

EmacsConf 2023

the joy of Emacs and Emacs Lisp

2023 December 02

09:30 general track



Authoring and presenting university courses with Emacs

© 2014–2024 James Endres Howell, PhD

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 \ macro molecules \ 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 |
    | small molecules |       | 2%  |           | 500 |
    | inorganic ions |       | 1%  |           | 20 |

  * 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
  -:--- 0_BMB401_SU24.org  Top (1,0)      (Org Olv Ind Fly/-- Z yas WK RAS Wrap) 23:17 0.44
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
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nucleotides	→ polynucleotides	"nucleic acids"
monosaccharides	→ polysaccharides	

- * Which of these three categories of polymer has a **geometric structural difference** from the other two?
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Polymerizations are condensation reactions; cleavage and depolymerization are hydrolysis reactions

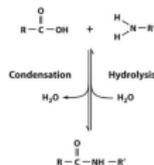


Figure 1: Polymerization of amino acids into proteins is a **condensation reaction**; the reverse reaction, depolymerization of proteins back to amino acids, is a **hydrolysis reaction**. Similarly, polymerization of nucleotides into nucleic acids,

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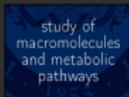
BMB 401
 General Biochemistry 1
 Summer 2024



1



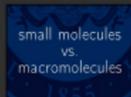
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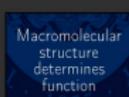
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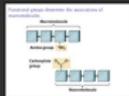
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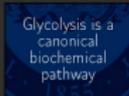
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18



19



20

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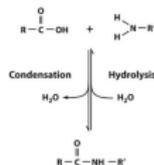


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<https://git.sr.ht/~jamesendreshowell/org-teach>

sourcehut [Log in](#) – [Register](#)

~jamesendreshowell/org-teach

summary tree log refs

Org macros for producing course slides and handouts from a single source

[974b16a8](#) – [James Endres Howell](#) 2 minutes ago

Add README.org and README.md

[8fde1643](#) – [James Endres Howell](#) 16 minutes ago

License under GPL3

[7d8cf2e8](#) – [James Endres Howell](#) 27 minutes ago

Delete unused image files

refs

master
[browse](#) ▶ [log](#) ▶

clone

read-only
<https://git.sr.ht/~jamesendreshowell/org-teach>

read/write
git@git.sr.ht:~jamesendreshowell/...
teach

[Clone repo to your account](#) ▶

You can also use your local clone with [git send-email](#).

org-teach

Org mode macros and some LaTeX and Beamer hacking for producing class slides and printable handouts for science courses. (Also a template for producing printed classroom worksheets.)

Note that the 'code' (minimal as it may be) is distributed under the GNU General Public License version 3, while the contents of the documents are distributed under a Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International license (CC BY-NC-SA 4.0).



authoring
presenting



presenting

Many others present and teach with Emacs!

David Wilson	<code>system-crafters.net</code>
Protesilaos Stavrou	<code>protesilaos.com</code>
Mike Zamansky	<code>cestlaz.github.io</code>

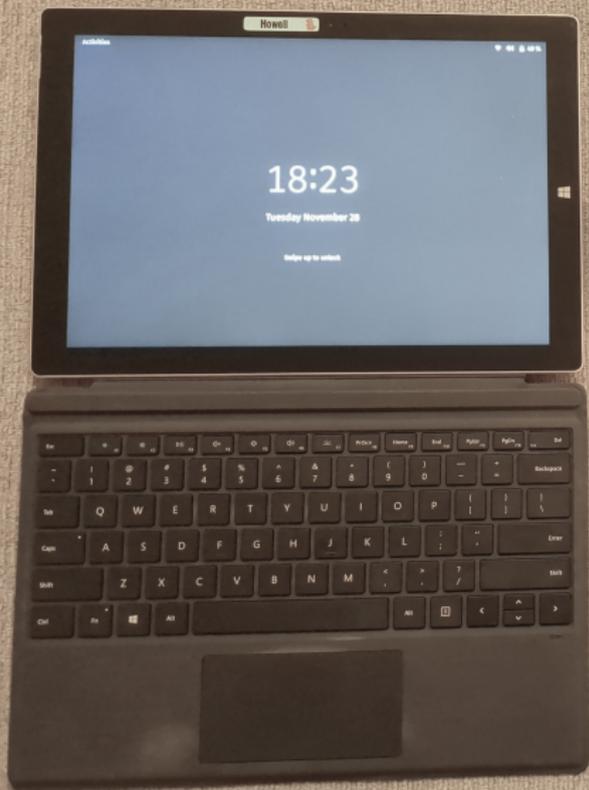
John Kitchin	<i>prior art</i>
Eric Fraga	<i>prior art</i>
Olivier Berger	<i>prior art</i>
Ro and Namkoon	<i>citation</i>

A person wearing a bear mascot costume is running on a track. The bear's mouth is wide open, showing its teeth. The person's arms are outstretched. The track has white lane markings. The word "Hardware" is overlaid in white text on the image.

Hardware

A large, faint watermark of a university seal is visible in the background. The seal features a central crest with a book and a quill, flanked by two figures. Below the crest is a banner with the text "LIBERTY AND INDEPENDENCE". The seal is surrounded by a circular border containing the text "1855" and other partially visible words like "VIRTUE" and "WISDOM".

Every course
meeting!





