

“Flipping” method of teaching physics and other technical subjects

JOHN GOREE

THE UNIVERSITY OF IOWA

1

Polls:

Polls:

Do you sometimes teach by

- writing on board?
- projector to show slides (powerpoint, etc.)?

Polls:

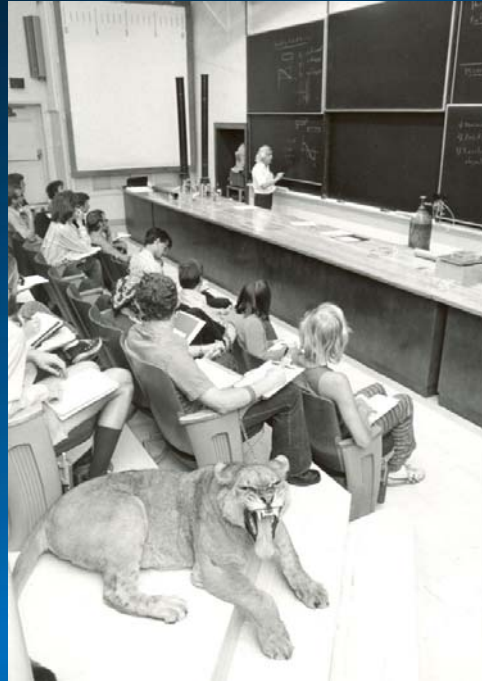
Do you sometimes teach by

- writing on board?
- projector to show slides (powerpoint, etc.)

Do you sometimes feel *there's too much material to cover to allow:*

- enough examples
- enough review
- a lot of discussion

Traditional lecture



Prof. Ricardo Gomez, Caltech, 1975

Flipping – what is it?

traditional



Before class



During class



After class

Flipping – what is it?

flipped



Before class



During class



After class

Flipping – what is it?



Before class



During class



After class

Two questions instructors ask about flipping:

What is it?

- short videos replace lectures
- class time used instead for discussion, examples, demonstrations

Doesn't it take a lot of time?

for easy migration, use what's familiar:

- your old slides or handwritten notes
- the same classroom
- hosting on Blackboard (or similar)

it's ok to start with *partial* flipping

There are many ways to do flipping

I will describe only one approach:

- Not a radical change in teaching
so it's sure to work
- Not an intense time-pressured experience for students
so they're happy

There are many ways to do flipping

I will describe only one approach:

- Not a radical change in teaching
so it's sure to work
- Not an intense time-pressured experience for students
so they're happy

The videos themselves help,
but the main impact is from
increased discussion & examples

