Authoring and presenting university courses with Emacs

DEPARTMENT OF
Biochemistry and
Molecular Biology

Penn State **SCIENCE**


Ludwig
Williman

```
#+MACRO: COURSE_NUMBER     BMB 401
#+MACRO: COURSE_TITLE      General Biochemistry 1
#+MACRO: SEMESTER          Summer 2024

#+INCLUDE: org-teach-headers-include.org

* Introduction, overview, and fundamentals
  {{{section-slide(1)}}}

  * What is biochemistry?
    {{{subsection-slide}}}

    {{{impact-slide(The study of \\ macromolecules \\ and \\ metabolic pathways)}}}

    {{{impact-slide(Activate your \\ prior learning)}}}

    {{{impact-slide(small molecules \\ vs. \\ macromolecules)}}}

    * Consider the relative components of an /E. coli/ cell.
      |                 |       <r> |          <r> |
      |                 | *Percent* |     *Number* |
      |                 | *by mass* | *of species* |
      |-----------------+-----------+--------------|
      | water           |       70% |            1 |
      | proteins        |       15% |        3,000 |
      | DNA             |        1% |            1 |
      | RNA             |        6% |      > 3,000 |
      | polysaccharides |        3% |            5 |
      | lipids          |        2% |           20 |
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      * What can you conclude from these numbers?

    * Biochemistry is "the study of biological macromolecules and their metabolic pathways."
      #+BEAMER: \pause
      * What kinds of *biological macromolecules* are there?
      * Which small monomers *polymerize* to produce macromolecules?
      * What is an example of a *metabolic pathway?*

  * The structure of macromolecules determines the function of macromolecules
    {{{subsection-slide}}}

    * Macromolecular polymers are synthesized from small-molecule monomers
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Mark set

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1.2 Macromolecular structure determines function

Macromolecular polymers are synthesized from small-molecule monomers

Monomers		Polymers	also known as
amino acids	⟶	polypeptides	*"proteins"*
nucleotides	⟶	polynucleotides	*"nucleic acids"*
monosaccharides	⟶	polysaccharides	

- Which of these three categories of polymer has a **geometric** structural difference from the other two?
- Which category of biomolecules is **missing** from this chart? How is that category **different?**

Polymerizations are condensation reactions; cleavage and depolymerization are hydrolysis reactions

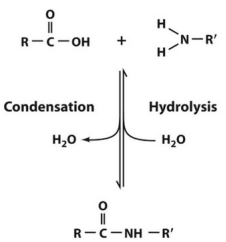

Figure 1: Polymerization of amino acids into proteins is a **condensation reaction**; the reverse reaction, depolymerization of proteins back to amino acids, is a **hydrolysis reaction**. Similarly, polymerization of nucleotides into nucleic acids,

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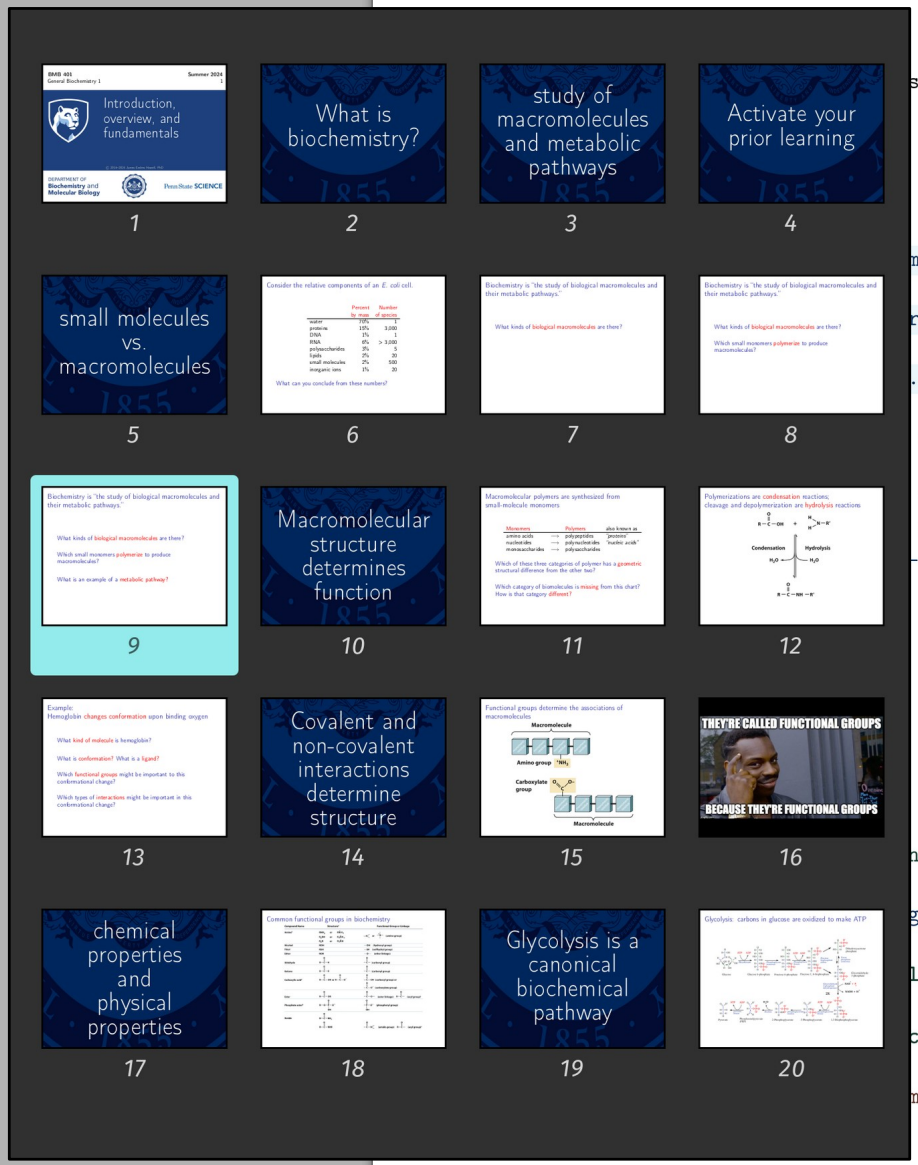


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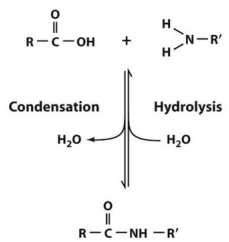

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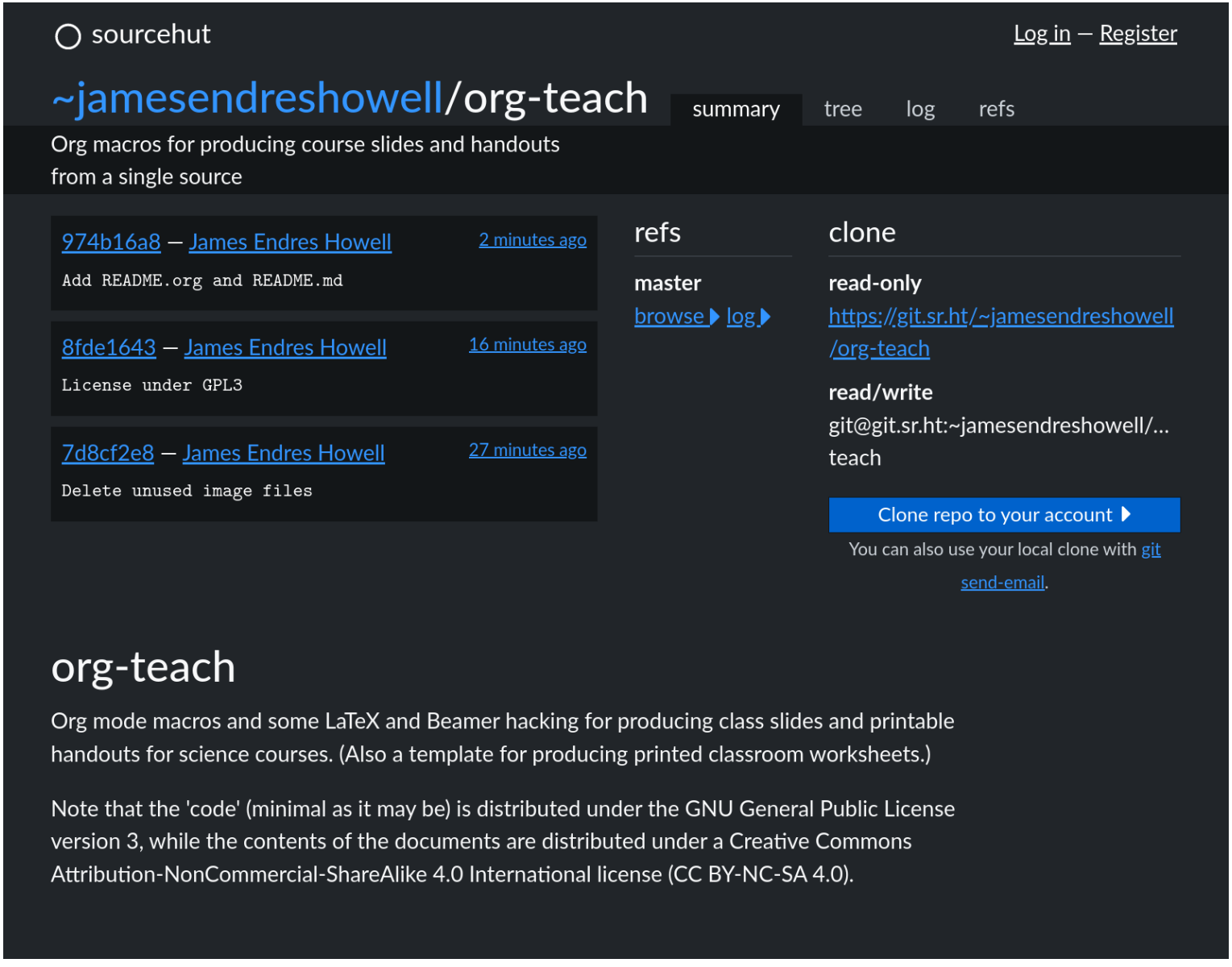
https://git.sr.ht/~jamesendreshowell/org-teach



authoring
presenting

presenting

Many others present and teach with Emacs!

David Wilson	`system-crafters.net`
Protesilaos Stavrou	`protesilaos.com`
Mike Zamansky	`cestlaz.github.io`
John Kitchin	*prior art*
Eric Fraga	*prior art*
Olivier Berger	*prior art*
Ro and Namkoon	*citation*

Hardware

Every course meeting!


Howell
Activities
18:23
Tuesday November 28
Swipe up to unlock
Howell
Activities
18:23
Tuesday November 28


logitech
SAMSON
PXD1
HDMI
Video Capture
logi

Presentation hardware: everything fits in a small backpack

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- GNU/Linux laptop

Presentation hardware: everything fits in a small backpack

GNU/Linux laptop

GNU/Linux tablet *with stylus*

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USB webcam and knobby tripod

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- USB remote lapel mic
- video output to USB input capture
- connectors, dongles, power supplies, spare batteries

Bonus:

You can do it on a very small budget!

