sciences. Cell day used easily crafted experiments and demonstrations to exemplify basic biological systems and principles and that was the reason it was effective.

This experience has reinforced my desire to stay active in the community, especially with children and education.

I would like to teach more and especially in the sciences. I feel it’s important for people to have scientific literacy in this day and age.
### MUSEUM STAFF FEEDBACK

**KEEP**

Students making alterations based on observations throughout the day, like learning that the 60 seconds of waiting time in the proteins experiment could be used to teach about proteins rather than just counting down.

The more personalized instruction definitely had a big impact on our guests and allowed for a deeper understanding of scientific concepts.

Students using interpretive skills to explain and relate high level scientific concepts to young children.

High level of preparedness definitely showed and we were all impressed by how well most of the PowerPoints were put together.

Cell passports were a great addition and we loved the “Cell-fie” aspect. We noticed guests staying longer and participating in more experiments than they normally do. We think this can be attributed to guests wanting to get more stamps on their cell passports. We also noticed that a lot of children enjoyed coloring the pictures on their passports while waiting for an experiment to open up.

**CHANGE**

One of the few opportunities for improvement we observed was that some students would pull out cell phones and start, what appeared to be texting, when their station was unoccupied.

For next year, use observation of guests to make adjustments to the different activities at each station.

### NOTES ON IMPORTANCE OF OBSERVING GUESTS DURING THE EVENT

We would be interested in hearing if the students observed any experiment stations being attended less frequently than others. Telling sign that the experiment or PowerPoint may need to be altered in some way.

Observations are a significant part of the process by which we create and refine DDL experiments. We would say the observations are even more important than the creation of the experiment itself. It is very rare that we put out an experiment and don’t alter it based on our observations of guests.

### EDUCATION STUDENTS FEEDBACK

**CHANGE**

Ask students what they learned after each station

PowerPoints not age or level appropriate for most kids-split into 2 age groups 3-9 yrs., 10-14 yrs. in order to target their instructional level.

Some slides used words above most of the kids’ vocabulary level. For example, instead of saying “Extracting cells from our cheeks and identifying basic cellular components under the microscope!” it could have said “We will look at our very own cheek cells in order to label the basic parts of a cell using a microscope.”

Hard to assess what they wanted to know since there was not an anticipatory set, which activates any prior knowledge for them to get excited about the topic, wanting to know more.

### SELF-GENERATED FEEDBACK - FINAL DEBRIEFING MEETING

**KEEP**

Keep popular stations: Cheek cell imaging, DIY DNA, and strawberry DNA extraction.

Keep in mind parents are also learning!

**CHANGE**

Make sure enough volunteers are recruited so that really popular stations have more than one student helping guests along the experiment. This is particularly important with the cheek cell imaging station, where guests need help with microscope use.

Might consider having more than one station of the really popular activities (or expanding on them) to help with guest flow and minimize waiting times.

Be better prepared to adapt to guests and adjust the level of explanations. For next year, Education major students could be recruited to provide training to Cell Day volunteer so that they know strategies on how to do this.
<table>
<thead>
<tr>
<th>Better signage at each station so that guests know where to go for each experiment. Consider using Cell Passport graphics to create signage.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Have passport include more fun activities instead of so many blank pages.</td>
</tr>
<tr>
<td>As the stations were set up, they built on each other’s content. For next time it would be better for station to be stand alone in content. This way when the lab gets really busy and guests walk in they can go to any station that is available and not be lost.</td>
</tr>
<tr>
<td>Change the less popular stations (cell puzzle, Funnyitis disease station) to include more hands on activities.</td>
</tr>
<tr>
<td>For the disease station, consider using more relevant diseases like cancer, colds, or sickle cell.</td>
</tr>
<tr>
<td>Do a better job at conversing with the kids to identify things they already know and maybe activate previous knowledge—Have you learned about cells in school? What have you learned?</td>
</tr>
<tr>
<td>Decrease planning time period leading to the next Cell Day. Did we really need to start as early as October?</td>
</tr>
<tr>
<td>Consider amount of time putting together PowerPoint slides. A lot of time was spent refining those, yet guests would usually rely on volunteer students as a source of information, and not the PowerPoint. At the same time we appreciate these files are important, they allow the museum to use the new activities that were generated.</td>
</tr>
<tr>
<td>Changes to make to Strawberry DNA extraction station based on guest observations:</td>
</tr>
<tr>
<td>-provide more detail on what the different reagents are doing to the strawberry DNA</td>
</tr>
<tr>
<td>-find a way to make the experiment neater (it was very messy making clean up very difficult!)</td>
</tr>
</tbody>
</table>