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*

Presentation hardware: everything fits in a small backpack

GNU/Linux laptop

GNU/Linux tablet *with stylus*

USB webcam and knobby tripod

Presentation hardware: everything fits in a small backpack

GNU/Linux laptop

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USB webcam and knobby tripod

USB remote lapel mic

Presentation hardware: everything fits in a small backpack

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video output to USB input capture

Presentation hardware: everything fits in a small backpack

GNU/Linux laptop

GNU/Linux tablet *with stylus*

USB webcam and knobby tripod

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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You can do it on a **very small budget!**

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

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You can do it on a **very small budget!**

libre software	\$0
used computer	\$400
used tablet	\$200
used monitors	\$100
webcam	\$100
microphone	\$100
miscellaneous	\$100

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<hr/>	
	\$1000

Especially if you're willing to upcycle and build.







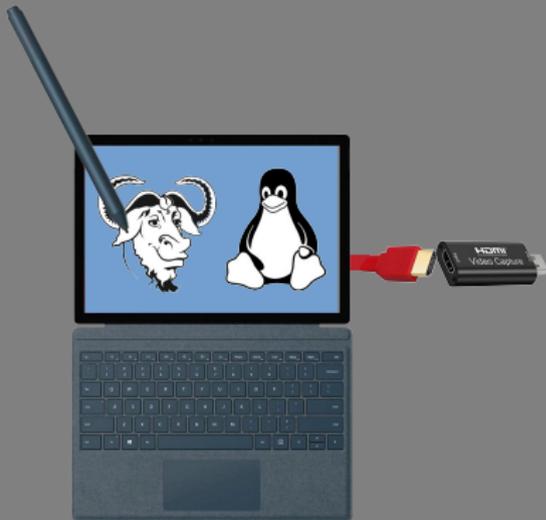


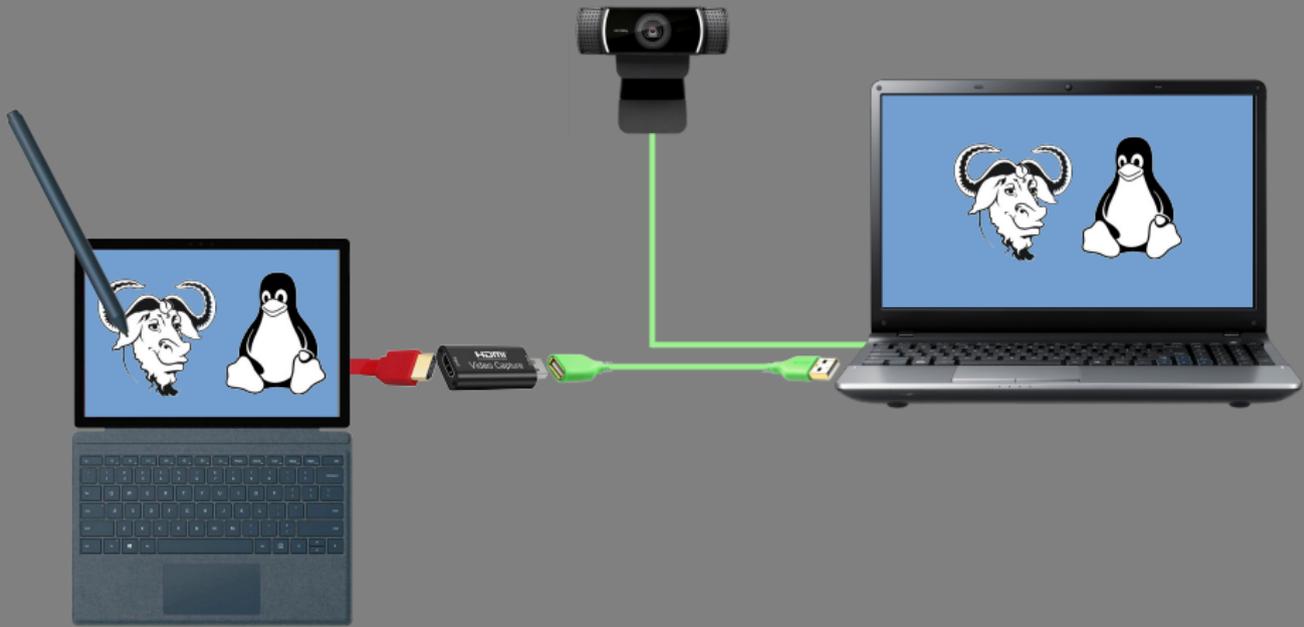




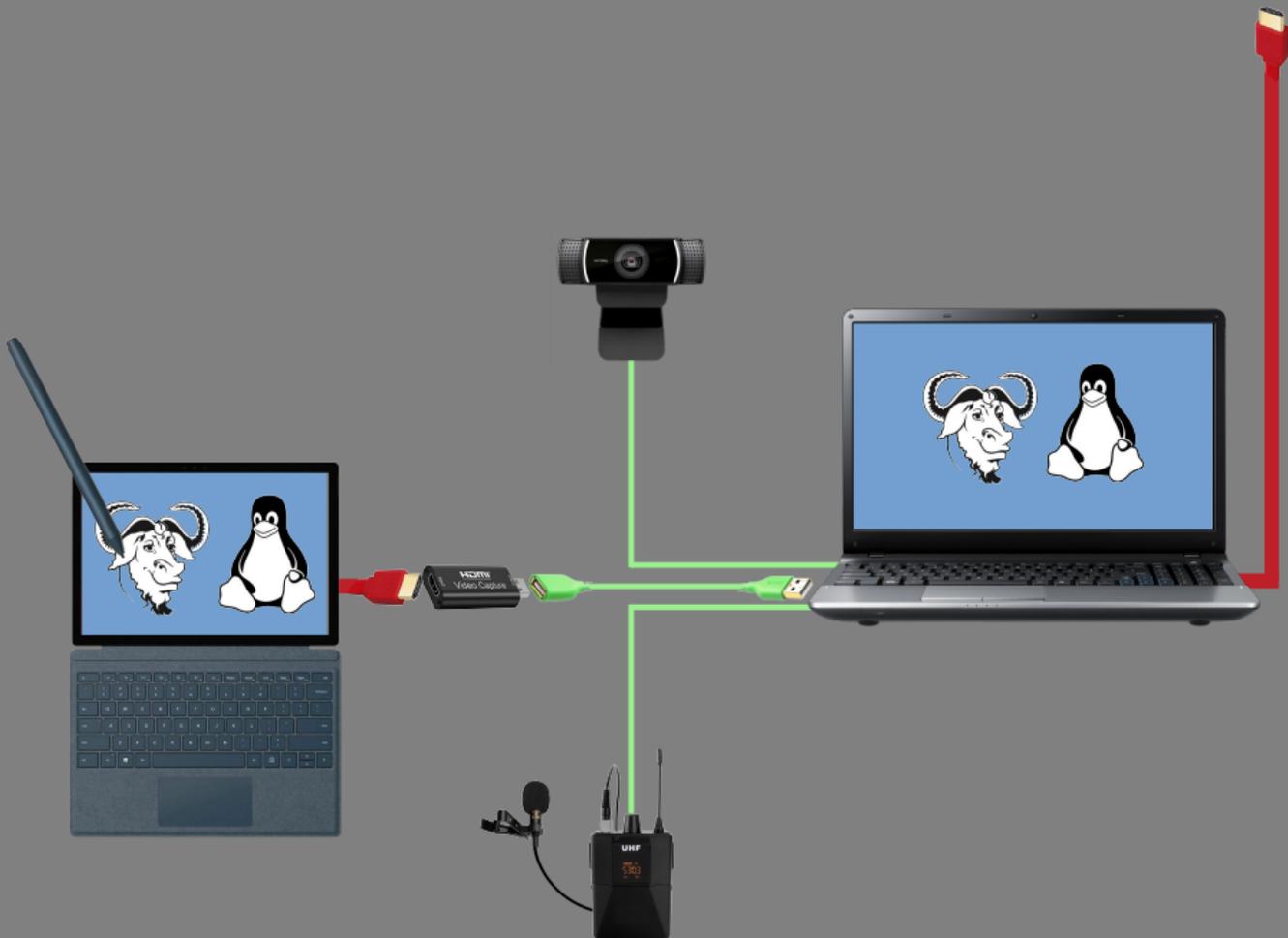




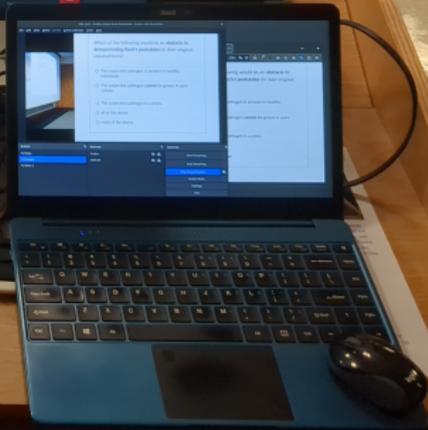
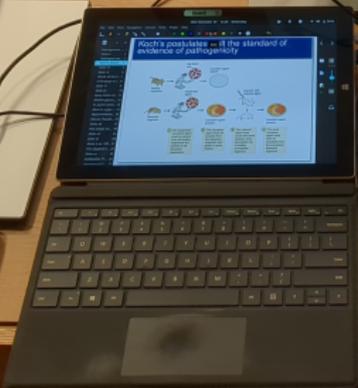
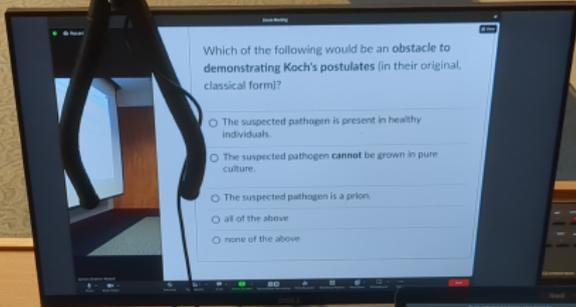












Which of the following would be an obstacle to demonstrating Koch's postulates in their original classical form?

- The suspected pathogen is present in healthy individuals.
- The suspected pathogen cannot be grown in pure culture.
- The suspected pathogen is a virus.
- all of the above
- none of the above

James Graham Moore

Hide Stop Video



A grayscale photograph of a person wearing a bear mascot costume, running on a track with arms outstretched. The bear's mouth is open, showing teeth. The word "Software" is overlaid in white text in the center of the image.