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libre software	$0

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libre software	$0
used computer	$400
used tablet	$200

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used computer	$400
used tablet	$200
used monitors	$100
webcam	$100
microphone	$100
miscellaneous	$100

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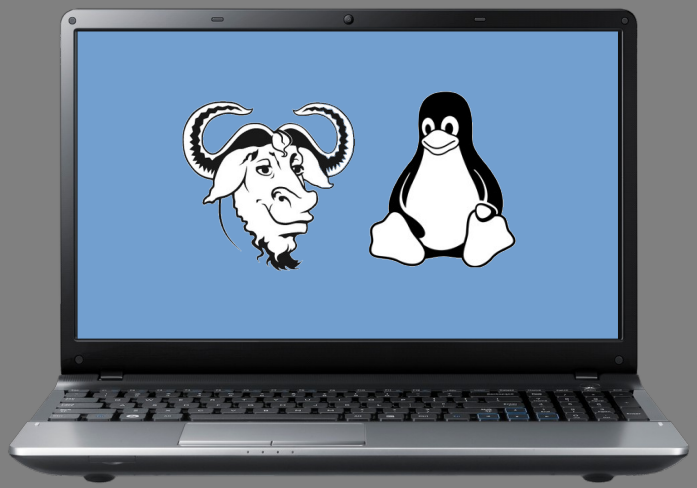
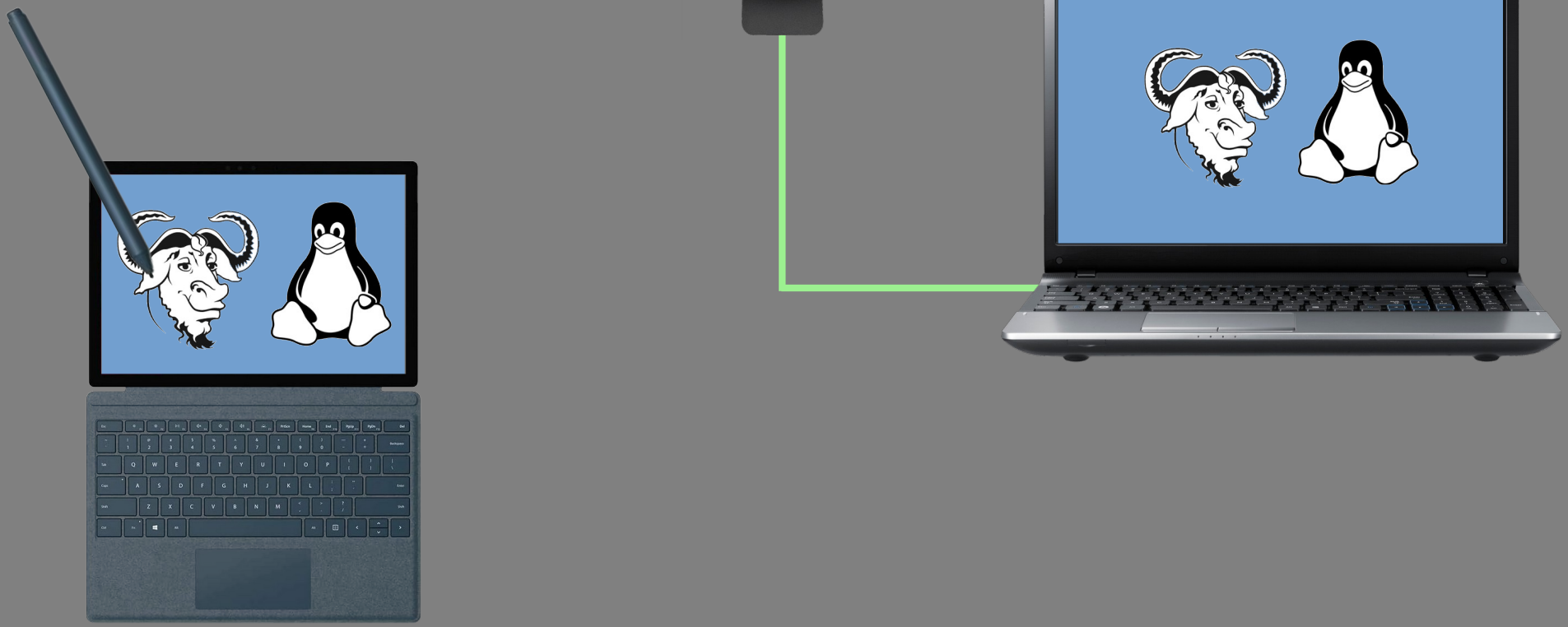
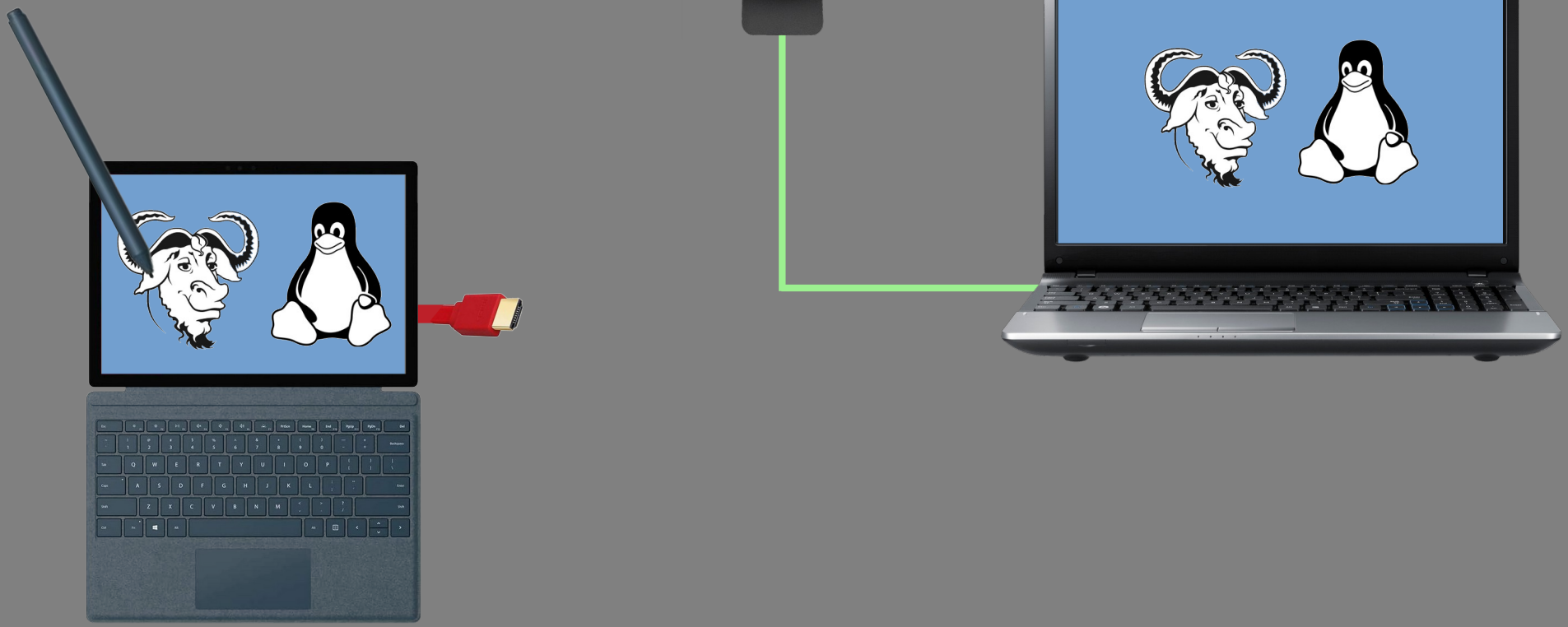
microphone	$100
miscellaneous	$100
	$1000

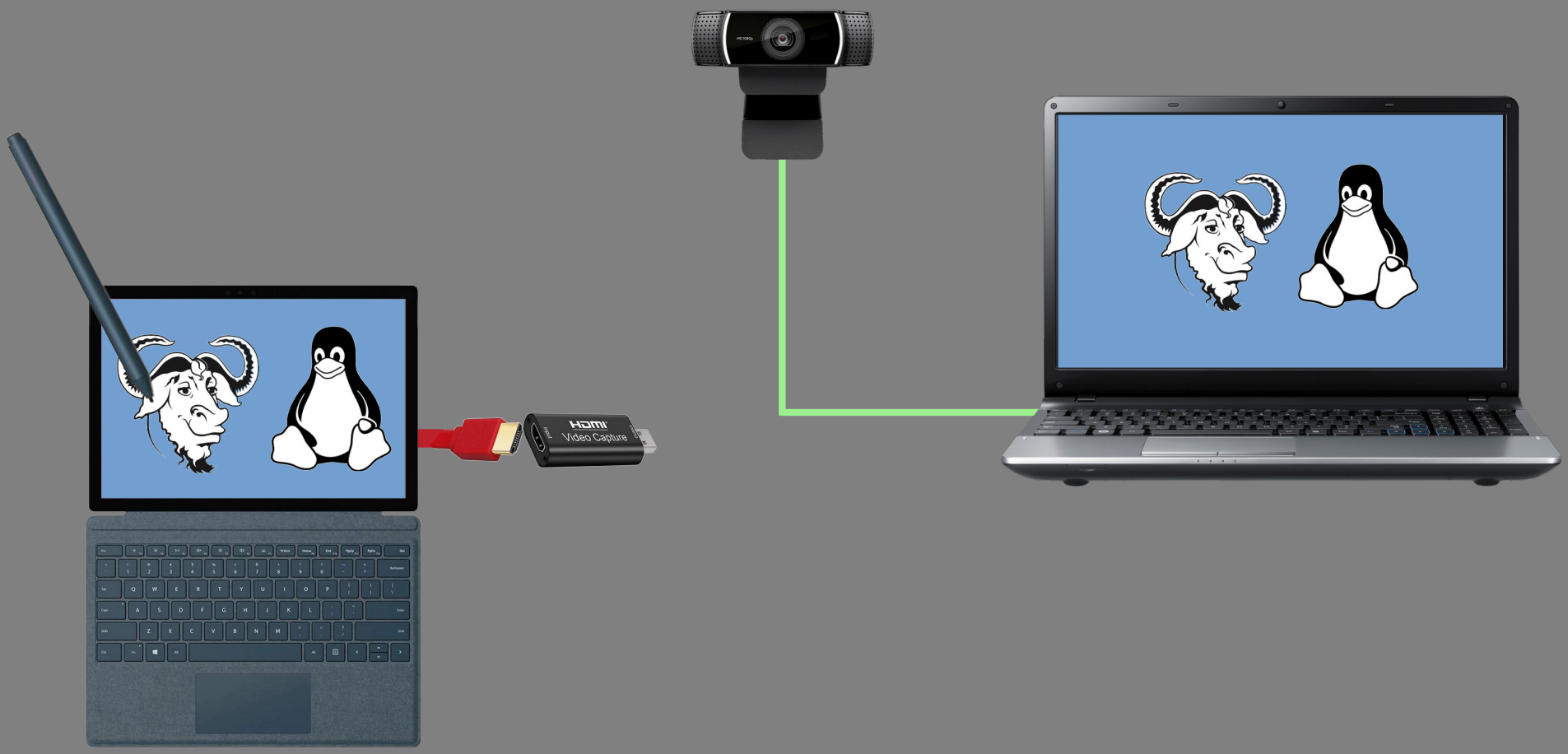
Especially if you're willing to upcycle and build.

