

Panel Session: Moderator: Igor Ivkovic

David Wang, Electrical and Computer Engineering, University of Waterloo

Maud Gorbet, Systems and Biomedical Engineering, University of Waterloo

Jen Boger, Systems Design Engineering, University of Waterloo and Research Institute for Aging

Flipped Classrooms: Perspectives on fostering student's curiosity and interest in research

Summary

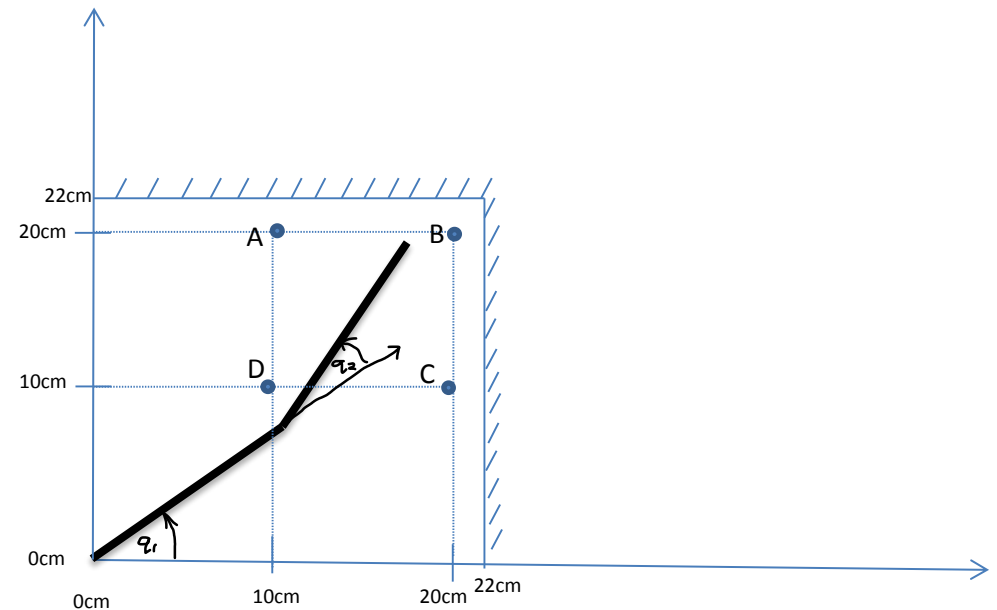
- David Wang
 - Flipped Classroom with online videos (technical elective)
- Maud Gorbet
 - Flipped Classroom in a core second year science/eng. course
- Jen Boger
 - Blended classroom in a 3rd year ethics core course

Dave Wang: Summary

- Introduction
- The Traditional Method
- Flipping the Classroom
- Creating the Online Videos
- Creating the Classroom activities
- Results

Dave Wang: The Traditional Method

- Partial powerpoints
- Lectures filled in the blanks
- Attendance issues
- Poor capstone project results



Dave Wang: Flipping the Classroom

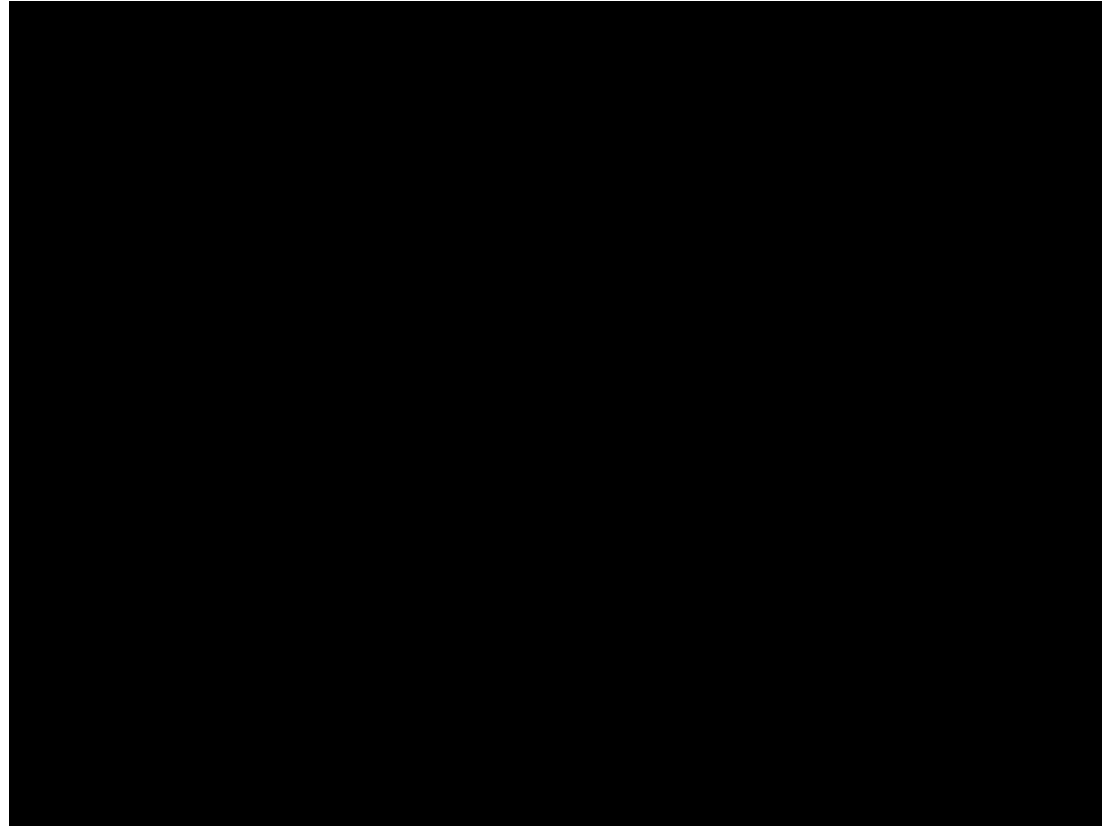
- Decided to fully flip
- All lectures online (25)
- Form of lectures the same (ie student fill in notes)
- Just over 30 minutes of video on average
- Class time was spent on exercises on Matlab with professor and TAs in attendance
- Every class had a quiz or a deliverable (Matlab script) worth 20 marks total
- Capstone project worth 30% (control of a robot)