Software

Presentation software: flexibility in function

Presentation software: flexibility in function

drawing and annotation

Xournal++

Presentation software: flexibility in function

drawing and annotation
web browser

Xournal++
Firefox

Presentation software: flexibility in function

drawing and annotation

web browser

video player

Xournal++

Firefox

VLC

Presentation software: flexibility in function

drawing and annotation

Xournal++

web browser

Firefox

video player

VLC

show code, take notes, examine text

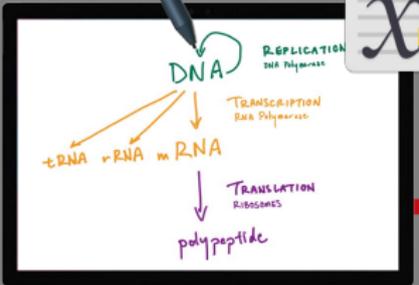
Emacs

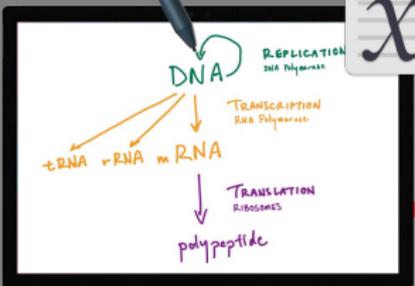
Presentation software: flexibility in function

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video player	VLC
show code, take notes, examine text	Emacs
video compositor (and recording!)	OBS Studio

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web browser	Firefox
video player	VLC
show code, take notes, examine text	Emacs
video compositor (and recording!)	OBS Studio
streaming/videoconferencing platform	Jitsi Meet







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

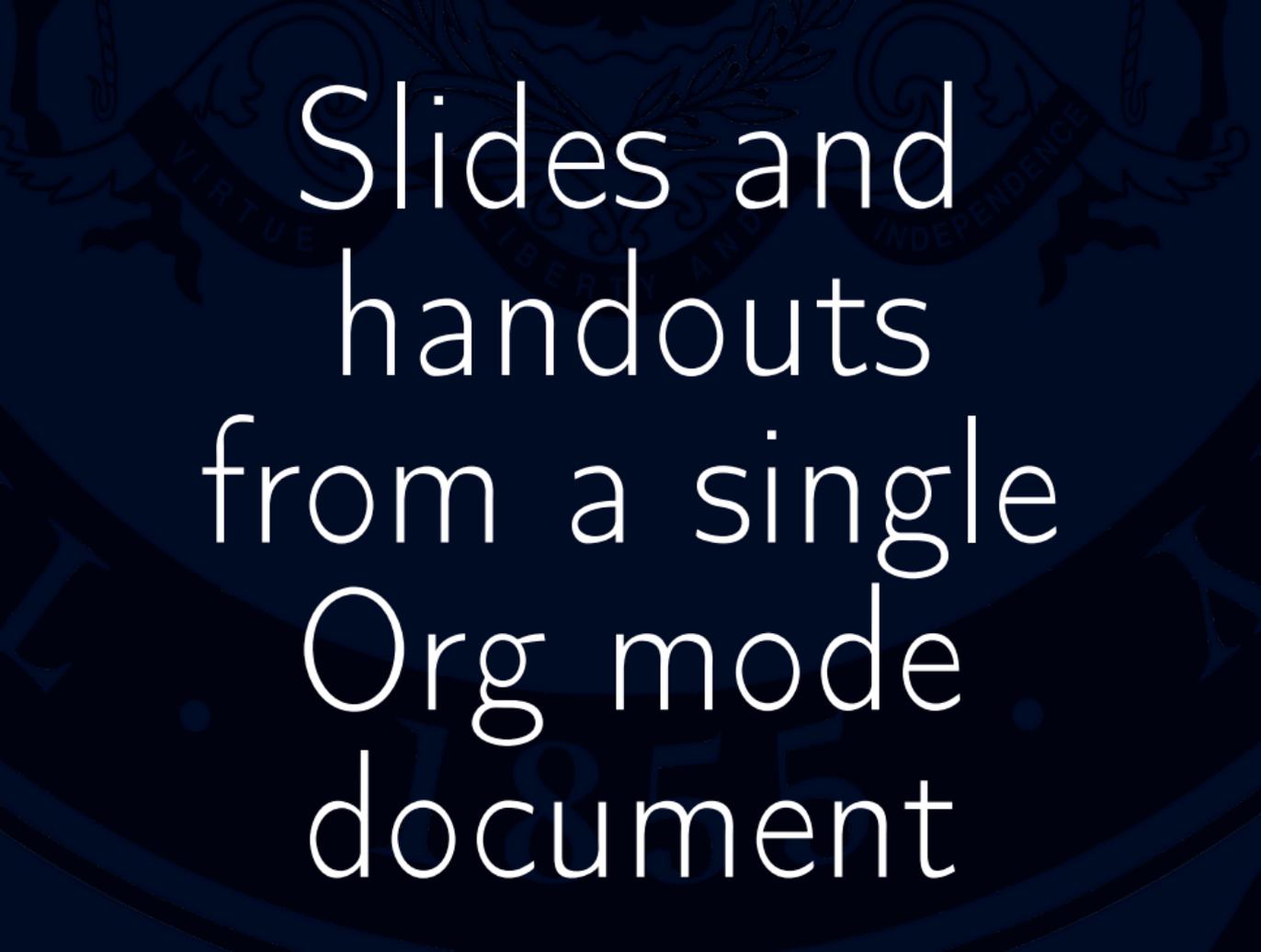
Inserting myself into **animations** is the killer app!

Emacs!

Emacs allows sophisticated presentation and manipulation of **text**.