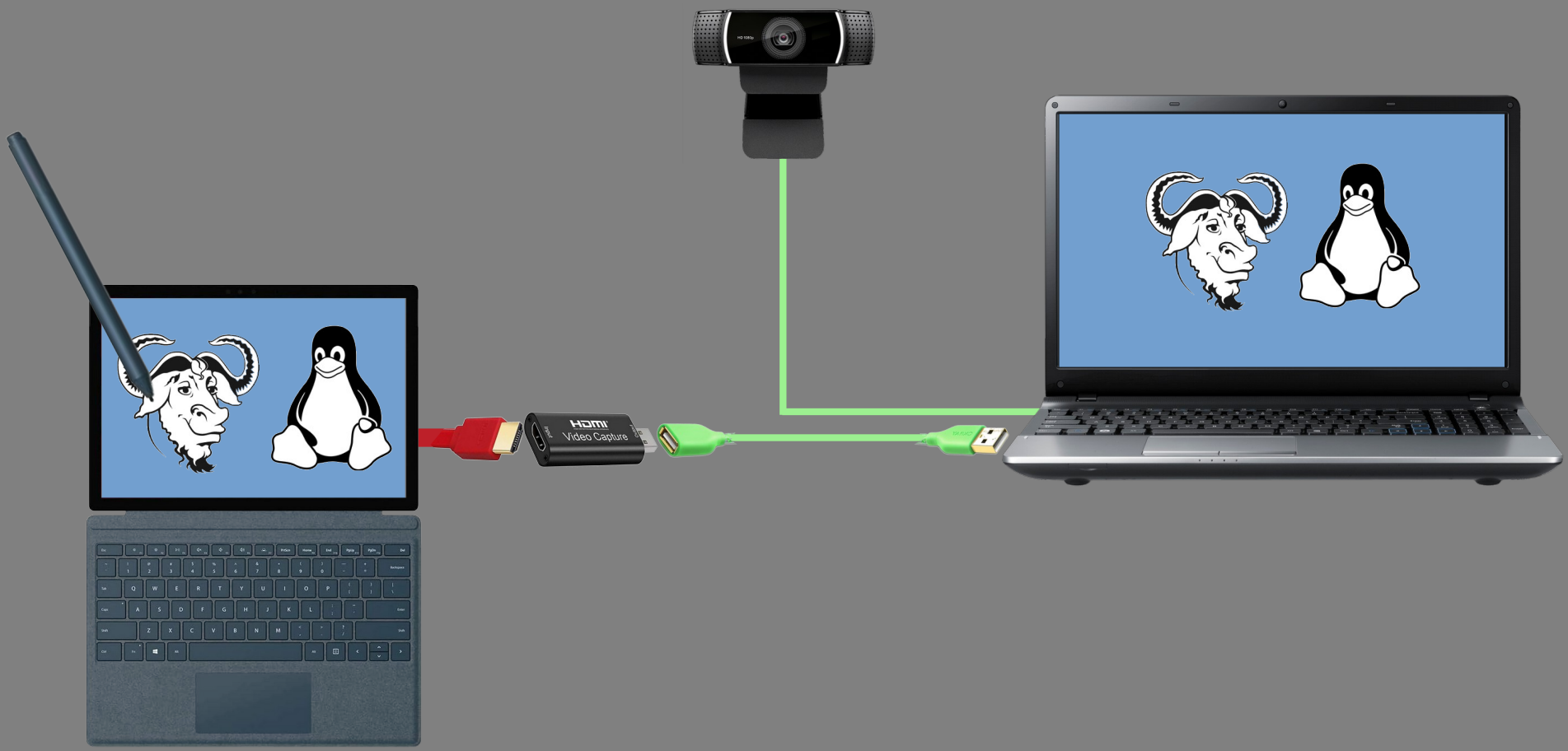

HDMI
HIGH-DEFINITION MULTIMEDIA INTERFACE
Input
Video Capture
Output








HDMI
Video Capture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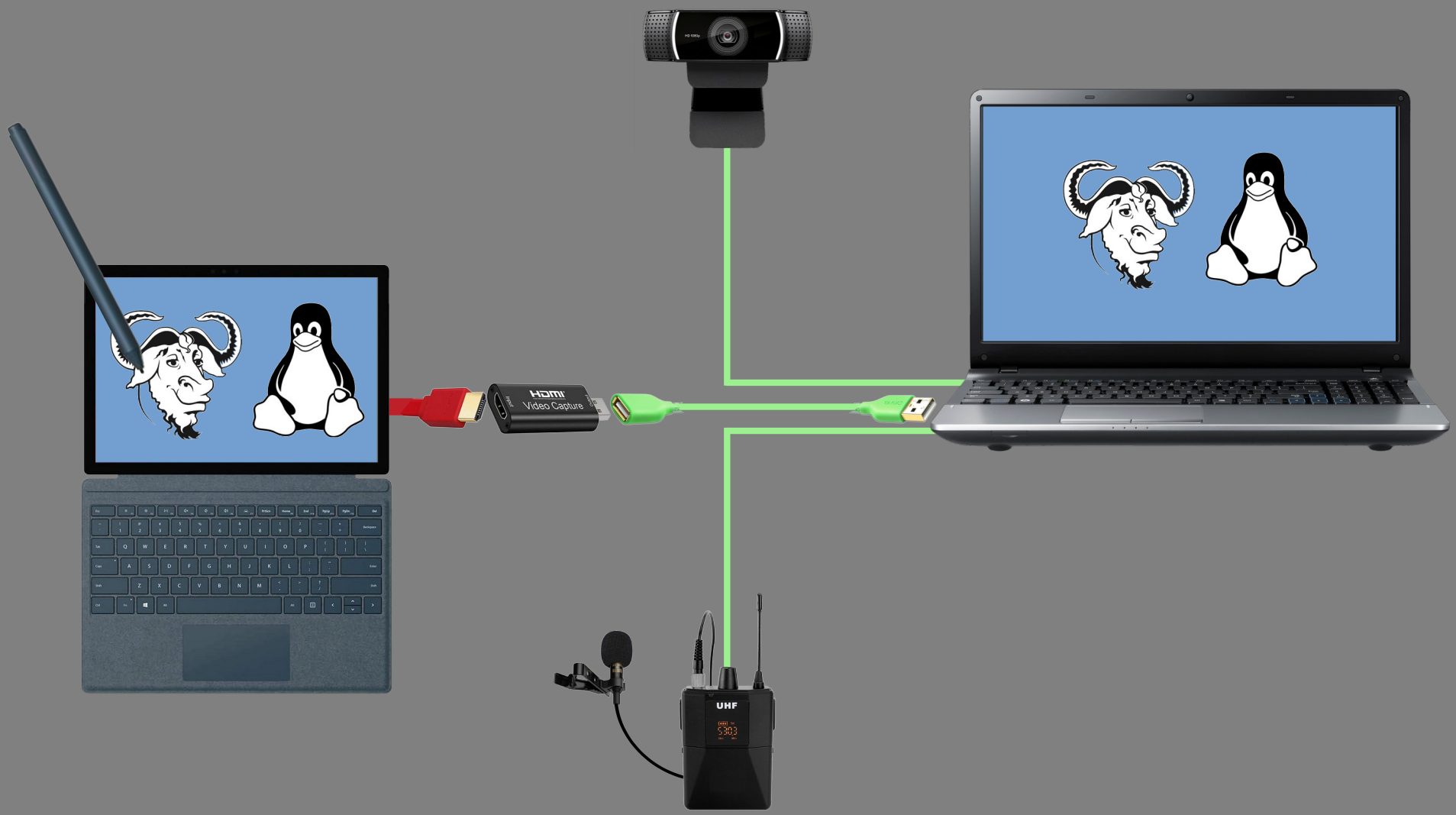
HDMI
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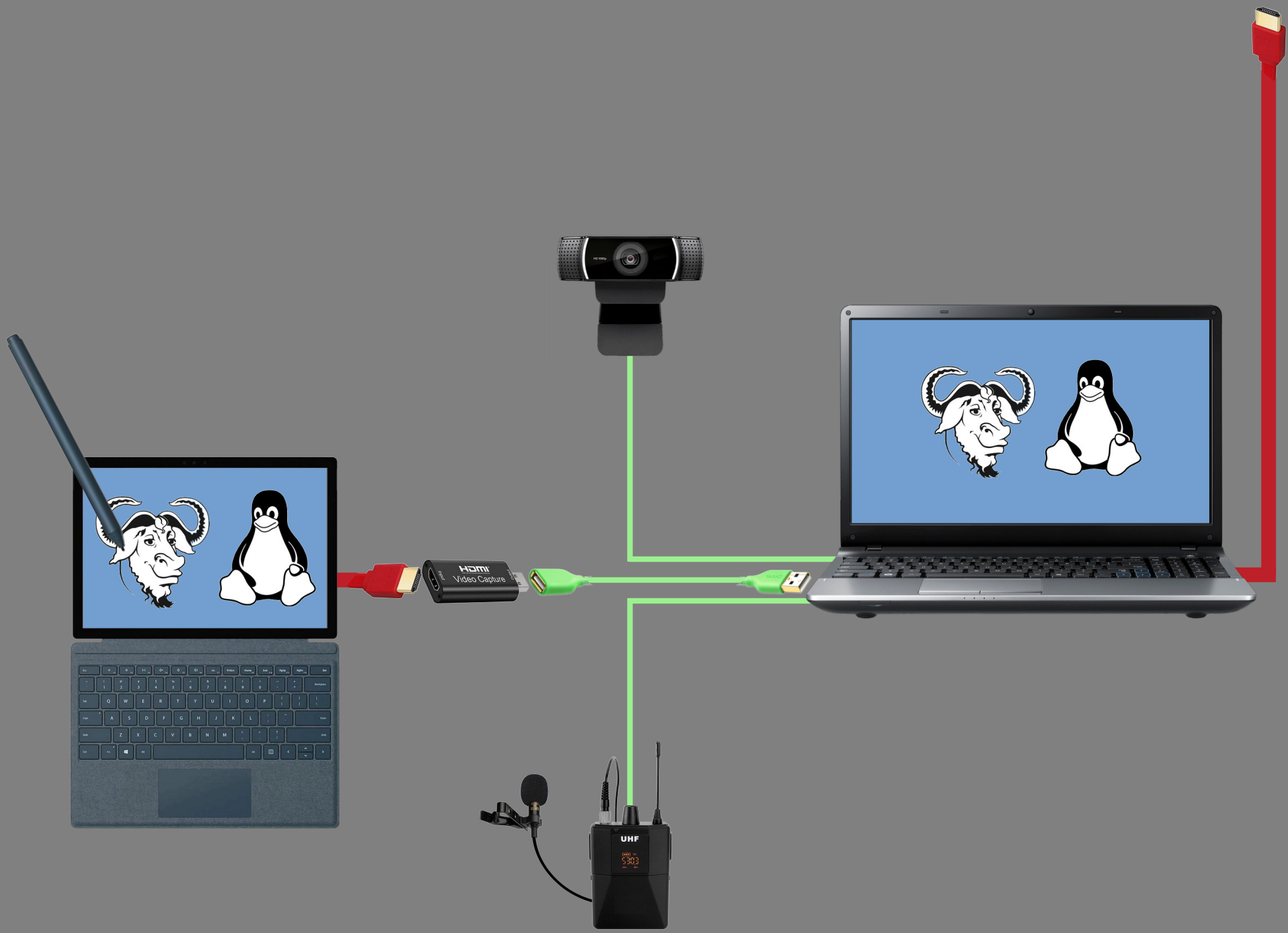
UHF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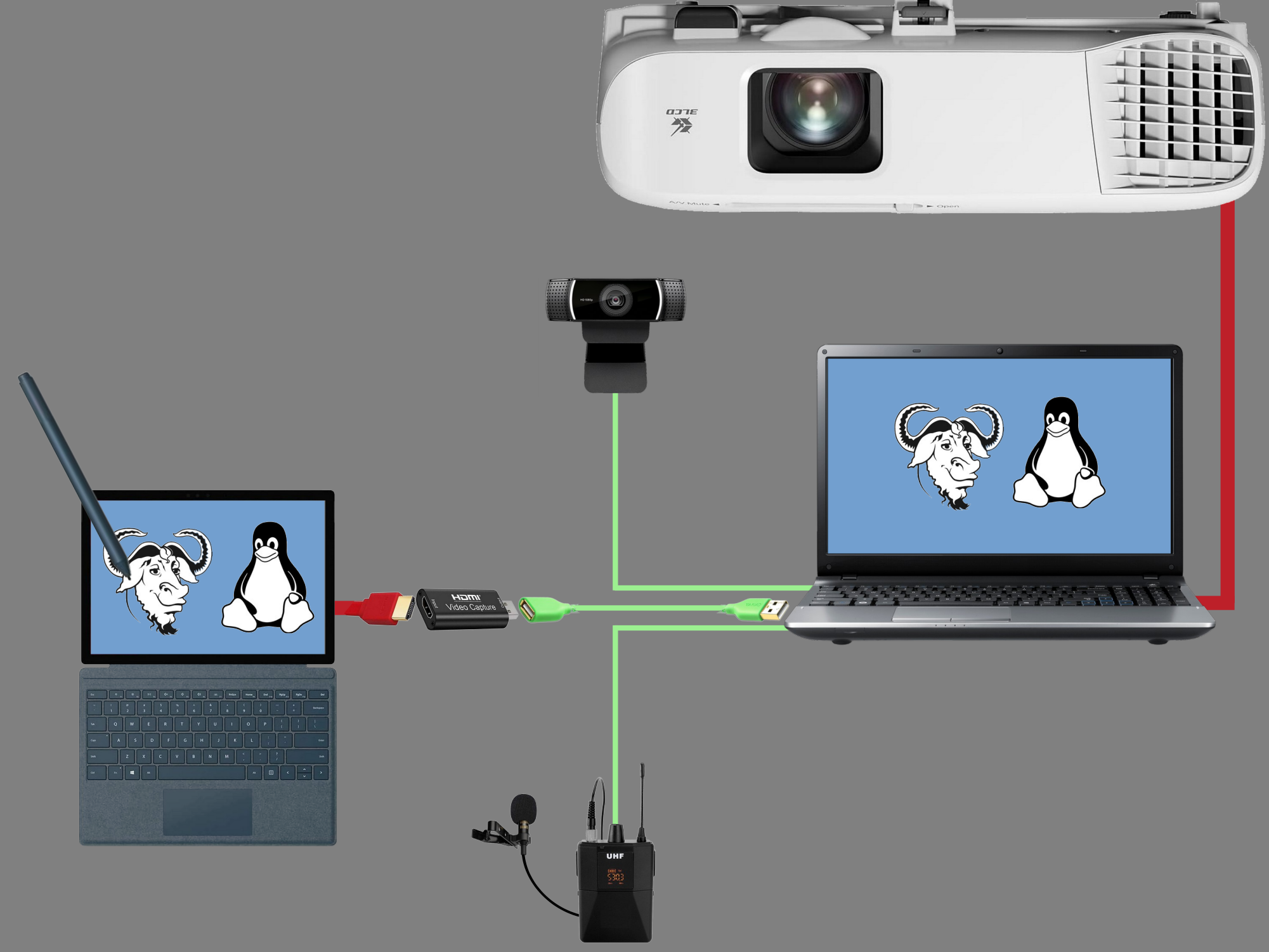
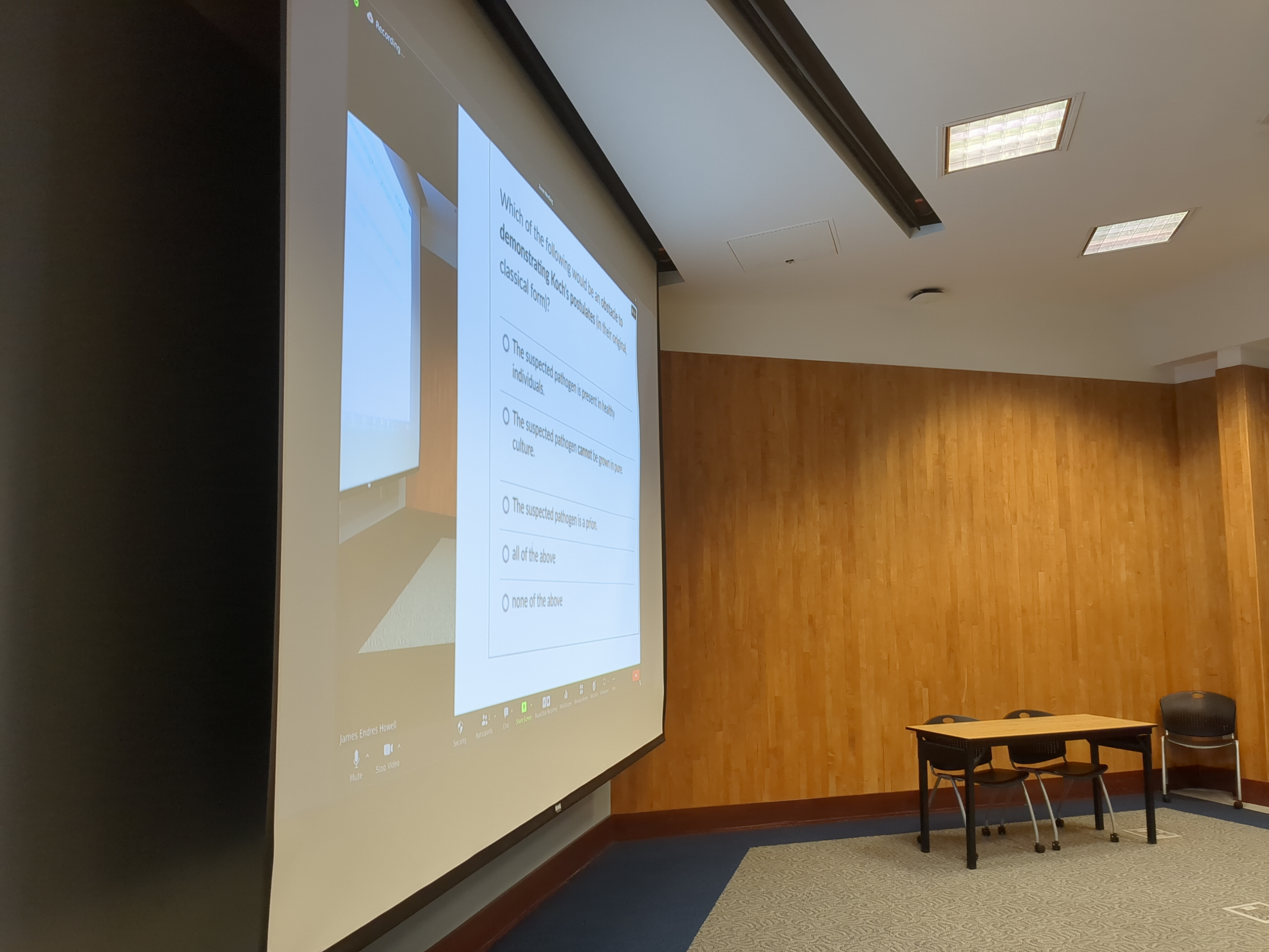

3LCD
A/V Mute
Open
HDMI
Video Capture
UHF


Zoom Meeting
Which of the following would be an obstacle to demonstrating Koch's postulates (in their original, classical form)?
The suspected pathogen is present in healthy individuals.
The suspected pathogen cannot be grown in pure culture.
The suspected pathogen is a prion.
