Flipping Out in the Classroom and Other Strategies to Enhance Student Engagement

Presented by Marie Fogarty, Steve Leadon, and Kathy Zarilla

Friday, February 19
Did you do your homework?
Seminar Outline

- Motivation
- The Flipped Instruction Model
- Data
- Reflections
- Strategies to increase active learning
Motivation

- Encourage student-centered learning
- Increase student engagement
- Increase instructor engagement
- To allow **application** of facts and concepts to real-life scenarios during class
- Provide opportunities to hear what the students are thinking
The Flipped Instruction Model

Before Class
- Watching videos and reading
- Getting familiar with terms and phrases
- Introduction to concepts
- Formative assessment
- Check for understanding

During Class
- Projects, problems, small groups, discussions, labs, creating things, analyzing things
- Formative assessment
- Check for understanding

After Class
- Projects, papers, creating things, reviewing key concepts
- Formative assessment
- Check for understanding

http://etale.org/main/2013/02/21/a-flipped-classroom-primer/
Our Design

- **Chose a BIO168 topic - Cell Biology**
  - **Pre-class exercise:**
    - to allow students to become familiar with cell organelles
  - **In class:**
    - Students assigned case studies of disorders and worked in groups (4-5) to identify cell organelles affected
    - Presented organelle to the class using the whiteboard
    - Instructor mini-lecture to wrap up/reinforce important points
  - **Post-Class:**
    - Online assignment to assess understanding of important concepts
Pre-class assignment

Name
Fill out this sheet and bring with you to class
Go to http://learn.genetics.utah.edu/content/cells/insideacell/ - Click on each organelle to zoom in and learn the function of that organelle.

Inside a Cell

<table>
<thead>
<tr>
<th>Organelle</th>
<th>What does it do?</th>
<th>Other Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Cell Membrane</td>
<td></td>
<td></td>
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<tr>
<td>2 Cytoskeleton</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Mitochondrion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Nucleus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Endoplasmic Reticulum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Golgi Apparatus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 Lysosome</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 * Microvilli</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9 * Cilia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 * Centrioles</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11 Vacuoles</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 Chloroplasts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13 Cell Wall</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* You will need to look up these organelles in your textbook.

Online Cell
@ learngeneretics.com
Berf Newlittle is a 23-year old male who has suffered from repeated episodes of **haemolytic anemia**. During these episodes Berf’s red blood cell counts drop off dramatically due to rupturing of large numbers of cells and the inability of his bone marrow to replace the ruptured cells fast enough. When Berf comes into your clinic for treatment, you initially suspect a hereditary deficiency in the enzyme glucose-6-phosphate dehydrogenase, but biochemical tests rule this out. An examination of his blood reveals that many of his red blood cells (RBCs) have an elliptical shape and your subsequent diagnosis is **hereditary elliptocytosis**. In this disorder, structures within the RBCs distort the shape of the cell from the normal biconcave, disc shape to an elliptical shape, causing premature damage and rupture of the cells.

Include the answers to these questions in your five minutes presentation

1. With what organelle might this disorder be associated?
2. What is the normal function of this organelle?
3. How does the structure of this organelle facilitate its function?
4. How does this particular disorder of this particular organelle produce/explain Berf’s symptoms?
In class
After Class

- Online assignment to assess learning (formative)
- Section on BIO168 exam 1 (summative)
- Student survey to gauge student engagement

Survey on Cell Biology module.

1. Overall did you enjoy the class format?
   1. Yes  2. Somewhat  3. No

2. For the pre-lecture assignment did you access the online materials that were posted?
   1. Yes  3. No

3. If so, did you enjoy how the material was presented?
   1. Yes  3. No

4. Did you enjoy working with your group to identify the organelle affected by a particular disorder?
   1. Yes  2. Somewhat  3. No

Other Comments:

Did the group activity help your understanding of the importance of the cell and particular cell organelles?
   1. Yes  2. Somewhat  3. No

Other Comments:

Any other comments - for example how do you think this module could be improved?
Flipped Implementation

- **Spring 2015:**
  - Marie Fogarty
  - Bio168 - 2 classes of 40

- **Fall 2015:**
  - Steve Leadon
  - Bio168 mini - 1 class of 20
  - Scott Stauble
  - Bio168 - 2 classes of 40

- **Spring 2016:**
  - Marie Fogarty
  - Bio168 - 1 classes of 60
  - Dorothy Wood
  - Bio111 - 1 class of 28
Qualitative Data
I have not done anything like this before and I very much enjoyed it.

Loved that the class was interactive; kept me awake; it helped me put the material into real life situations.

Students bought in to the exercise

Good module and informative

It was good that you could lead the students to questions that you most wanted answered.
I like the group activity because of the brainstorming activity within a short time.

I really hope that we have more classes like this – It helps the information stick, rather than having someone read it to me. The interaction was good.

I enjoyed being able to discuss class information and put together ideas.

It was fun to hear other people's ideas and knowledge.

What about doing the assignment first and then the review afterwards.
Some students did not contribute to the group.

I prefer lecture-driven learning. The format was enjoyable and helped me to think about specific organelles in a different light, but the mini lecture helped me learn about the overall function of each organelle.

I wish my group would have participated more – only half of the group participated.

Would have liked more time for explanations.