Dave Wang: Creating the Online Videos

- Webcam and Apowersoft Screen Recorder Pro with Microsoft Surface Pro and Yeti Blue Mic
- Need to “point” to material
- Need overenthusiasm
- Used www.piazza.com for any questions. Average response time of 55 minutes

Dave Wang: Creating the Online Videos

- Example of online video



Dave Wang: Creating the Classroom Activity

- 1 TA for every 10 students
- Groups of 2 (randomly assigned)
- Matlab exercises. Two levels of difficulty. Deliverable is the easier problem.
- They could apply techniques to capstone project if they finished early

Dave Wang: Results

- Almost perfect attendance for an 8:30am lecture
- Found out about student abilities quickly
 - Struggles with some threshold concepts such as linearization
 - Only some of the students familiar with Matlab
- Finished in 10 weeks rather than 12 and completed more material

Dave Wang: Results

- Last year, there were 22 groups (average 3 members each).
 - 10 groups completed the project specifications without noise (45%)
 - 0 groups completed the project with noise included (0%)
- This year, there were 18 groups (average 2 members each).
 - 11 groups completed the project specifications without noise (61%)
 - 16 groups completed the project specifications when the time at the target points was relaxed (89%)
 - 9 groups completed the project with noise included (50%)

Dave Wang: Results

- Students surveyed at end of course
 - 63% of class agreed or strongly agreed that they liked the online videos
 - 83% of class felt the length of the videos was about right
 - 93% of class felt the capstone project helped their understanding
 - 88% of class felt confident about ability to tackle new problems
 - 71% felt the flipped class helped learning more than traditional
 - 61% felt flipped was more engaging and 20% felt it was less engaging

Dave Wang: Results

- Attendance up
- Engagement up
- Ability to actually use software and to do a legitimate design is up significantly
- Feedback to students greatly improved
- Workload about right
- Video, projects and deliverables about right

David Wang

- Questions?

Maud Gorbet: Student feedback on 2nd year core course (materials science)

- Loved the course but it would be nice to have more examples, hands on experience
- I really like the real world examples. Need more applications
- More applied problems!!
- Should have labs

ME: not enough time to answer the interesting questions

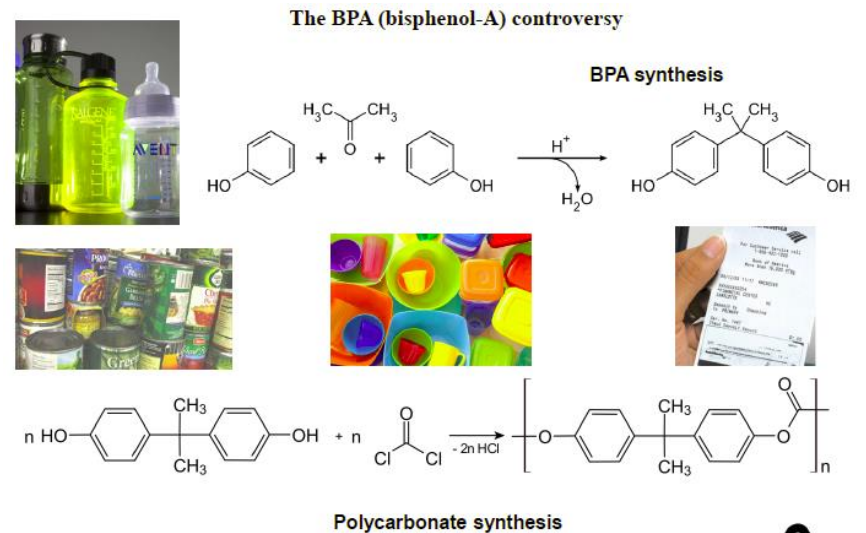
Maud Gorbet: Flipping the Classroom in materials science

- Decided to fully flip
- Lecture slides online with additional textbook chapter reading
- Online short quiz to complete prior class
- Class time dedicated to different learning activities

Maud Gorbet: In class learning activities to foster curiosity and inquiry

Class time = working session, apply concepts, experience, ask questions

- Draw connections between concepts
- Small practice exercises
- Apply concepts to more complex problems