all of the above
none of the above
Koch's postulates are the standard of evidence of pathogenicity
ADDITIONAL MICS BELOW


Recording...
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all of the above
none of the above
James Endres Howell
Mute
Stop Video
Security
Participants
Chat
Share Screen


Software

Presentation software: flexibility in function

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drawing and annotation `Xournal++`

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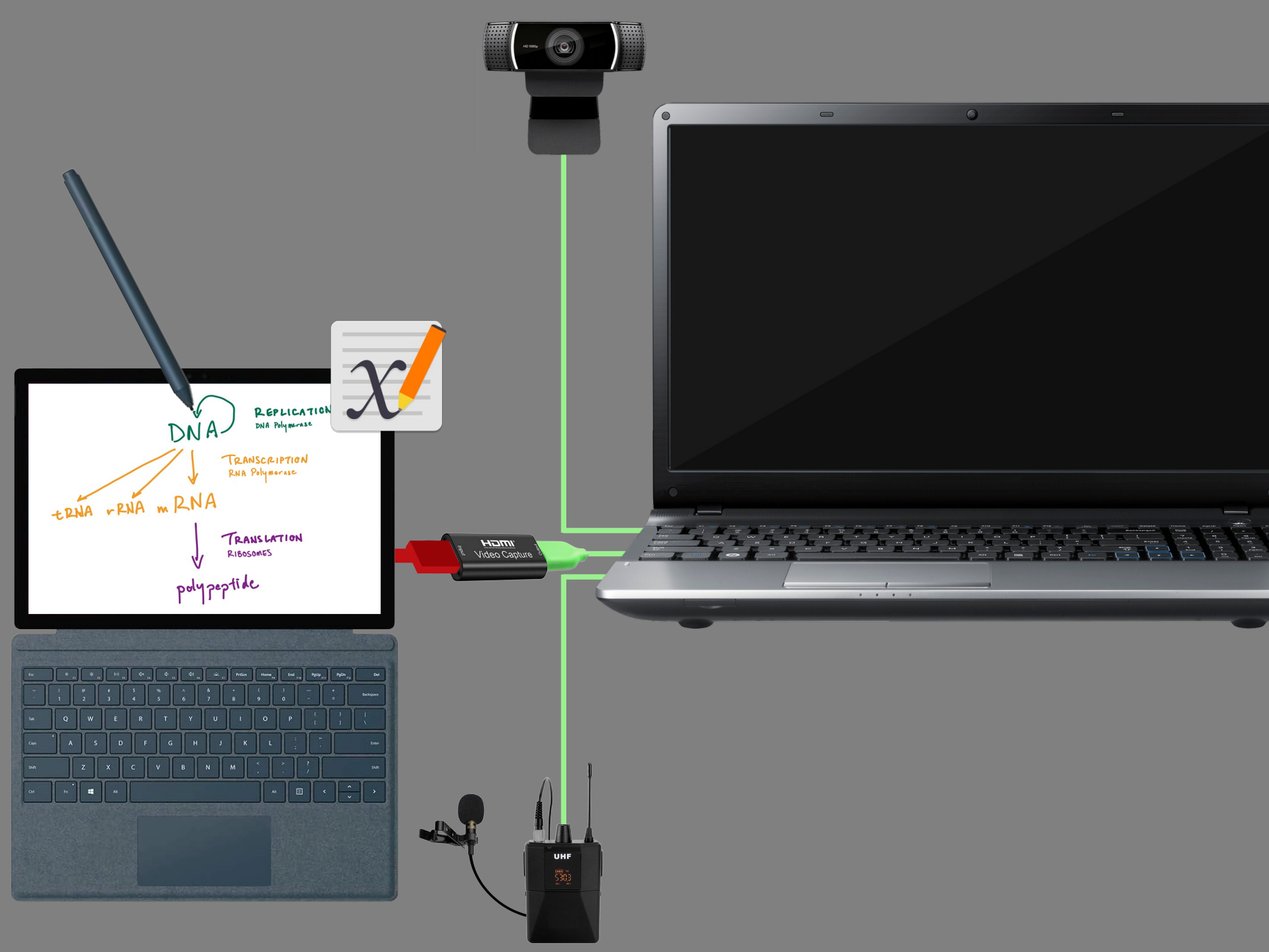
streaming/videoconferencing platform	`Jitsi Meet`


DNA
REPLICATION
DNA Polymerase
TRANSCRIPTION
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Demonstrations

Xournal ++

Xournal++ allows drawing with a stylus on a tablet.