“Flipping” method of teaching physics and other technical subjects

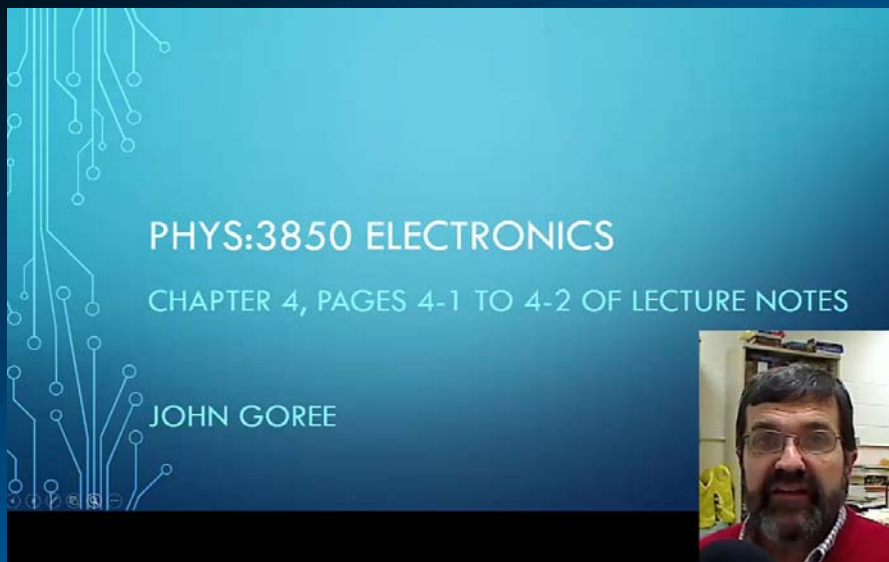
JOHN GOREE

THE UNIVERSITY OF IOWA

2

Example flip videos

Approach #1: flip video using pdf handwritten notes



PHYS:3850 ELECTRONICS
CHAPTER 4, PAGES 4-1 TO 4-2 OF LECTURE NOTES

JOHN GOREE

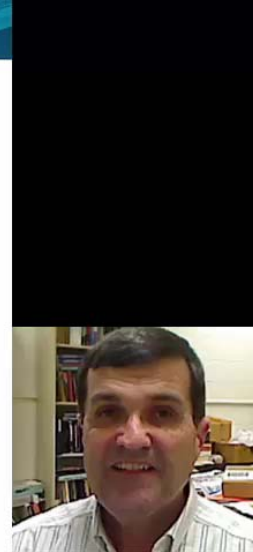
The image shows a video player interface. The main content is a slide with a light blue background and a white circuit board pattern on the left. The text on the slide is 'PHYS:3850 ELECTRONICS', 'CHAPTER 4, PAGES 4-1 TO 4-2 OF LECTURE NOTES', and 'JOHN GOREE'. In the bottom right corner of the video player, there is a small inset video showing a man with glasses and a beard, wearing a red shirt, speaking into a microphone. The video player has a black progress bar at the bottom.

Approach #2: flip video using **powerpoint**

Flip video – before lecture 34

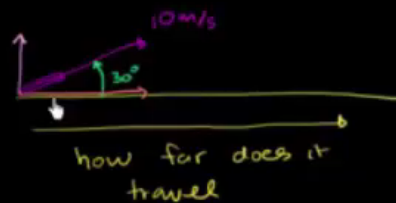
PHYS: 1400 (029:008) Basic Physics

Prof. John Goree
The University of Iowa



Approach #3: **Whiteboard** screencast (requires tablet device)

Projectile at an angle



credit: khanacademy.org

Compare to a video capture of a classroom lecture



Prof. Walter Lewin, MIT OpenCourseWare

“Flipping” method of teaching physics
and other technical subjects

JOHN GOREE

THE UNIVERSITY OF IOWA

3

Problems that flipping solves



What to do during class?



With flipping, you have more time. What to do with it?

What to do during class?



With flipping, you have *more time*. What to do with it?

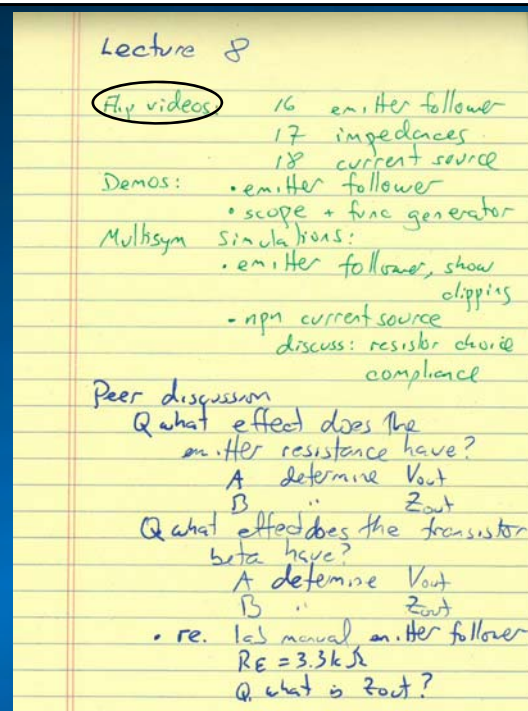
Examples & discussion:

- Problem solving
- Demonstrations or simulations
- Peer instruction

An activity agenda, instead of lecture notes

Agenda that I followed
in a class

(first page)



An activity agenda,
instead of lecture notes

Agenda that I followed
in a class
(first page)

Lecture 8

Flip videos 16 emitter follower
17 impedances
18 current source

Demos: • emitter follower
• scope + func generator

Multisim Simulations:
• emitter follower, show clipping
• npn current source
discuss: resistor choice compliance

Peer discussion

Q what effect does the emitter resistance have?

A determine V_{out}

B " Z_{out}

Q what effect does the transistor beta have?

A determine V_{out}

B " Z_{out}

• re. lab manual emitter follower
 $R_E = 3.3k\Omega$

Q what is Z_{out} ?

Lecture 8

Flip videos 16 emitter follower
17 impedances
18 current source

Demos: • emitter follower
• scope + func generator

Multisim Simulations:
• emitter follower, show clipping
• npn current source
discuss: resistor choice compliance

Peer discussion

Q what effect does the emitter resistance have?