Authoring with Emacs

The background features a large, faint watermark of the University of Toronto crest. The crest is circular and contains the text "UNIVERSITY OF TORONTO" at the top and "1827" at the bottom. A banner across the center of the crest reads "VIRTVTUE LIBERABIT VOS". The crest is surrounded by decorative flourishes and a laurel wreath.

Slides and
handouts
from a single
Org mode
document

The background of the slide features a large, faint watermark of the Harvard University seal. The seal is circular and contains the text "HARVARD UNIVERSITY" around the top edge and "1855" at the bottom. In the center of the seal, there is a shield with a book and a lamp, flanked by two figures. Above the shield is a banner with the word "VIRTUE" and below it is another banner with the word "INDEPENDENCE".

entirely
assembled
in Emacs

Org mode: part of GNU Emacs

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write documents in **plain text**

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write documents in **plain text**

mark up text (and **tables!**) with **legible formatting**

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export $\text{L}^{\text{A}}\text{T}_{\text{E}}\text{X}$ to produce PDF documents like the **handouts**

Org mode: part of GNU Emacs

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export \LaTeX to produce PDF documents like the **handouts**

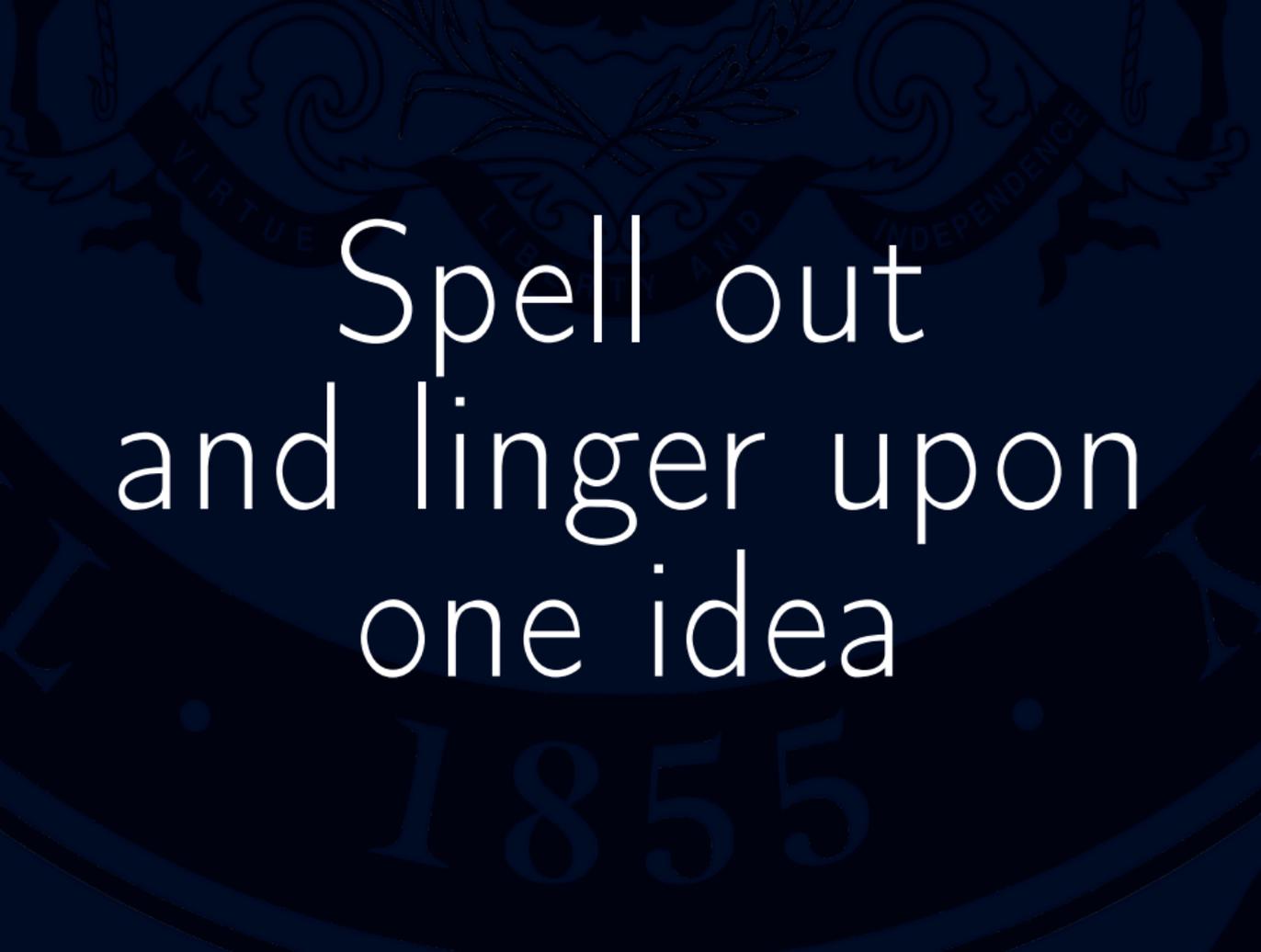
export **BEAMER** to produce PDF slides like these ones



Pedagogy
first!

A person wearing a bear mascot costume is running on a track. The bear has its mouth open, showing its teeth. The person's arms are outstretched. The background is a blurred track with lane markings.

Simply a
collection of
export
customizations



Spell out
and linger upon
one idea

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Make explicit
one idea
at a time

Some concepts
are best
explained
(in text?)