Most lecture halls do not have blackboards or whiteboards!

Even better: highlight and annotate the slides in real time.

It's the reason for producing slides as PDFs rather than presenting directly with Emacs.

Firefox

Assignments are all online, so we can review them in class.

We jump to Wikipedia or image search almost every day!

VLC

Inserting myself into animations is the killer app!

Emacs!

Emacs allows sophisticated presentation and manipulation of text.

Authoring with Emacs

Slides and handouts from a single Org mode document


entirely
assembled
in Emacs

Org mode: part of GNU Emacs

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write documents in plain text

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export BEAMER to produce PDF slides like these ones

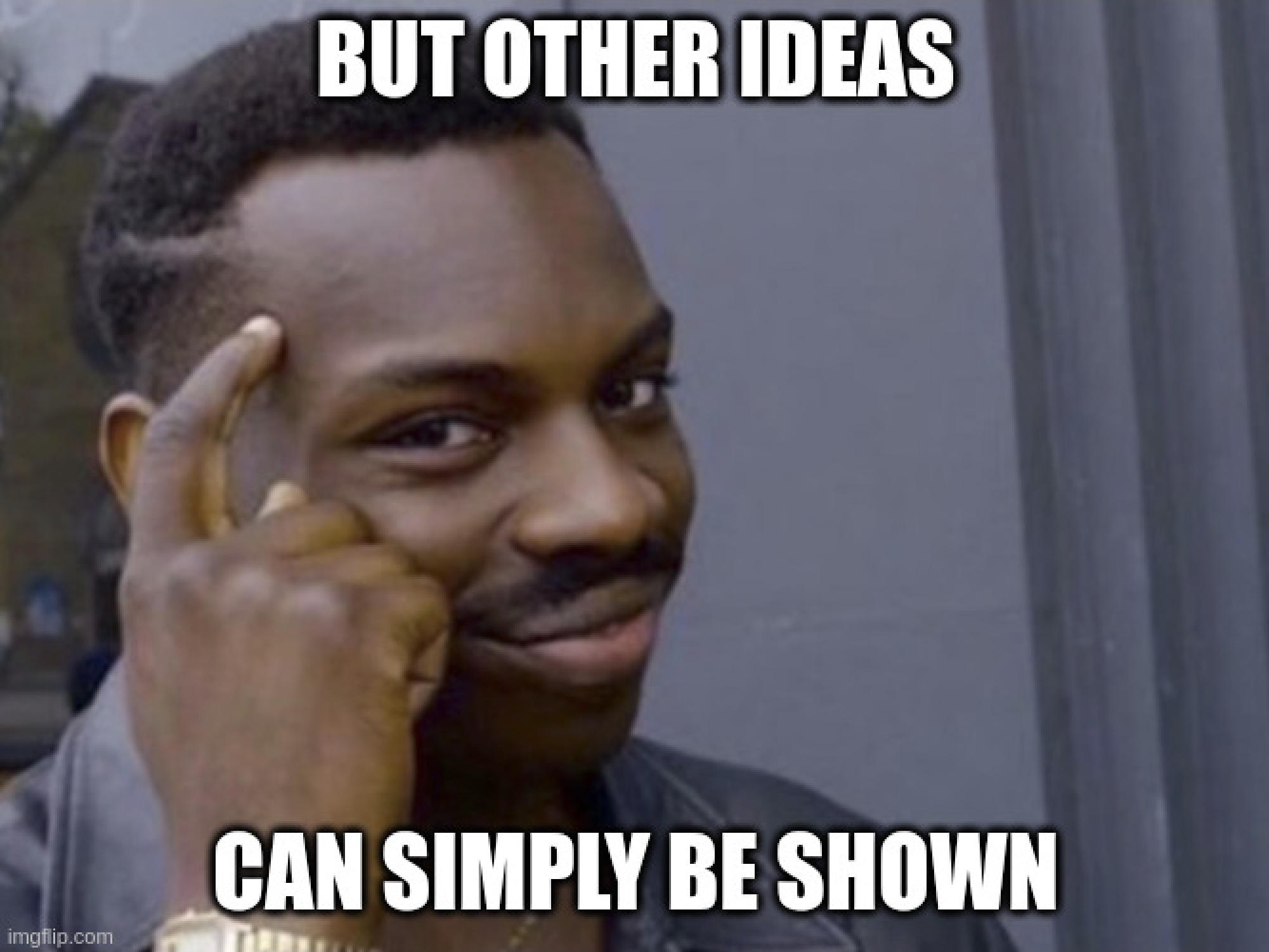
Pedagogy first!


Simply a
collection of
export
customizations

Spell out and linger upon one idea

Make explicit one idea at a time

Some concepts are best explained (in text?)


BUT OTHER IDEAS
CAN SIMPLY BE SHOWN
imgflip.com

Pedagogy first!

Make explicit
one idea
at a time.

Some concepts	are best explained in text.
	can simply be shown.
	require a sequence of images.
	require an animation.

Contrast: death by Powerpoint

These methods
improve course authoring in multiple fundamental ways:

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Separate the work of writing, developing, scaffolding
from the work of wrangling class slides.

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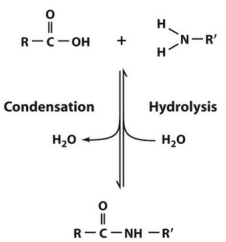

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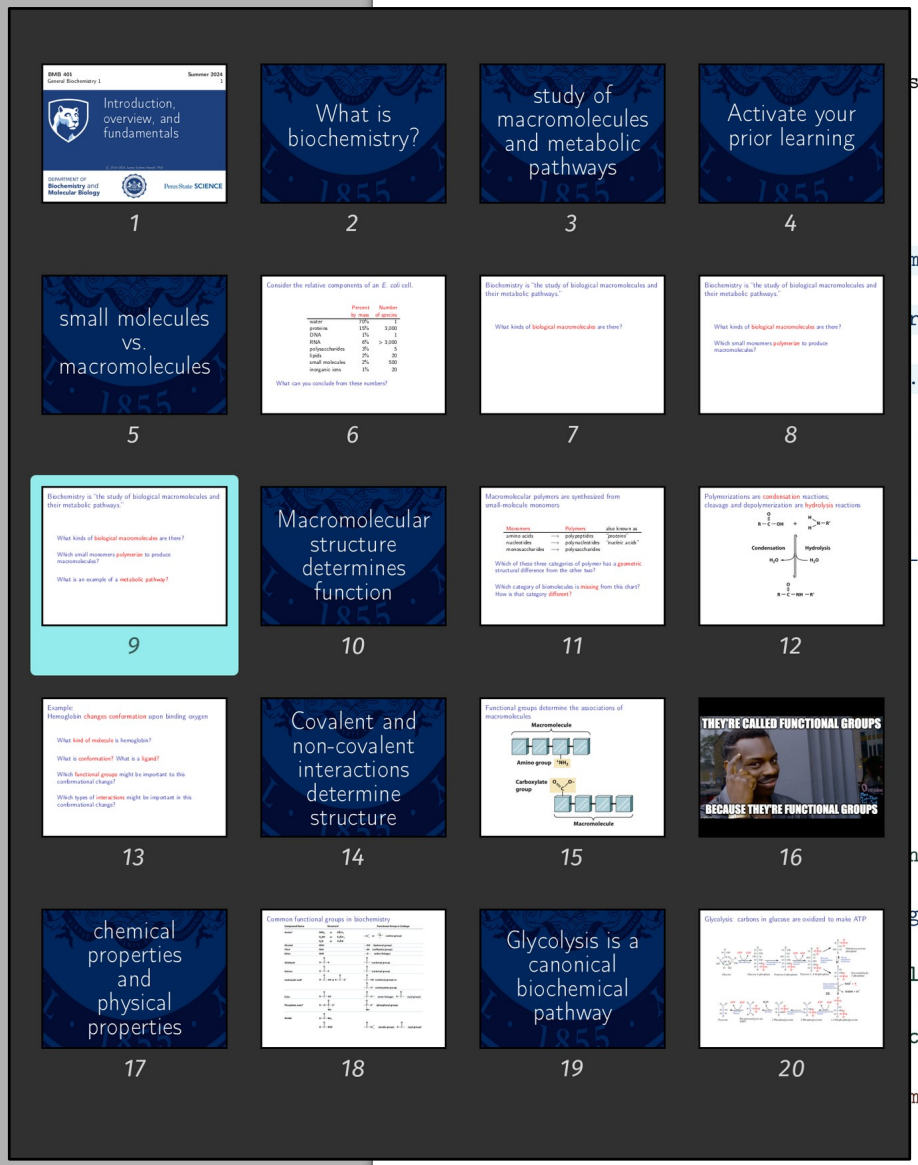


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- What kinds of **biological macromolecules** are there?
- Which small monomers **polymerize** to produce macromolecules?
- What is an example of a **metabolic pathway?**

1.2 Macromolecular structure determines function

Macromolecular polymers are synthesized from small-molecule monomers

Monomers		Polymers	also known as
amino acids	⟶	polypeptides	*"proteins"*
nucleotides	⟶	polynucleotides	*"nucleic acids"*
monosaccharides	⟶	polysaccharides	

- Which of these three categories of polymer has a **geometric** structural difference from the other two?