Maud Gorbet: In class "BIG" learning activities to foster exploration

The case for on site testing of hardness and toughness for icebreaker vessels



Disaster in the Making

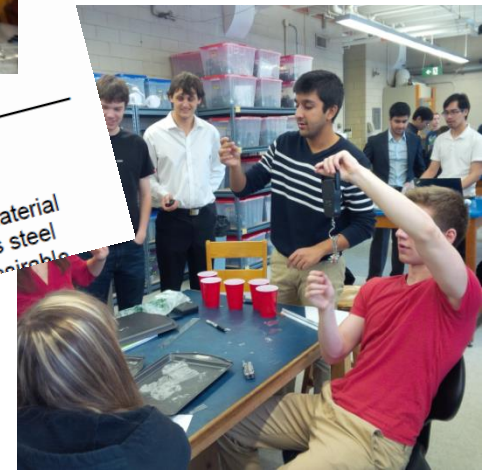
Why ARCUM cannot afford to reduce the budget for testing of materials

MEMO

TO: Director of Materials Engineering Department, Boston Scientific
FR: Research Group 1; [REDACTED]
RE: Biocompatibility Studies Funding: Stent Material Selection for Continued Research
DA: March 30, 2017

Recommended Material Selection for Further Research for Commercial Stent Use

While looking at stent requirements, our group found that there may be a more advantageous material than the ones currently being used. The alloy composition we recommend is a 35% Pt-stainless steel alloy that has been annealed at 1022 degrees Celsius. We feel this material will be the most desirable.



Maud Gorbet: Mini-project to foster inquiry

A Chemical Analysis of Climbing Chalk



A Look Into Spider Silk and its Application in Body Armour

800 to 1200 words

**Average of 17 references
per paper!**

Effects of Expanded Thermoplastic
Polyurethane (E-TPU) in Adidas Boost
Sneakers

Cymbal alloys



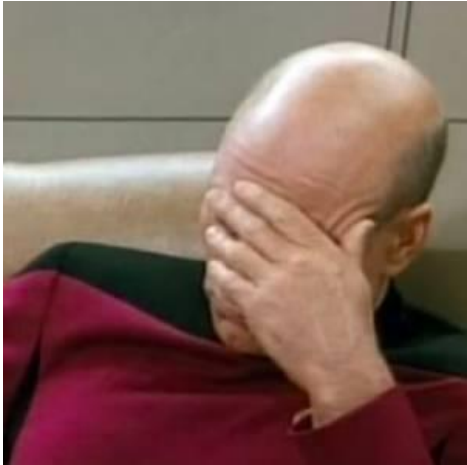
Success of the flipped classroom

- Students embrace and engage in all the opportunities to explore, question, apply



- BUT....

Maud Gorbet: What happens in a flipped classroom when students are not curious

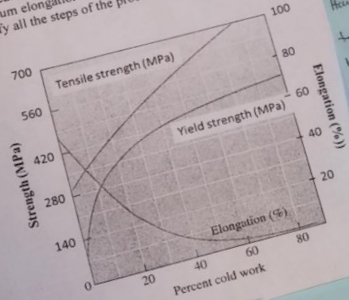


- Change problem format, adapt flipped classroom
- Some are genuinely not interested but most of them
 - Are afraid of asking questions
 - Don't like asking questions (introvert)
 - Don't know how to ask questions

Maud Gorbet: Teaching... to be curious

Inquiry - Question 4

A rolled Cu-30 wt% Zn plate 12.7 mm thick has a 2% elongation as-received by the supplier. The desired specifications for the final sheet are a thickness of 3.175 mm, minimum tensile strength of 483 MPa and minimum elongation of 7%. Assume that the rolling is conducted so that the width of the sheet is unchanged. Specify all the steps of the procedure to obtain the desired properties.



How many times do you need to anneal and cold work?
How would you know what the quantitative changes are after each process?

How would you measure elongation?

Relationship btwn annealing + elongation?

How do you measure strength?

How to measure yield strength?

How to ↑ elongation?

Is annealing "un-elongating"?

Does elongation affect thickness?

How do you physically elongate the material?

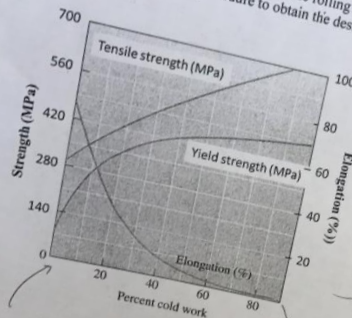
How does elongation affect tensile strength?

How do you "roll" the material?

How does rolling Zn affect any of you keep cold working, annealing, does the material degrade?

Inquiry - Question 4

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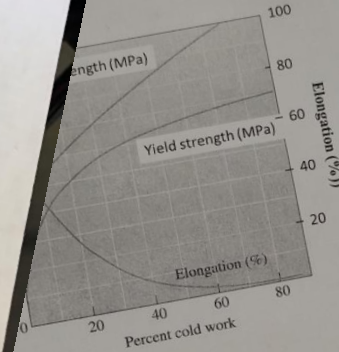
- What is annealing vs cold work?
→ how do they affect the graphed quantities

→ To get Step:
① how much CW?
② how much anneal?
→ is the quality of the material lowered from these processes?
→ elongation decreases while tensile str. & yield str. increase?

how can we read this graph?