BUT OTHER IDEAS

CAN SIMPLY BE SHOWN

Pedagogy first!

Make explicit
one idea
at a time.

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

Contrast: death by Powerpoint

These methods

improve course authoring in **multiple fundamental ways:**

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Effective course materials must provide a way
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Separate the work of writing, developing, scaffolding
from the work of wrangling class slides.

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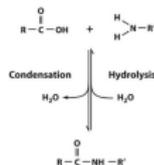


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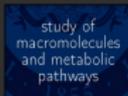
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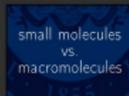
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5



6



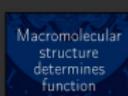
7



8



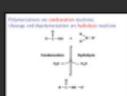
9



10



11



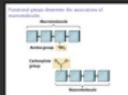
12



13



14



15



16



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18



19



20

1 Introduction, overview, and fundamentals

1.1 What is biochemistry?

Consider the relative components of an *E. coli* cell.

	Percent by mass	Number of species
water	70%	1
proteins	15%	3,000
DNA	1%	1
RNA	6%	> 3,000
polysaccharides	3%	5
lipids	2%	20
small molecules	2%	500
inorganic ions	1%	20

- What can you conclude from these numbers?

Biochemistry is "the study of biological macromolecules and their metabolic pathways."

- 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

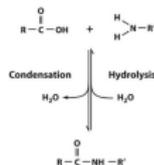


Figure 1: Polymerization of amino acids into proteins is a condensation reaction; the reverse reaction, depolymerization of proteins back to amino acids, is a hydrolysis reaction. Similarly, polymerization of nucleotides into nucleic acids,

* Macromolecular polymers are synthesized from small-molecule monomers

!---- 0_BMB401_SU24.org Top (1,0) (Org Olv Ind Fly/-- Z yas WK RAS Wrap) 23:17 0.44
 Mark set



Everything is
an outline

Следующий Слайд
(NEXT SLIDE, PLEASE)

FOR RE-EDUCATION
CAMPAIGNS, NOTHING IS BETTER
THAN THE *AUTOCONTENT WIZARD*!

COMRADE,
WHY ARE WE HAVING THIS MEETING?
THE RATE OF INFORMATION TRANSFER
IS ASYMPTOTICALLY APPROACHING
ZERO!

THERE'S **NO** BULLET LIST
LIKE STALIN'S BULLET LIST!

BUT WHY READ
ALoud **EVERY** SLIDE?

Edward Tufte, *The Cognitive Style of PowerPoint*



No
executive
function
to waste

A person wearing a bear mascot costume is running on a track. The bear's mouth is wide open, showing its teeth. The person's arms are outstretched to the sides. The track has white lane markings. The background is a blurred green field.

org-teach



A peek
at the
sources

org-teach: Org mode macros for custom BEAMER markup

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

<code>{{{pause}}}</code>	force split a frame into multiple overlay slides
--------------------------	---

<code>{{{newline}}}</code>	break a line in the slides <i>but not in the handouts</i>
----------------------------	--