- Which category of biomolecules is **missing** from this chart? How is that category **different?**

Polymerizations are condensation reactions; cleavage and depolymerization are hydrolysis reactions

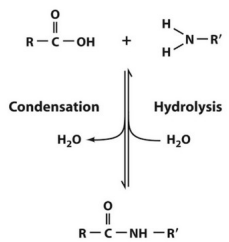
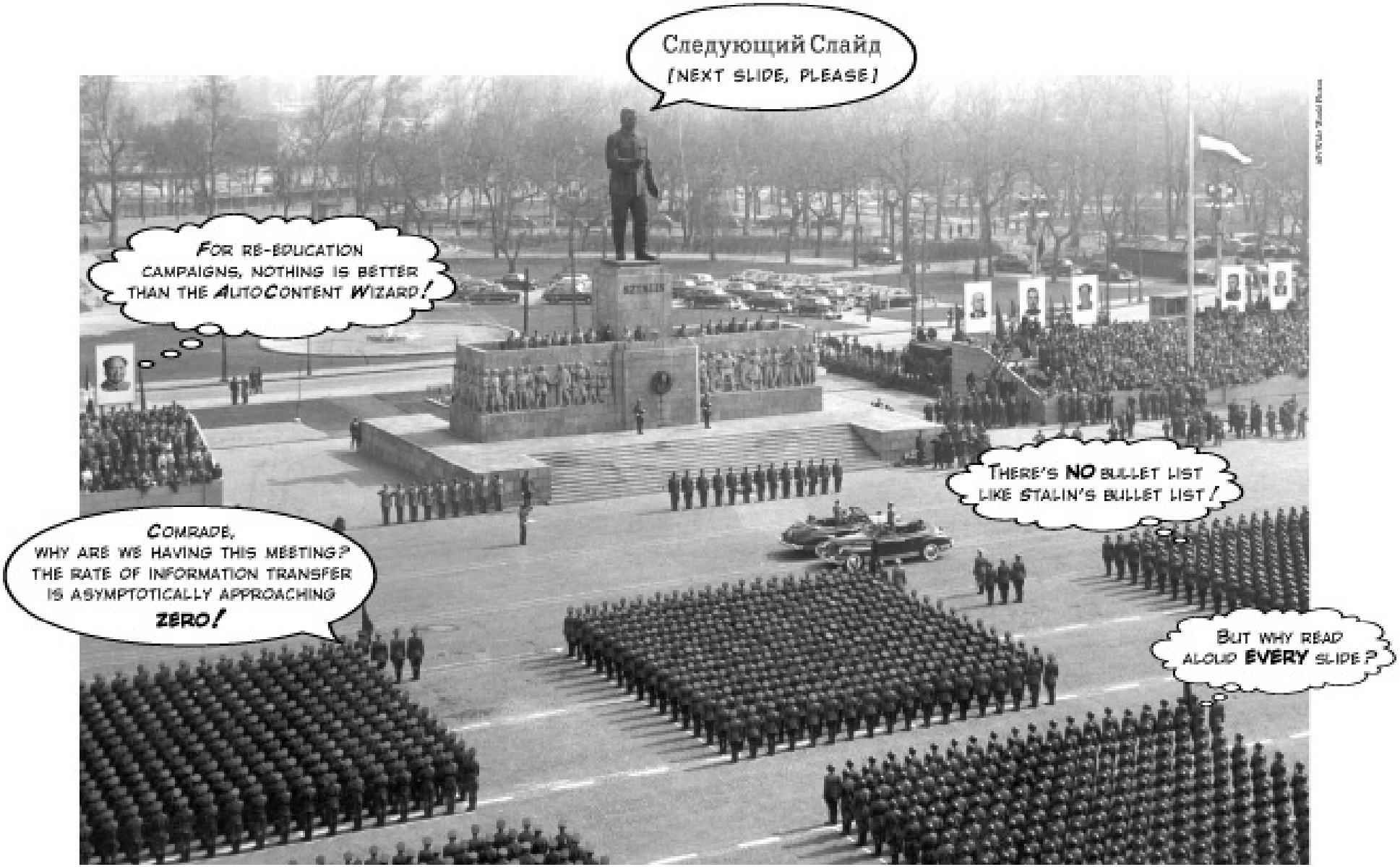


Figure 1: Polymerization of amino acids into proteins is a **condensation reaction**; the reverse reaction, depolymerization of proteins back to amino acids, is a **hydrolysis reaction**. Similarly, polymerization of nucleotides into nucleic acids,

Everything is an outline



Edward Tufte, *The Cognitive Style of PowerPoint*

No executive function to waste

org-teach

A peek at the sources

org-teach: Org mode macros for custom BEAMER markup

```
#+INCLUDE: org-teach-headers-include.org
```

`{{{pause}}}`	force split a frame into multiple overlay slides
`{{{newline}}}`	break a line in the slides *but not in the handouts*
`{{{whitespace-break}}}`	break a line in the slides and add extra whitespace

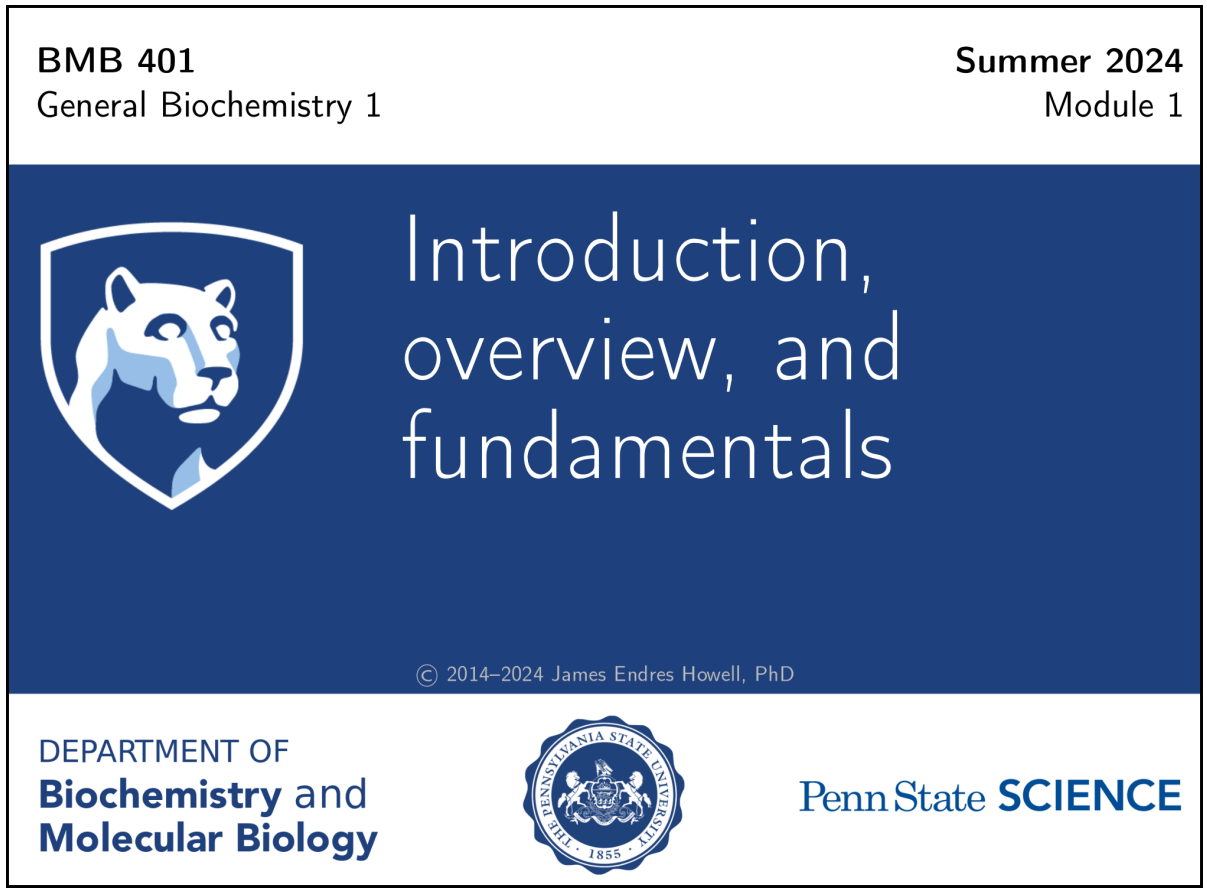
org-teach: Org mode macros for custom BEAMER frames

```
#+INCLUDE: org-teach-headers-include.org
```

text slides	H3 beamer frame
figure slides	H3 beamer frame
slide includes	include other Org files *version control*
`{{{section-slide}}}`	insert a custom H1 frame
`{{{subsection-slide}}}`	insert a custom H2 frame
`{{{impact-slide}}}`	insert a high-impact text frame
`{{{image-slide}}}`	insert an image-only frame
`{{{blank-slide}}}`	insert a blank white slide
`{{{include-slides-pdf}}}`	insert single- or multi-page PDF

Section slides (H1)

```
#+MACRO: COURSE_NUMBER      BMB 401
#+MACRO: COURSE_TITLE       General Biochemistry 1
#+MACRO: SEMESTER           Summer 2024
* Introduction, overview, and fundamentals
{{{section-slide(Module 1)}}}
```



Subsection slides (H2)

```
** Macromolecular structure determines function
{{{subsection-slide}}}
```

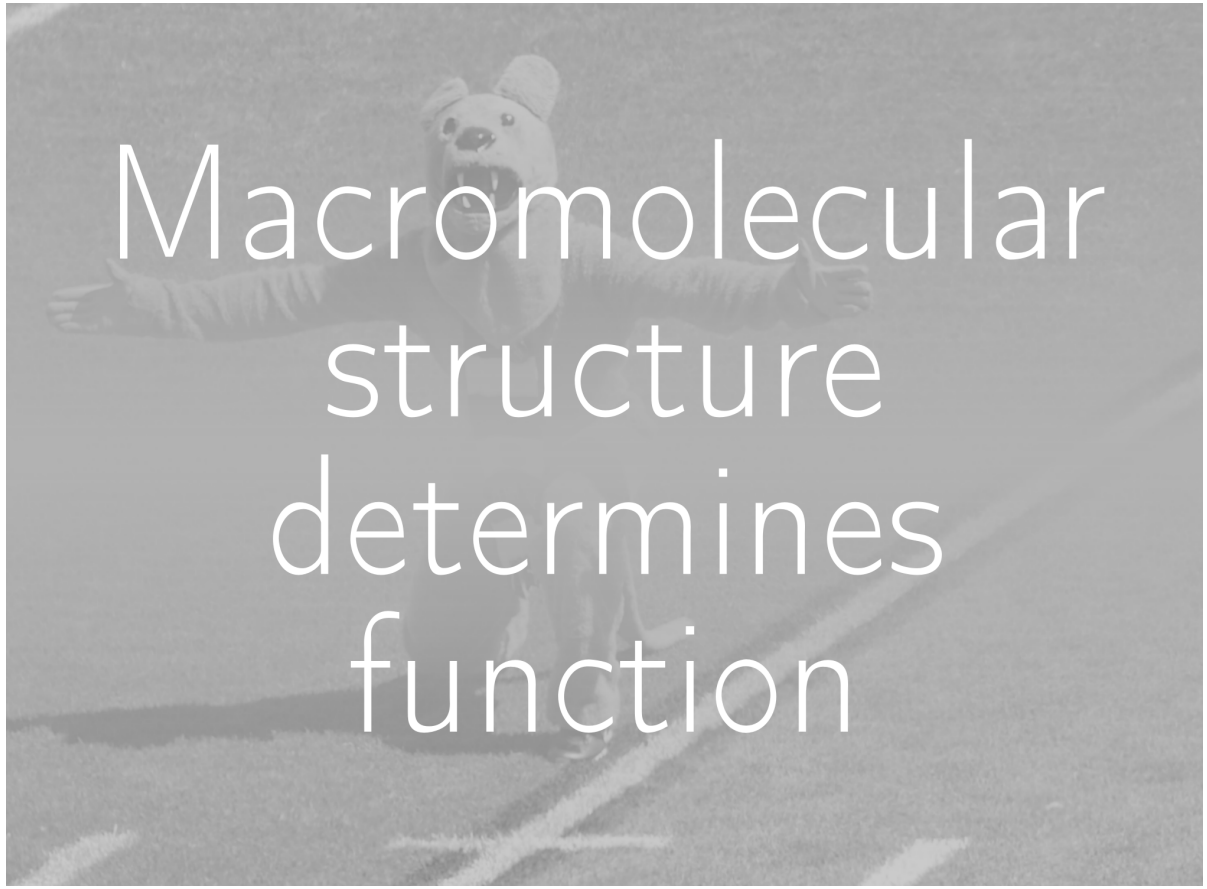


Figure 2: Subsection slides correspond to major lecture topics

Text slides (H3)

