LISC 300
The Process of Discovery in the Biomedical Sciences:

Our goal: to empower our students to experience the joy of discovery

Ken Rose and Nader Ghasemlou and Edwin Ocran

Special thanks to the TLC for grant support
LISC 300
The Process of Discovery in the Biomedical Sciences:

Did we reach our goal?

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A brief description of LISC 300

The ‘problem’

Educators in science must satisfy two demands

The facts

The high level ‘stuff’
The ‘problem’

The facts

The high level ‘stuff’
The result

The high level ‘stuff’

The facts
The primary learning objective of LISC 300

To identify the *questions* that must be answered to resolve major controversies or gaps of knowledge that impede:

- the understanding of fundamental principles in the Biomedical Sciences
- and/or their application to health care.
The topics for 2017

- the microbiome (focus on inflammatory bowel disease)
- chronic pain
- Alzheimer’s disease

52 students

16
18
18
Steps along the road to discovery

Weeks 1-3
The ‘blue sky’ phase

Goal: create a long list of possible questions and, based on a preliminary review of the literature, select 6 questions

Support provided in week 1
• a short ‘package’ of information
• brief presentations by on-campus ‘experts’
• interviews with patients or care givers
• advice and support from 18 undergraduate mentors
End of first session in week 2

1. Is it more effective to isolate a specific bacterial strain when investigating the link between cancer and the gut microbiome or to target specific genes?

2. What ethically safe techniques may be used for this purpose?

3. How might the introduction of probiotics and/or antibiotics support or affect the microbiome?

4. What impact will treating or modifying the microbiome have on the individual's gut microbiome as a whole?

5. What is the interplay between the microbiome and other seemingly unrelated conditions?

6. Why are there so many cases of IBD in Westernized society and in young "healthy" individuals?

7. What are specific gaps in clinical treatments for people who suffer from IBS and what could be potential avenues to develop diagnostic tests?
But not all roads to discovery were this smooth!
Many students were confused and frustrated

But all previous science courses were concerned with the answers

What do you mean by a ‘good’ question?

You are supposed to ask the questions
Each group was divided into 6 teams

18 students

- 3 students
- 3 students
- 3 students
- 3 students
- 3 students
- 3 students
The next steps along the road to discovery

**Weeks 4 - 7**

The seek, read, judge, and assimilate information stage

The goal: to build a comprehensive database to support the claim that the selected questions are ‘good’ questions

**Support**

- a short introduction to how to use Pubmed
- many conversations and many questions
- advice and support from 18 undergraduate mentors
Student reaction was variable

I can see the light at the end of the tunnel!
Or...
There were many questions

I thought you were supposed to set the curriculum.

I know nothing about this topic. Where do I began?

How will I know when I have the ‘right’ information?
Have we aimed too high?
The final steps along the road to discovery

**Weeks 8 to 11**
The dissemination phase

Goals:
1. Deliver a high impact, readily accessible, and visually stunning public presentation
2. Combine the rationale for all questions into a written document that illustrates that the whole is greater than the sum of the parts

**Support**
- many more discussions
- rehearse, rehearse, rehearse
- advice and support from 18 undergraduate mentors
Each group was rearranged into 3 teams.
The outcome: public presentation

Three presentations

Mixed: outstanding to a ‘work-in-progress’

Awesome!

Awesome!
The outcome: written rationale for all questions

Three documents

Excellent
Excellent/outstanding
Outstanding
### Student questionnaire – week 12
(based on comments/ranks from 46 of 52 students)

<table>
<thead>
<tr>
<th>Skills acquired</th>
<th>Percent of answers agree/strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collaboration/team work</td>
<td>95</td>
</tr>
<tr>
<td>Critical thinking</td>
<td>94 (70)</td>
</tr>
<tr>
<td>Concise written communication</td>
<td>91</td>
</tr>
<tr>
<td>Identify and overcome challenges</td>
<td>93</td>
</tr>
<tr>
<td>Investigative techniques</td>
<td>91</td>
</tr>
</tbody>
</table>
What do you like most about this course?

‘Critical thinking -- I loved how instead of having to memorize a textbook, I was able to learn better by reading research papers and I loved how I ended up coming up with valid questions. Overall, I was very inspired.’

‘The course was self-directed and allowed students to investigate something they were interested in. It's rare to be able to study whatever you want (more or less) in a university setting, or at least at Queen's University.’

‘How much I learned about how to learn!’
What was the major benefit/virtue of this course?

‘I think I learned that there is always room for improvement regarding writing and critical analysis. I learned that it is ok not to get it right the first time.’

‘Ability to explain hard science concepts in simple ways’

‘I learned the value of teamwork, and the huge benefits that can arise from effective collaboration!’
What advice do you have for students who may want to pursue this course in the future?

‘TAKE IT!!!! You will be a better student for it.’

‘Do it! All the hard work is worth it.’

‘DO IT! this course taught me so much and I can't believe how much I learned over the course of the year.’

‘Be open to change and to exploring things you may at first have no interest in. Be confident in your research and always stay curious. Never worry about not knowing the answer or seeking help in understanding science that may seem way beyond you. And work as a team, there is strength in numbers and we learn best through each other.’
Did we reach our goal to empower students to experience the joy of discovery?

Would I encourage others to develop a similar course tailored to their program?

YES!