<code>{{{whitespace-break}}}</code>	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)}}}
```

BMB 401
General Biochemistry 1

Summer 2024
Module 1



Introduction,
overview, and
fundamentals

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DEPARTMENT OF
**Biochemistry and
Molecular Biology**



PennState **SCIENCE**

Subsection slides (H2)

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

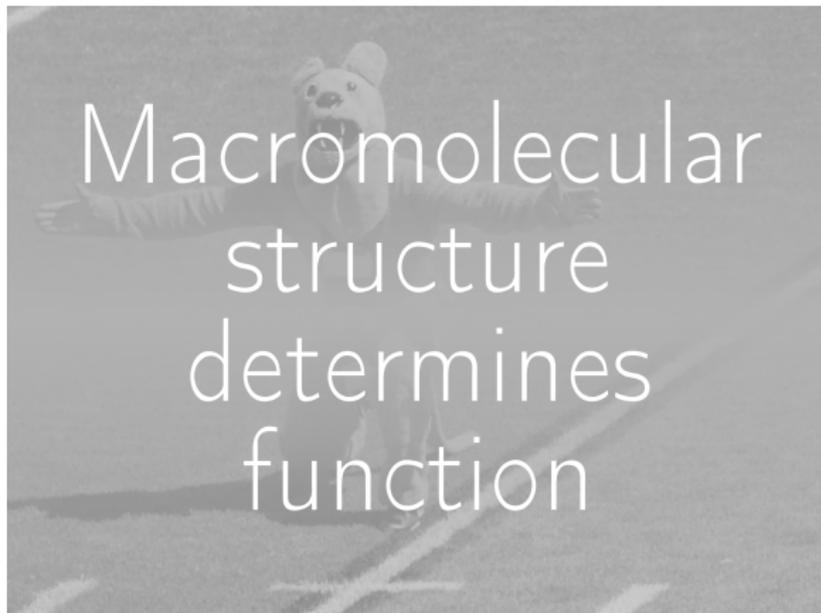


Figure 2: Subsection slides correspond to major lecture topics

Text slides (H3)

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

Biochemistry is "the study of biological macromolecules and their metabolic pathways."

What kinds of biological macromolecules are there?

Which small monomers polymerize to produce macromolecules?

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\paperwidth
 [[./_img/glycolysis-pathway.png]]

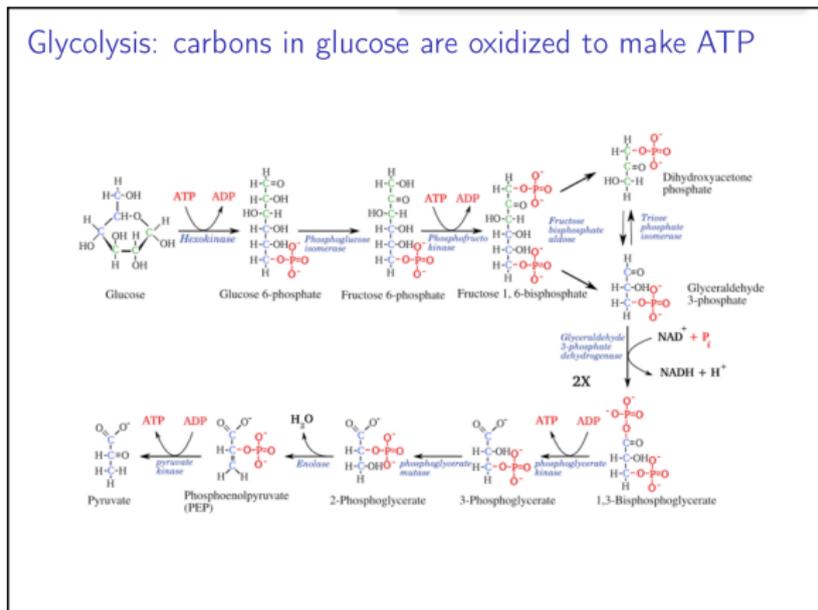


Figure 4: Figure slides include a title, an image, and optionally text.

Impact slides (under H1 or H2)

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

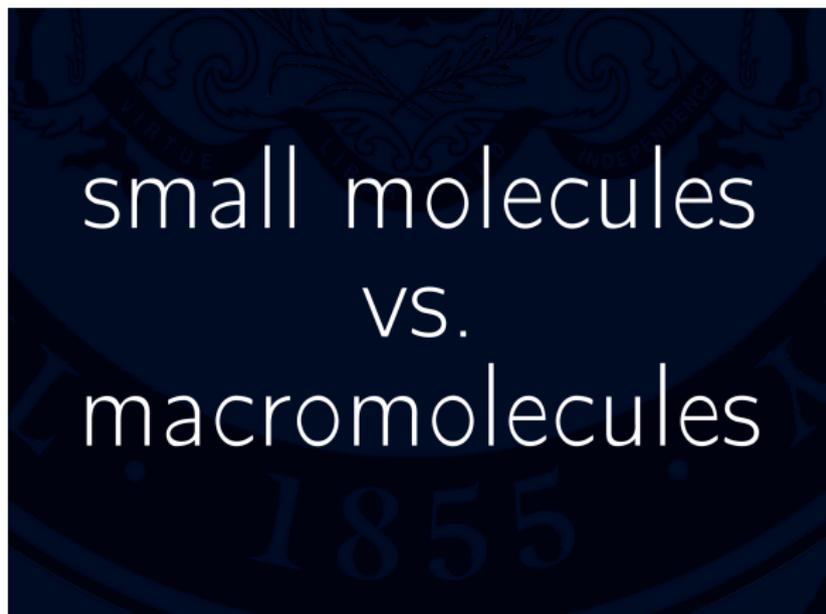


Figure 5: Impact slides: “*Let us pause and consider this key idea.*”

Image slides (under H1 or H2)

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

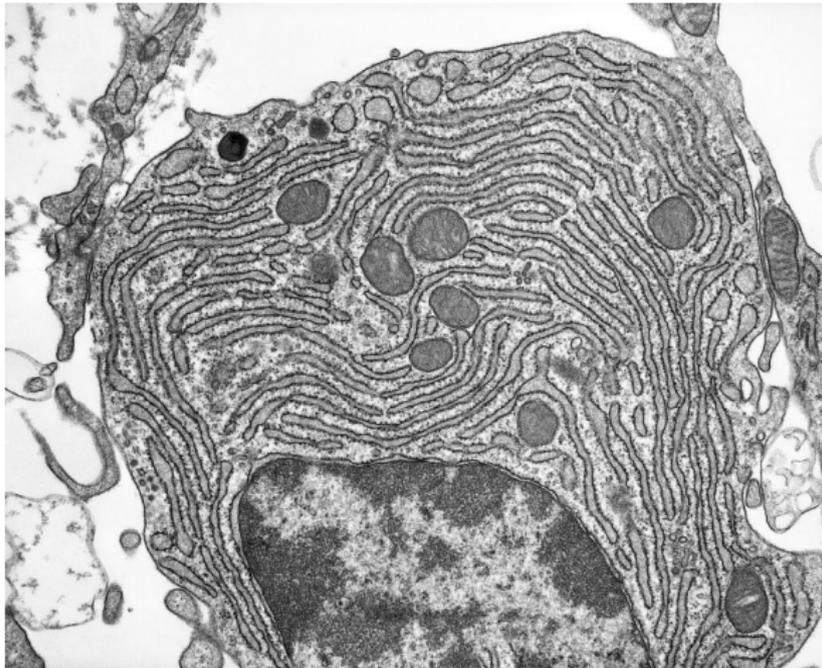


Figure 6: Image slides contain an image filling the entire frame.

Blank slides (under H1 or H2)

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

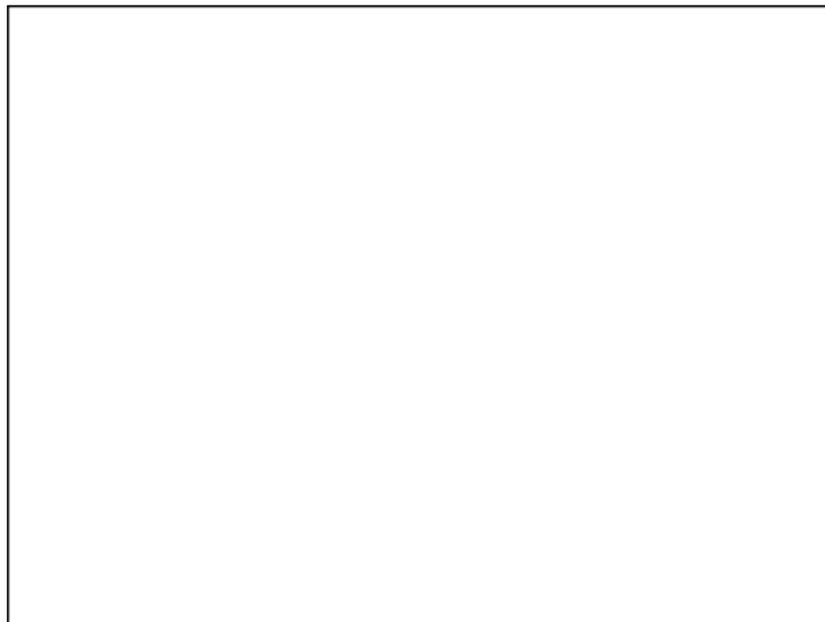


Figure 7: Blank slides are an empty white frame.

PDF includes (under H1 or H2)

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

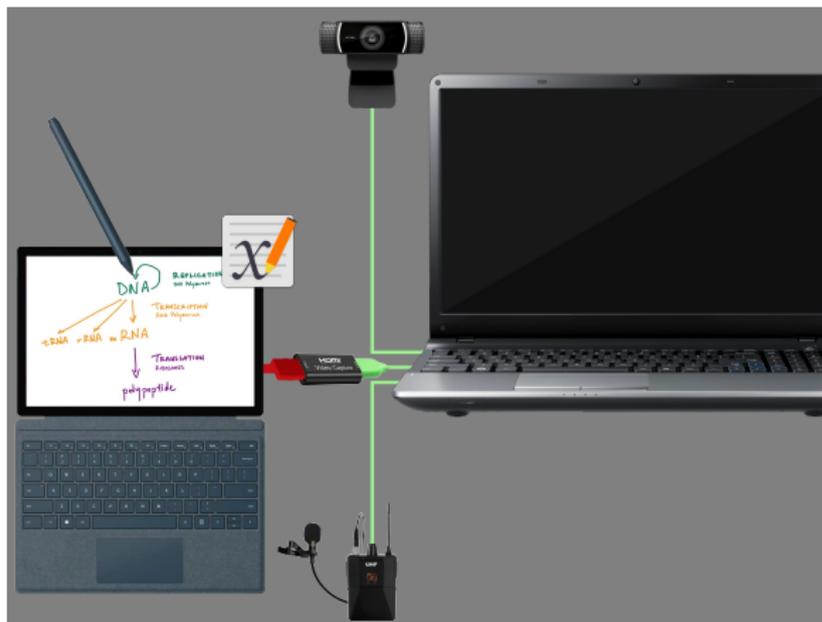


Figure 8: PDF includes: directly imports multi-page PDFs in place (useful for importing e.g. graphical sequences produced in LibreOffice Impress)

A person wearing a bear costume is kneeling on a grassy field with arms outstretched. The bear's mouth is open, showing its teeth. The background is a grassy field with some white markings. The text "Please use and share!" is overlaid in white on the image.