```
*** Biochemistry is "the study of biological macromolecules
**** What kinds of *biological macromolecules* are there?
**** Which small monomers *polymerize* to produce macromole
**** What is an example of a *metabolic pathway?*
```

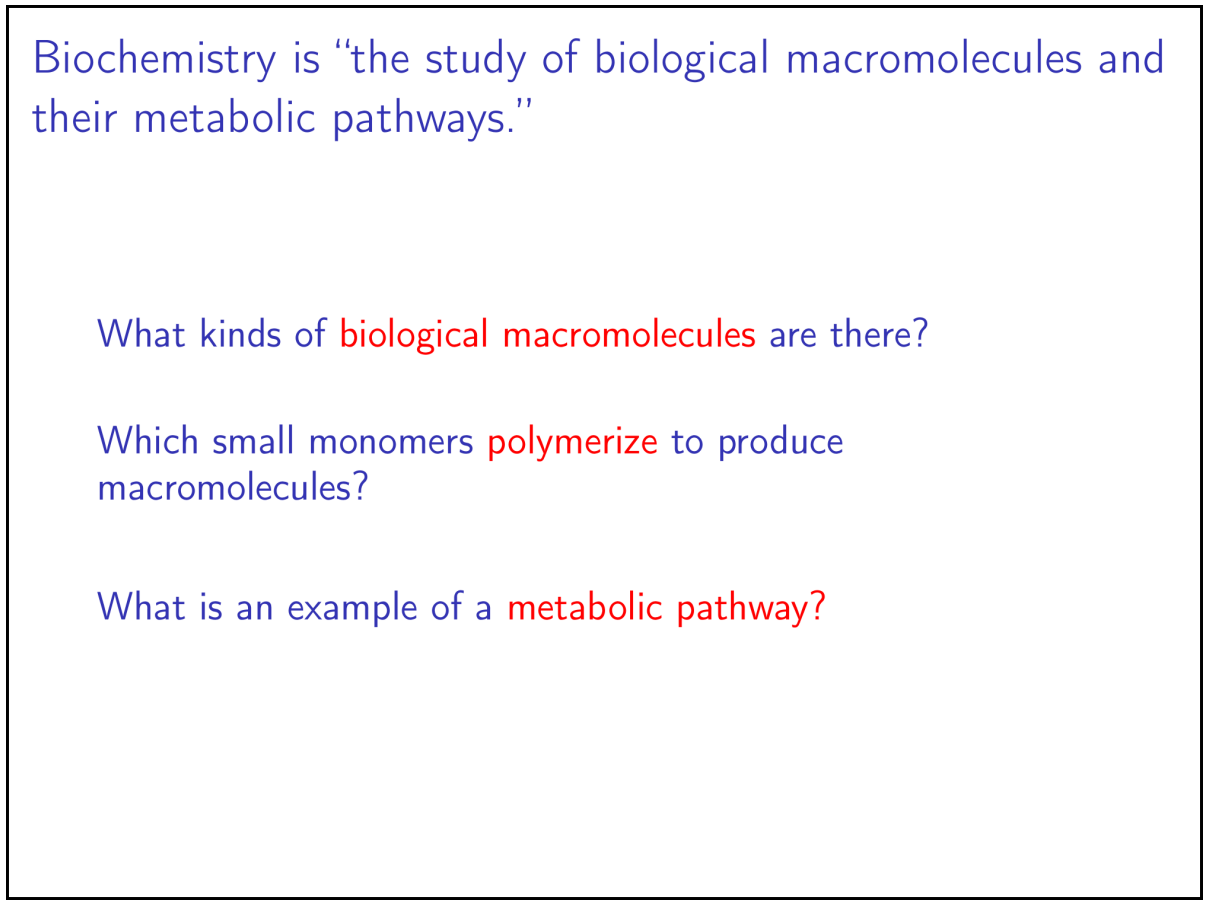


Figure 3: Text slides display formatted Org text, including tables.

Figure slides (H3)

```
*** Glycolysis: carbons in glucose are oxidized to make ATP
#+ATTR_LATEX: :placement [H] :float nil :width 0.85\paperwi
[[./_img/glycolysis-pathway.png]]
```

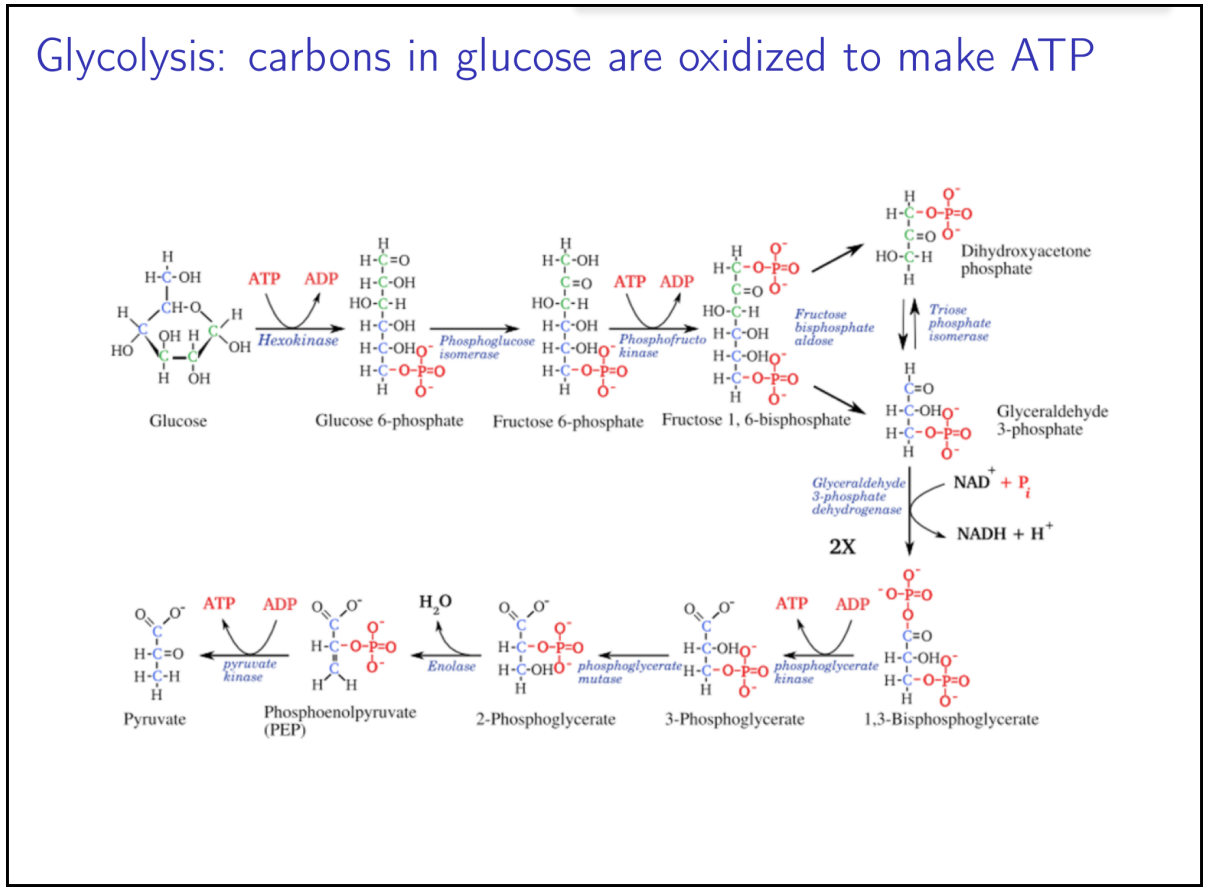


Figure 4: Figure slides include a title, an image, and optionally text.

Impact slides (under H1 or H2)

```
{{{impact-slide ( small molecules \\ vs.  \\
macromolecules ) }}}
```

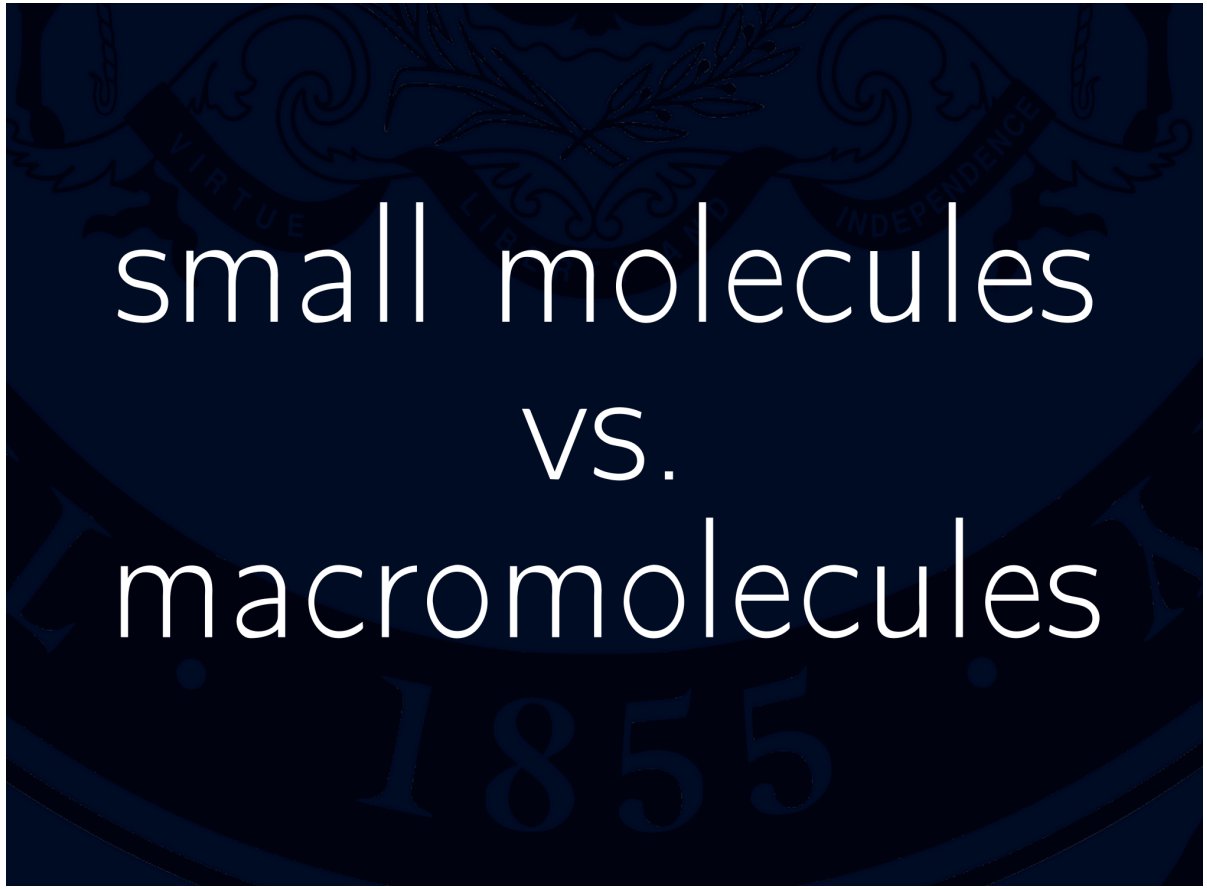