A determine V_{out}

B " Z_{out}

Q what effect does the transistor beta have?

A determine V_{out}

B " Z_{out}

• re. lab manual emitter follower
 $R_E = 3.3k\Omega$

Q what is Z_{out} ?

An activity agenda,
instead of lecture notes

Agenda that I followed
in a class
(first page)

Lecture 8

Flip videos 16 emitter follower
17 impedances
18 current source

Demos: • emitter follower
• scope + func generator

Multisim Simulations:
• emitter follower, show clipping
• npn current source
discuss: resistor choice compliance

Peer discussion

Q what effect does the emitter resistance have?

A determine V_{out}

B " Z_{out}

Q what effect does the transistor beta have?

A determine V_{out}

B " Z_{out}

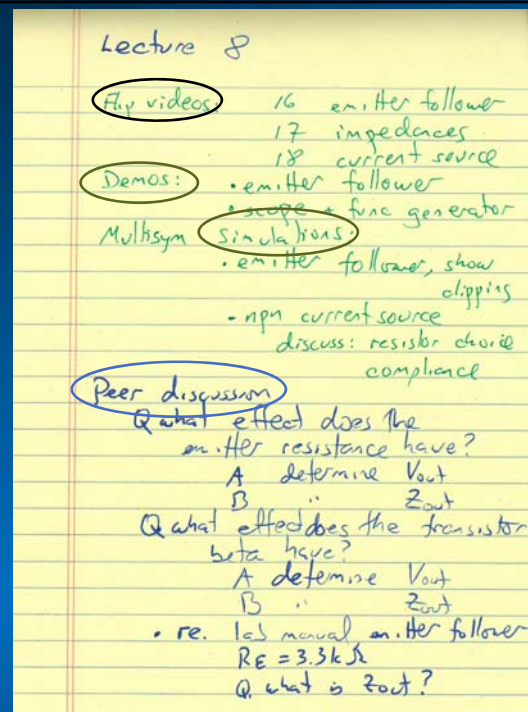
• re. lab manual emitter follower
 $R_E = 3.3k\Omega$

Q what is Z_{out} ?

An activity agenda,
instead of lecture notes

Agenda that I followed
in a class

(first page)



Another approach:
in-class homework

best in a room with
large tables



Mark Andersland
Engineering
Univ. of Iowa

“Flipping” method of teaching physics and other technical subjects

JOHN GOREE

THE UNIVERSITY OF IOWA

4

Outline


- Flipping - what is it?
- Problems flipping solves
- **Good practices**
- How to do it:
 - Hosting, equipment and software

Good Practices

Video length (minutes):

- 4-6 general education
- 5-7 intermediate course
- > 10 never

Not a whole lecture, like this:

4  Lec 03: Vectors | 8.01 Classical Mechanics, Fall 1999 (Walter Lewin) 49:41 49:41

Which is more tempting to watch?

Understanding Forensic Pathology- Lecture by Dr. Michael ...
<https://vimeo.com/70083353>
 Jul 10, 2013
 This is just a 10 minute segment of the lecture that was given by Dr. Michael Pollanen. The complete lecture is ...

Medical School Pathology, Chapter 25 - YouTube
www.youtube.com/watch?v=BybIPXFtEc
 Apr 16, 2012 - Uploaded by Dr. Prodigious
 Chapter 25 -- The Skin (Robbins Pathology) Other chapters-
[http://www.youtube.com/playlist?list ...](http://www.youtube.com/playlist?list...)

Good Practices

Quizzes, to coerce students to view videos.

Good Practices

Quizzes, to coerce students to view videos.

Ways to quiz:

In class:

- Clickers
- Paper

Good Practices

Quizzes, to coerce students to view videos.

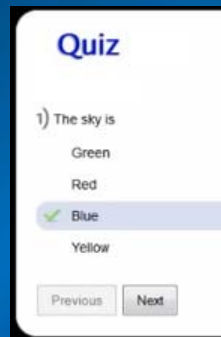
Ways to quiz:

In class:

- Clickers
- Paper

As part of the video:

- Flash or HTML5



Good Practices

Example **paper quiz** question
for Electronics (an intermediate course for physics majors)

Which is true for an ideal op-amp:

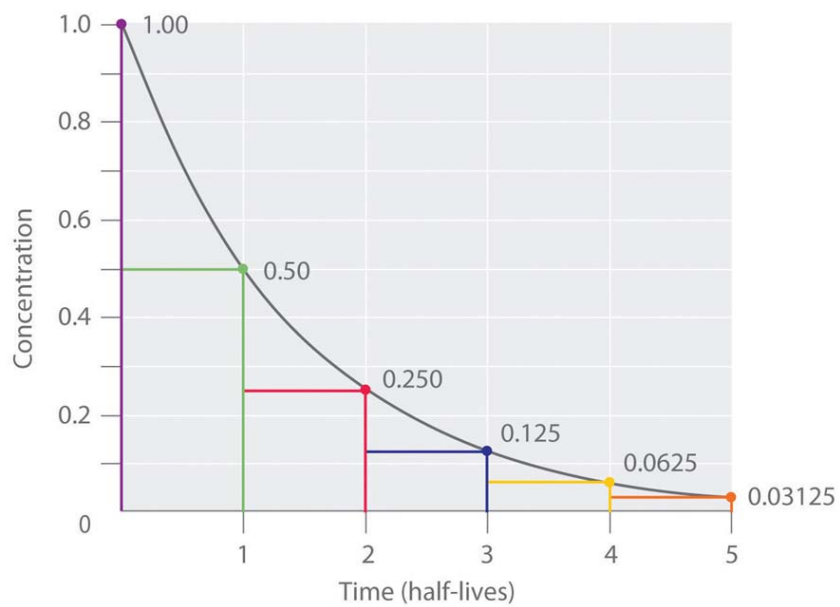
- | | <u>Voltages at the two inputs</u> | <u>The output voltage</u> |
|-----|-----------------------------------|--------------------------------|
| (a) | <u>same</u> | responds to the input currents |
| (b) | <u>different</u> | responds to the input currents |
| (c) | <u>same</u> | responds to the input voltages |
| (d) | <u>different</u> | responds to the input voltages |

Good Practices

Next 5 slides:

clicker quiz slides (Basic Physics -- a general education class)

Half-life



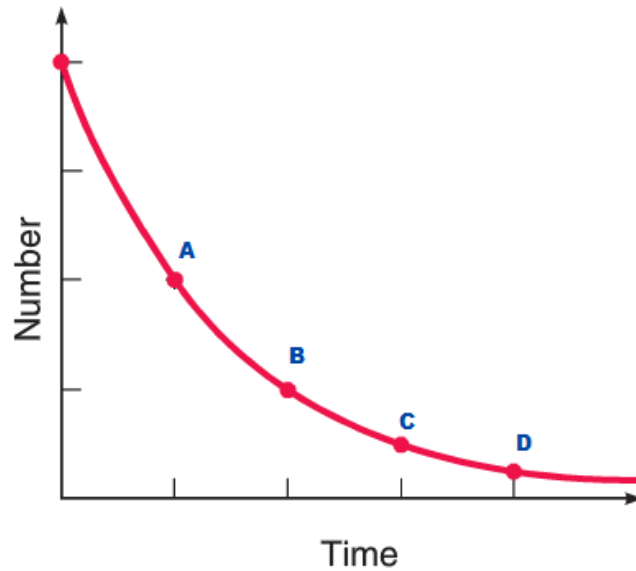
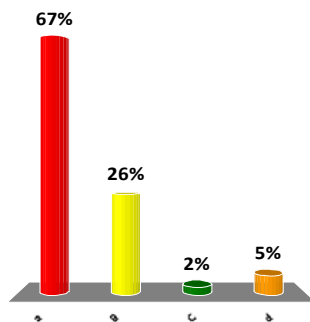
Clicker poll

next slide

Clicker **poll**: you
ARE allowed to
discuss this with
neighbor

The number of nuclei in a sample are plotted vs time.

At which data point is the time equal to the half-life?

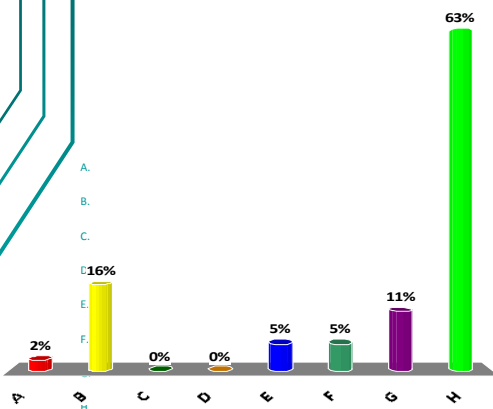


A.
B.
C.
D.

[Clicker quiz \(flip video\)](#)

Clicker quiz: you
ARE NOT
allowed to
discuss this with
neighbor

Which is correct
regarding radiation PET
imaging in medicine?