- What does rolling copper do?

12.7 mm thick has a 2% elongation as-received by the supplier. The desired specifications for the final sheet are a thickness of 3.175 mm, minimum tensile strength of 483 MPa and minimum elongation of 7%. Assume that the rolling is conducted so that the width of the sheet is unchanged. Specify all the steps of the procedure to obtain the desired properties.



- What is elongation?
- why is tensile strength measured in mPa?
- what do intersections of lines tell us?
- why 3 properties?
- how do I read graph?
- why elongation negative? have axis value and line on graph
- what is annealing?
- Is desired thickness 3.175 mm?
- Area under slopes have importance?

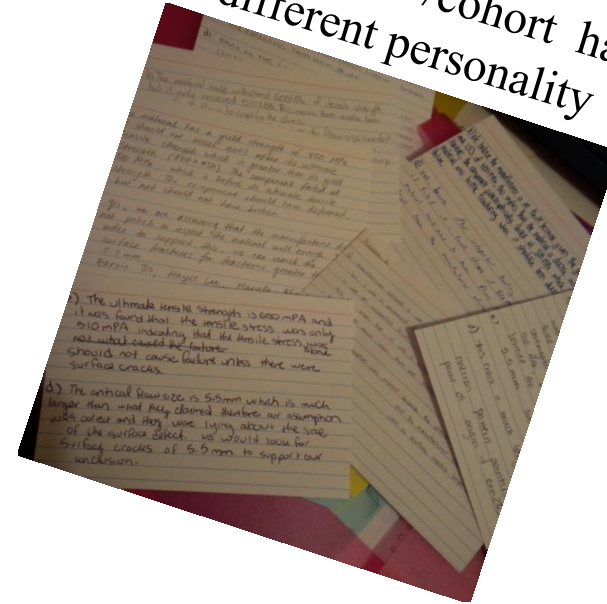
What?
How?
Why?
What if?

Maud Gorbet: Inquiry and the flipped classroom: it does work...

Sometimes we just need to remind
students how to ask questions



Every "class"/cohort has a
different personality



- Even the students who didn't like the flipped classroom ended up engaging enthusiastically in the case studies.
- Our classrooms are not designed for flipped classroom
- TAs are not used to the flipped classroom.

Maud Gorbet

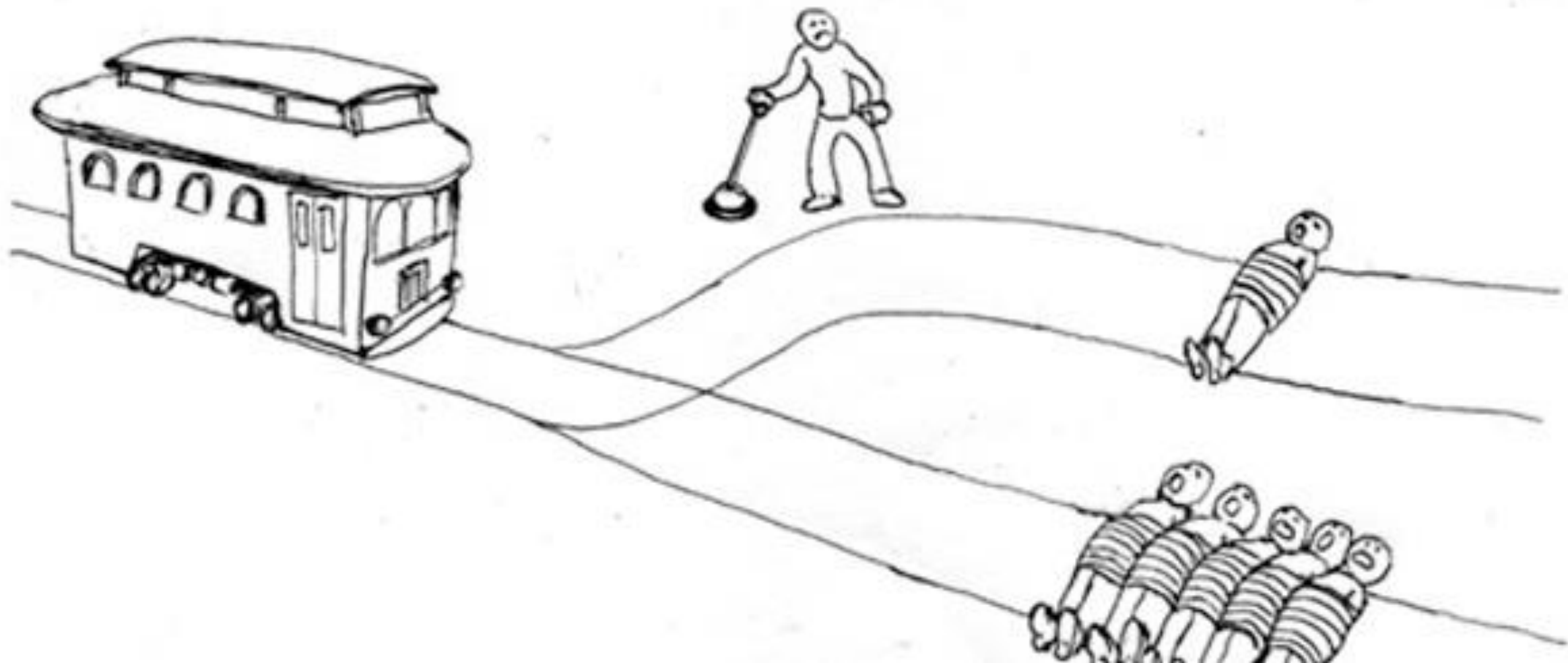
- Questions?