Figure 5: Impact slides: "*Let us pause and consider this key idea.*"

Image slides (under H1 or H2)

```
{{{image-slide(./_img/rough-er.jpg)}}}
```

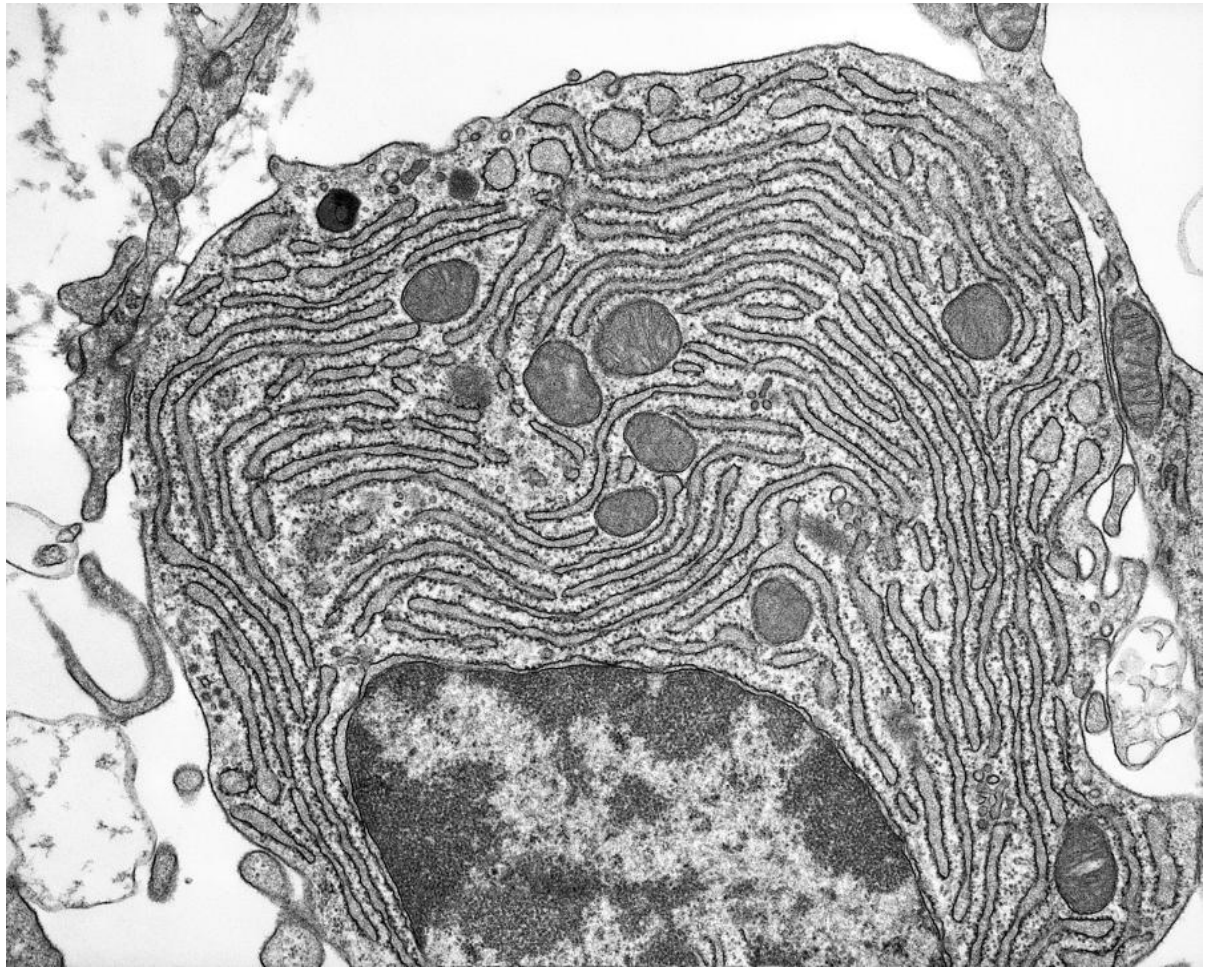


Figure 6: Image slides contain an image filling the entire frame.

Blank slides (under H1 or H2)

```
{{{blank-slide}}}
```

Figure 7: Blank slides are an empty white frame.

PDF includes (under H1 or H2)

```
{{{include-slides-pdf(_img/software-setup.pdf)}}}
```

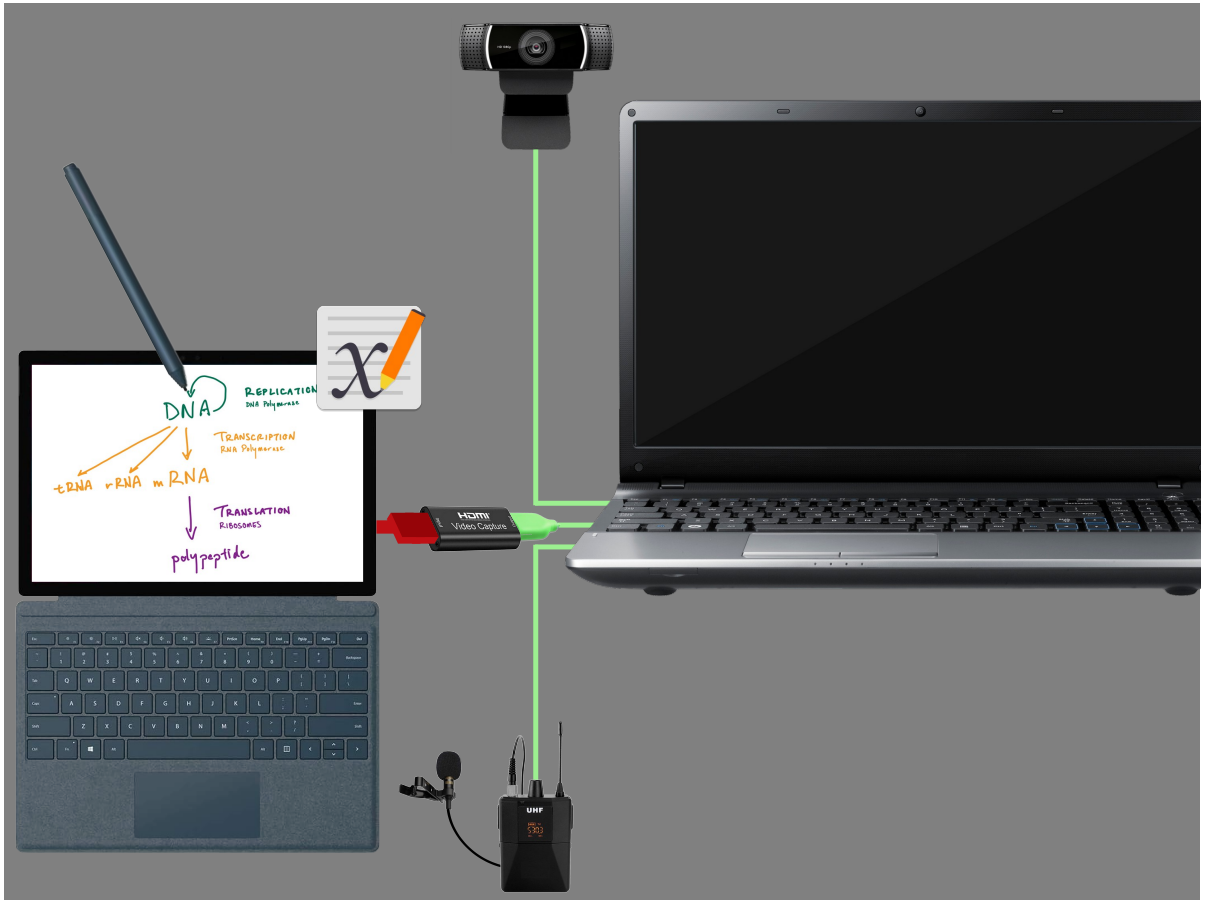
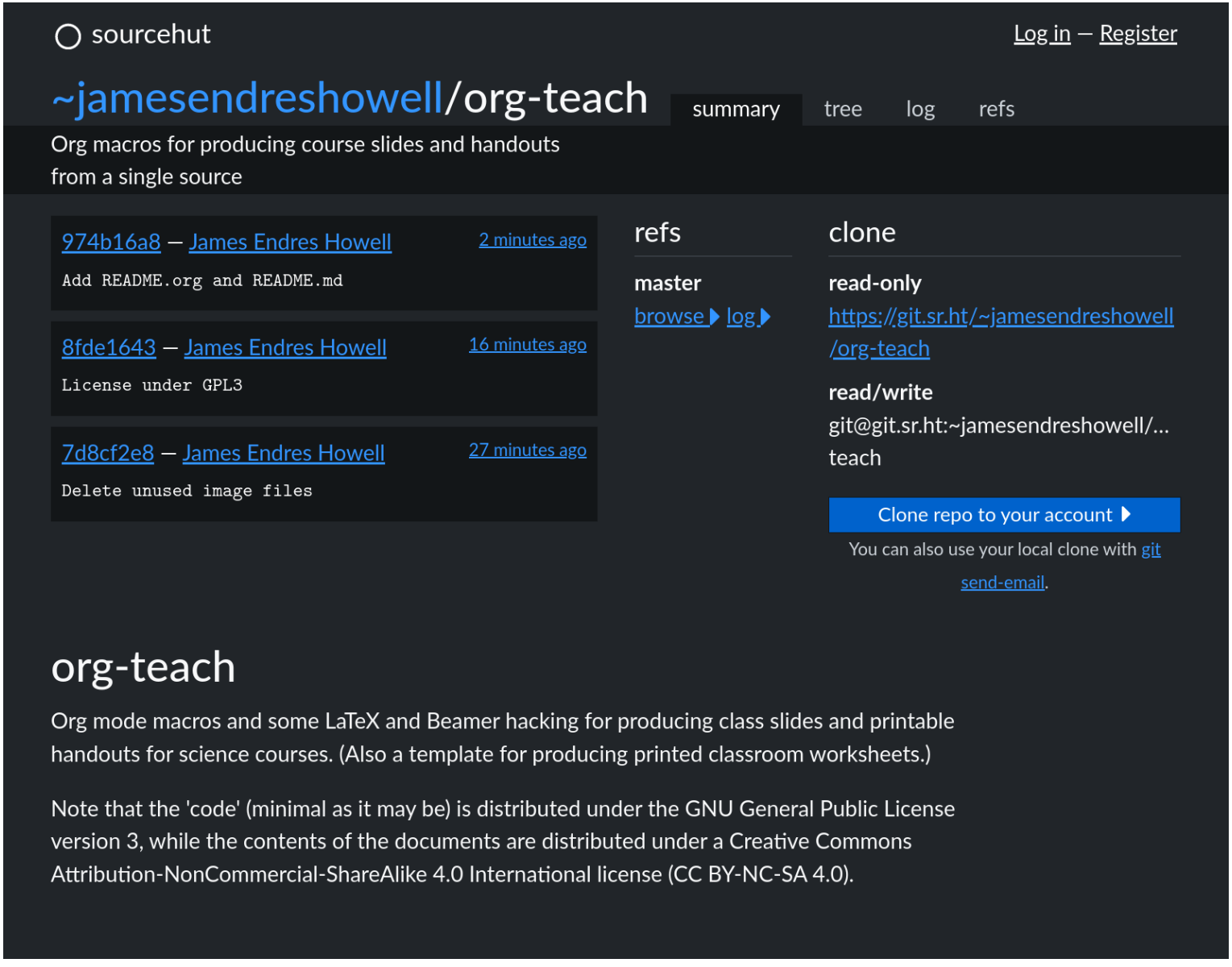


Figure 8: PDF includes: directly imports multi-page PDFs in place (useful for importing *e.g.* graphical sequences produced in LibreOffice Impress)


Please use and
share!

https://git.sr.ht/~jamesendreshowell/org-teach



I hope to hear from you!

James Endres Howell

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