Please use and
share!

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

The screenshot shows the Sourcehut interface for the repository `~jamesendreshowell/org-teach`. At the top, there is a navigation bar with the repository name, a "summary" tab selected, and other tabs for "tree", "log", and "refs". The repository description reads: "Org macros for producing course slides and handouts from a single source".

On the left, there is a list of recent commits:

- Commit `974b16a8` by James Endres Howell, 2 minutes ago. Description: "Add README.org and README.md".
- Commit `8fde1643` by James Endres Howell, 16 minutes ago. Description: "License under GPL3".
- Commit `7d8cf2e8` by James Endres Howell, 27 minutes ago. Description: "Delete unused image files".

On the right, the "refs" section shows the `master` branch with links to "browse" and "log". Below this, the "clone" section provides options for cloning the repository:

- read-only**: `https://git.sr.ht/~jamesendreshowell/org-teach`
- read/write**: `git@git.sr.ht:~jamesendreshowell/...`

A prominent blue button says "Clone repo to your account". Below it, a note states: "You can also use your local clone with [git send-email](#)."

The main content area features the heading `org-teach` and a paragraph: "Org mode macros and some LaTeX and Beamer hacking for producing class slides and printable handouts for science courses. (Also a template for producing printed classroom worksheets.)"

A final note states: "Note that the 'code' (minimal as it may be) is distributed under the GNU General Public License version 3, while the contents of the documents are distributed under a Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International license (CC BY-NC-SA 4.0)."

I hope to hear from you!

James Endres Howell

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email `howell@psu.edu`

mastodon `@jameshowell@emacs.ch`

sourcehut `~jamesendreshowell`