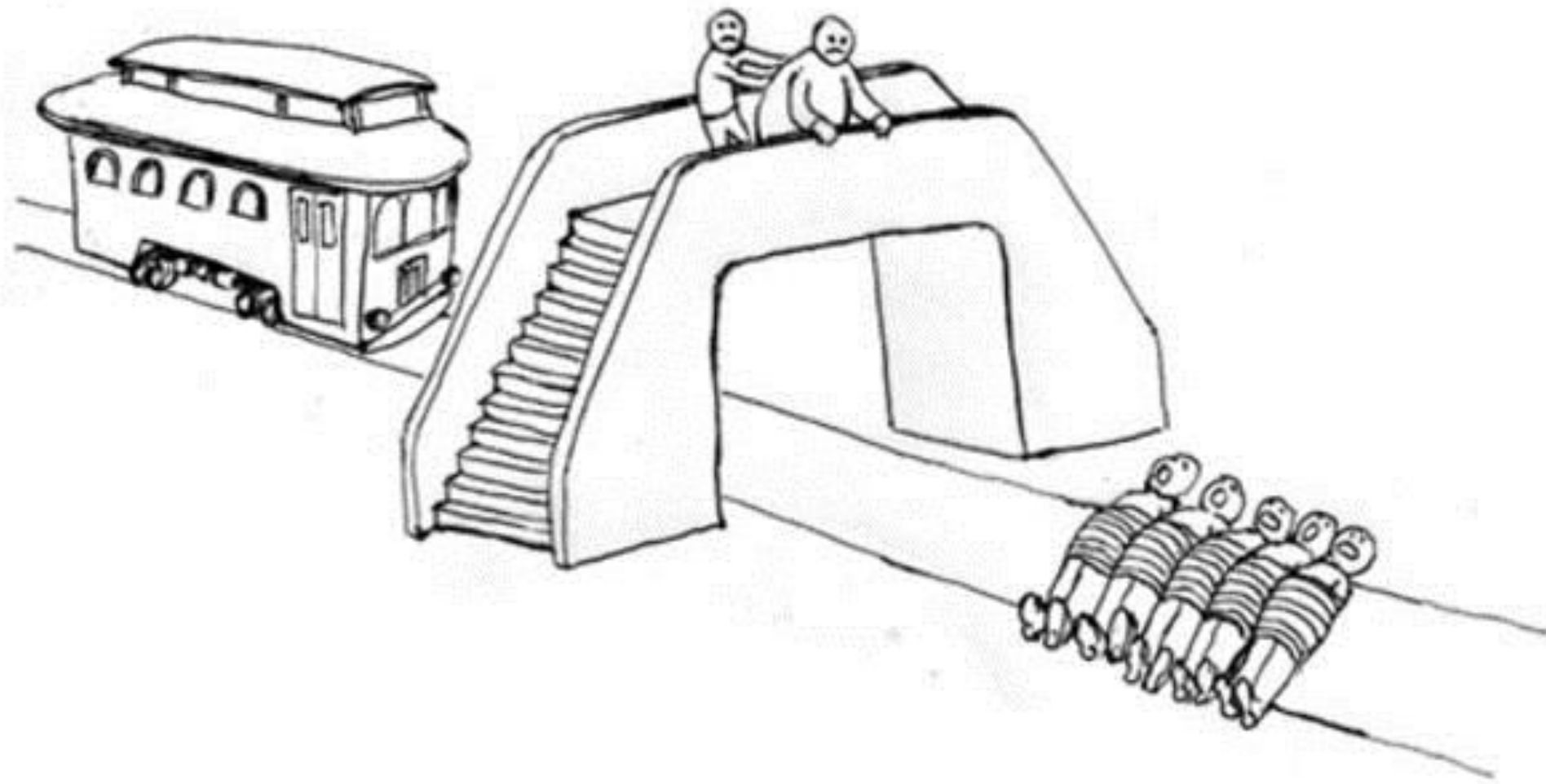
Jen Boger

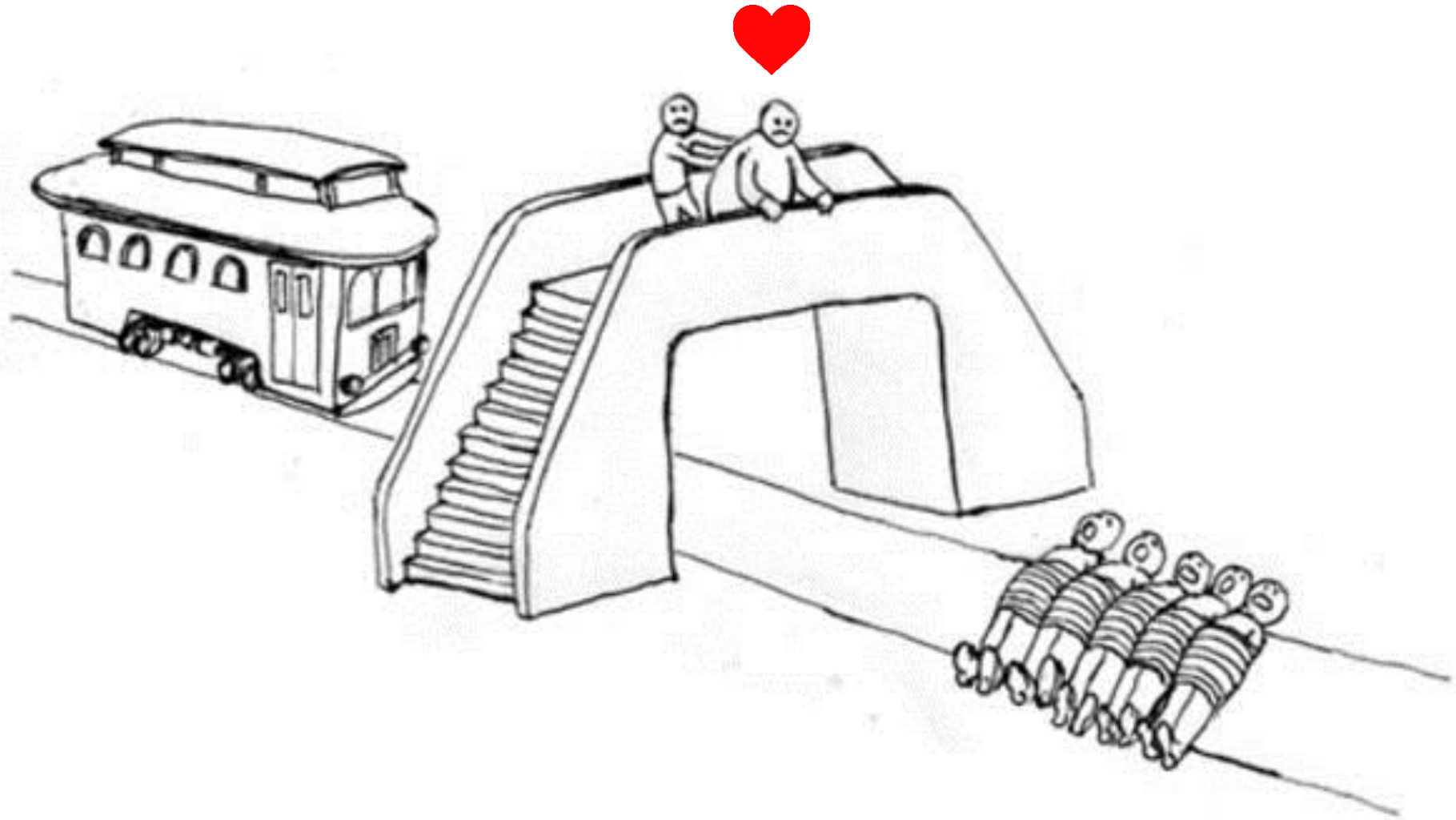
- Biomedical Engineering Ethics – 3rd year core course