I prefer traditional lecture.
Quantitative Data
<table>
<thead>
<tr>
<th>Cell Biology Question</th>
<th>Percentage of Students with Correct Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Most of the ATP required to power cellular operations is produced in the</strong></td>
<td></td>
</tr>
<tr>
<td>A) mitochondria.</td>
<td>100%</td>
</tr>
<tr>
<td>B) nucleus.</td>
<td></td>
</tr>
<tr>
<td>C) ribosomes.</td>
<td></td>
</tr>
<tr>
<td>D) Golgi apparatus.</td>
<td></td>
</tr>
<tr>
<td>E) endoplasmic reticulum.</td>
<td></td>
</tr>
<tr>
<td><strong>The plasma membrane is ________</strong></td>
<td></td>
</tr>
<tr>
<td>A) a double layer of protein enclosing the plasma</td>
<td>94%</td>
</tr>
<tr>
<td>B) a membrane composed of tiny shelves or cristae</td>
<td></td>
</tr>
<tr>
<td>C) a single-layered membrane that surrounds the nucleus of the cell</td>
<td></td>
</tr>
<tr>
<td>D) the phospholipid bilayer surrounding the cell</td>
<td></td>
</tr>
<tr>
<td><strong>Cells of the small intestine and kidney tubule have a &quot;brush border&quot; composed of ____</strong>, which are cell extensions that increase surface area.</td>
<td></td>
</tr>
<tr>
<td>A) cilia</td>
<td>79%</td>
</tr>
<tr>
<td>B) microvilli</td>
<td></td>
</tr>
<tr>
<td>C) rugae</td>
<td></td>
</tr>
<tr>
<td>D) hairs</td>
<td></td>
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<tr>
<td>E) flagella</td>
<td></td>
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</tbody>
</table>

**Topic Presented in Flipped Classroom**
<table>
<thead>
<tr>
<th>Cell Biology Question</th>
<th>Percentage of Students with Correct Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Topic Not Presented in Flipped Classroom</strong></td>
<td>**Fall 2015 (Flipped)</td>
</tr>
<tr>
<td>The most abundant high-energy compound in cells is A) DNA. B) adenosine diphosphate. C) RNA. D) adenosine monophosphate. E) adenosine triphosphate.</td>
<td>79%</td>
</tr>
<tr>
<td>A red blood cell placed in pure water would _______. A) neither shrink nor swell B) swell and burst C) shrink D) swell initially, then shrink as equilibrium is reached</td>
<td>63%</td>
</tr>
<tr>
<td>If cells are placed in a hypertonic solution containing a solute to which the membrane is impermeable, what could happen? A) The cells will shrink at first, but will later reach equilibrium with the surrounding solution and return to their original condition. B) The cells will lose water and shrink. C) The cells will swell and ultimately burst. D) The cells will show no change due to diffusion of both solute and solvent.</td>
<td>73%</td>
</tr>
<tr>
<td>Cell Biology Question</td>
<td>Percentage of Students with Correct Answer</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------------------</td>
<td>---------------------------------------------</td>
</tr>
<tr>
<td><strong>Topic Presented in Flipped Classroom</strong></td>
<td>Fall 2015 (Flipped)</td>
</tr>
<tr>
<td></td>
<td>Fall 2014</td>
</tr>
<tr>
<td>Matching questions:</td>
<td></td>
</tr>
<tr>
<td>Nucleus:</td>
<td>95</td>
</tr>
<tr>
<td>Contains genetic material</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Mitochondria:</td>
<td>94</td>
</tr>
<tr>
<td>Burns carbohydrates to produce ATP</td>
<td>86</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Rough ER:</td>
<td>77</td>
</tr>
<tr>
<td>Site of protein building</td>
<td>76</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Golgi apparatus:</td>
<td>77</td>
</tr>
<tr>
<td>Packages proteins for shipping around the cell</td>
<td>88</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Cell membrane:</td>
<td>92</td>
</tr>
<tr>
<td>Separates the outside of the cell from the inside</td>
<td>86</td>
</tr>
</tbody>
</table>
DATA combined across instructors

**Nucleus:**
Contains genetic material

**Mitochondria:**
Burns carbohydrates to produce ATP

**Rough ER:**
Site of protein building

**Golgi apparatus:**
Packages proteins into vesicles

Flipped | Non-Flipped
--- | ---

- Nucleus:
  - Flipped: $90\%$; $n = 140$
  - Non-Flipped: $75\%$; $n = 80$

- Mitochondria:
  - Flipped: $92\%$; $n = 140$
  - Non-Flipped: $86\%$; $n = 80$

- Rough ER:
  - Flipped: $75\%$; $n = 140$
  - Non-Flipped: $76\%$; $n = 80$

- Golgi apparatus:
  - Flipped: $74\%$; $n = 140$
  - Non-Flipped: $88\%$; $n = 80$
Summary and Reflections (1)

- Students enjoyed the flipped module and it certainly increased classroom engagement
- It increased student camaraderie and students were more willing to speak up in class and ask questions
- Students came to class prepared
- Need more data to comment on whether our test scores improve
- Well established across STEM disciplines that active learning is a more effective classroom strategy than lecture.. for example:
Summary and Reflections (2)

- UNC Biology department reported that their active-learning interventions decreased the black-white achievement gap by half and closed the gap for first-generation students compared to continuing-education students
  - Relevant for Durham Tech student population

- Our take home message:
  Any method of encouraging active student-centered learning and providing opportunities for students to assimilate and to practice information retrieval is beneficial for student-learning

Eddy and Hogan, Journal of CBE-Life Sciences Education
What now?

- We plan to combine flipped instruction with traditional lecture for now! (BIO168)

- Continue to increase active-learning components in both lecture and lab
  - Half of our current instruction time is lab-based, which is already a more active learning environment
General Strategies we use to increase classroom preparedness and student engagement

- Zaption learning tours before class
- Technologies such as clickers to review and check student understanding
- Mcgraw Hill pre-lecture assignments
- Pre-lab exercises / quizzes
- Short activities in class or lab including case-studies, rapid fire quizzes, think-pair-share
RAPID FIRE QUIZ
Discussion