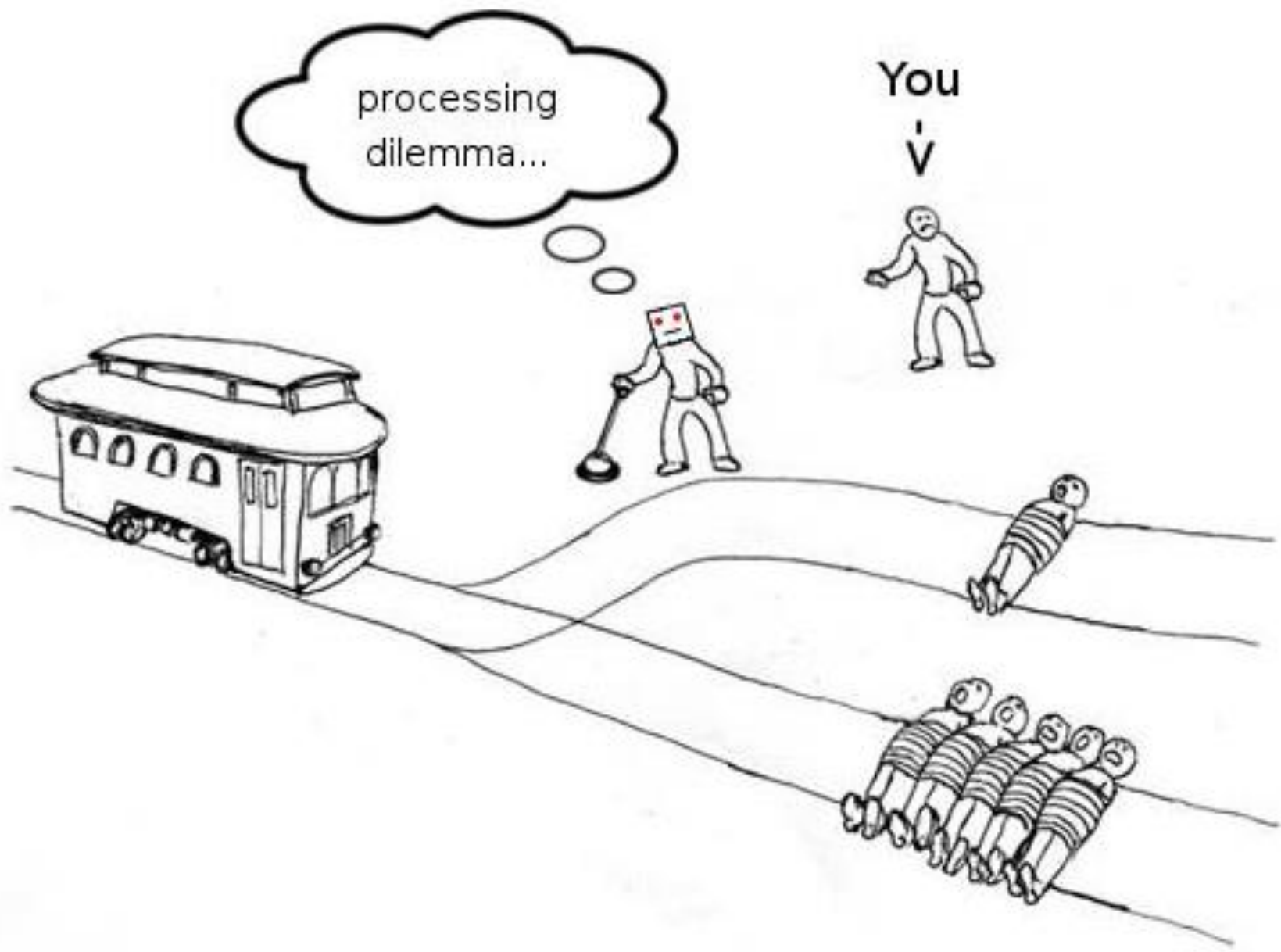
How am I going to make ethics interesting, relevant, and accessible?

How am I going to equip students for the situations they will (likely) inevitably face?









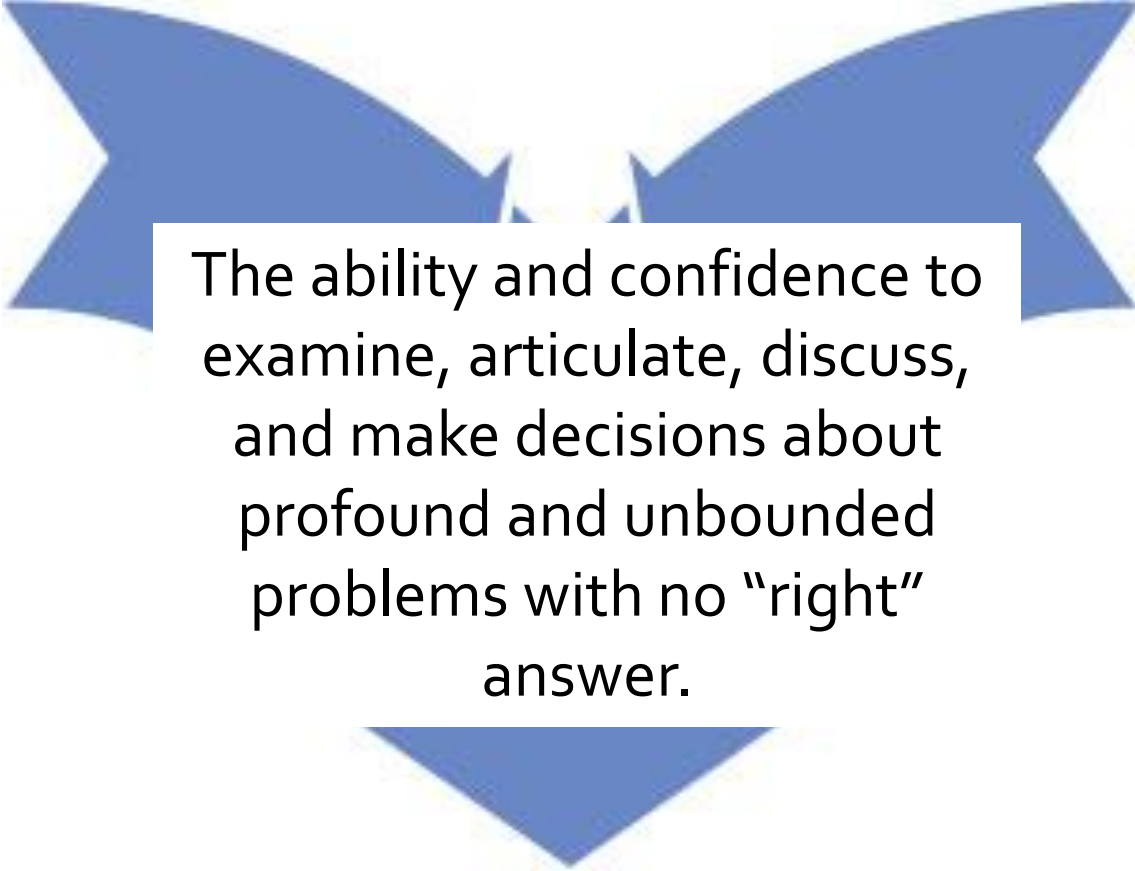
processing
dilemma...

You
↓
↓
↓

What is biomedical engineering ethics?

**Biomedical
Engineering**

Philosophy



The ability and confidence to
examine, articulate, discuss,
and make decisions about
profound and unbounded
problems with no “right”
answer.

Biomedical Engineering Ethics

Approaches we used:

- **Weekly online activities (reading/video + discussion post)**



- In-class activities
 - Code of ethics compare & contrast
 - ALRAP analysis
 - Debates
 - Clickers
- Guest lecturers
- Ethical situation of concern analysis every two weeks
- Written "reflection" assignment (5 page paper)
- Group video assignment

End of term survey:

Students agreed or strongly agreed that...

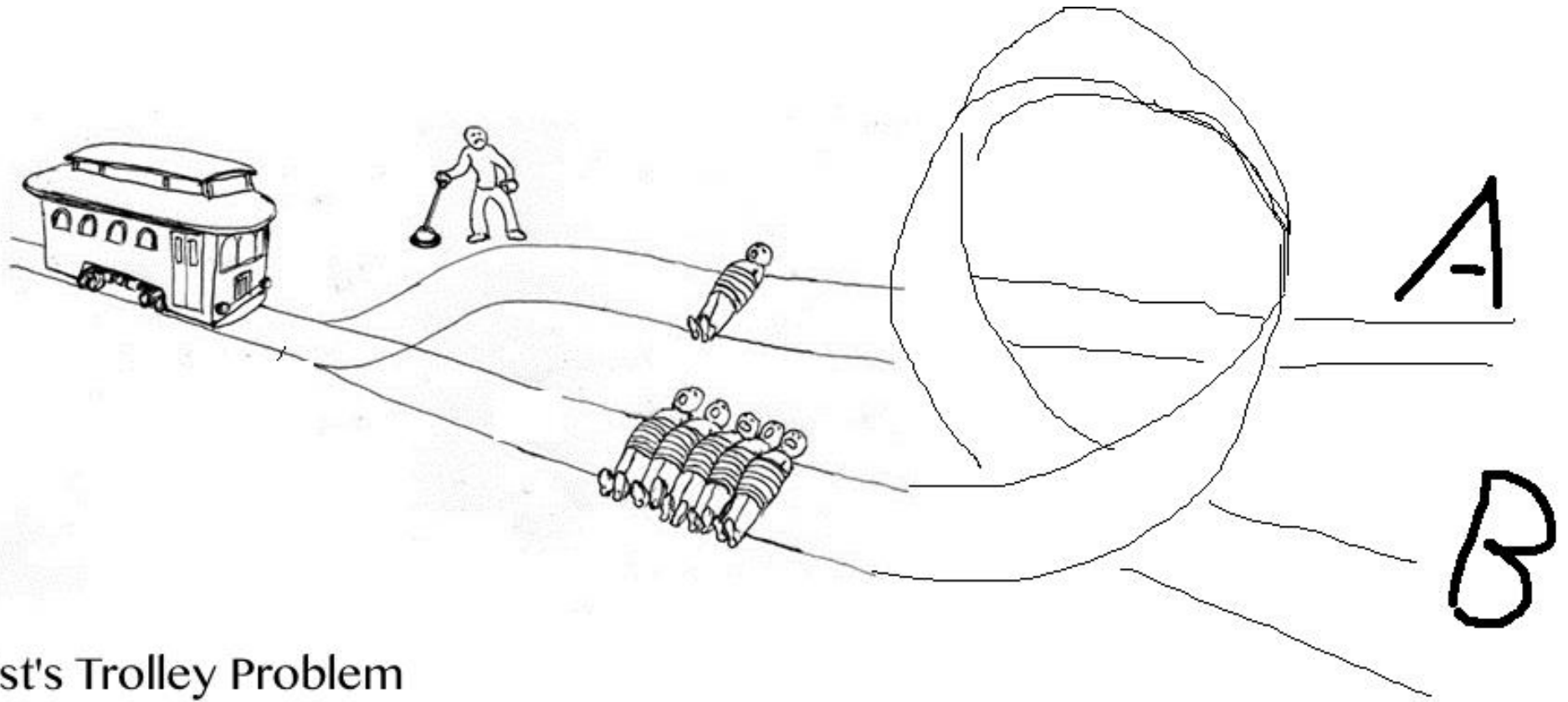
- Course was interesting - 61.5%
- Enjoyed the course – 61.5 %
- Could see how what they learned would be useful in their future career – 61.5%

What they liked:

- Learning about and applying philosophical thinking
- Engaging in group discussion / debates
- Guest lectures

What they didn't like:

- **Reading!!**
- Workload was too high compared to other courses



Hedonist's Trolley Problem

The track is heading towards B.

If you pull the lever, it will switch to A but it won't do the totally sick loop-da-loop.

Jen Boger

- Questions?
- See the ethics videos at:
- <https://www.youtube.com/playlist?list=PLqIETQfQKkZx6NC4ypwEaGoOf222Yaoq4>

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