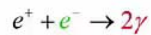
	Kinds of radiation detected	How it is produced
A	Alpha and gamma ray	$p + \bar{p}$
B	Alpha and gamma ray	$e^- + e^+$
C	Alpha ray only	$p + \bar{p}$
D	Alpha ray only	$e^- + e^+$
E	Beta and alpha rays	$p + \bar{p}$
F	Beta and alpha rays	$e^- + e^+$
G	Gamma ray only	$p + \bar{p}$
H	Gamma ray only	$e^- + e^+$

Before that quiz, students viewed a video with this:

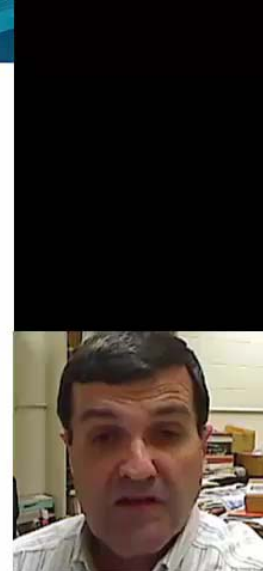
Nuclear

Positron emission tomography (PET) imaging in medicine:

- An isotope F^{18} that emits **positrons** is introduced into the patient.
- **Positrons** annihilate with electrons in the patient's body.



gamma ray detectors



“Flipping” method of teaching physics and other technical subjects

JOHN GOREE

THE UNIVERSITY OF IOWA

5

Good Practices

Verify students are viewing videos

ICON PHYS:1400:0AAA/BBB Fall14 Basic Physics

Course Home | Content | Discussions | Dropbox | Quizzes | Links | Grades | Edit Course

Content > Reports

Statistics

Statistics Feedback SCORM Reports

Export Statistics Reset Statistics

Content Users

Total Number of Users: 86

Users Who Have Visited Content: 86

Average Time Spent on Content: 83:30:07

Expand All Collapse All

Content	Users Visited	Average Time Spent
Unit1. Lab Manual and Worksheet		
Unit2. Sample Exam Questions		
Unit3. Powerpoint Slides for Exam Review Presentations		
Unit4. Multimedia Player		
i. SUMIT Multimedia Player	33	0:00:18
ii. Basic-Physics-flip-video-view-before-lecture-3	71	0:27:09
iii. Basic-Physics-flip-video-view-before-lecture-4b	70	0:31:06

ii. Basic-Physics-flip-video-view-before-lecture-3	71	0:27:09
iii. Basic-Physics-flip-video-view-before-lecture-4b	70	0:31:06

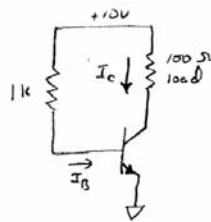
Good Practices

Guiding the eye amongst the clutter

ON = switch closed

use "saturated mode" by applying
lots of base current $I_B \approx 10mA$

we'll show how to find this

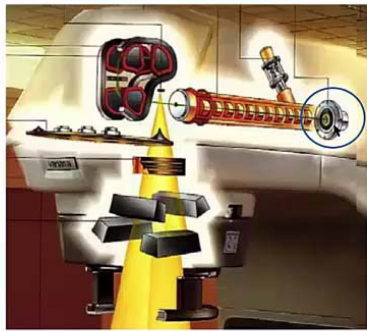


Example:
with PDF of
handwritten
notes

Good Practices


Guiding the eye amongst the clutter

Radiation Therapy



Electron source:
Similar to a Crooks tube

patient



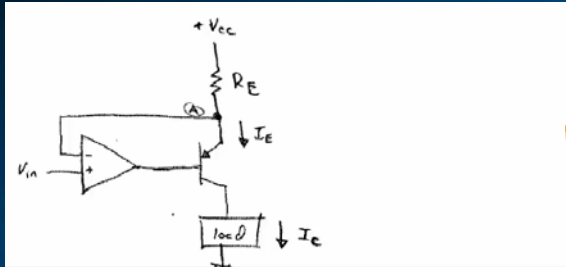
Example:
with
powerpoint

Good Practices

Showing something
from a previous page

Good Practices

Showing something
from a previous page



This space
is available!

to analyze: identify components & nodes & rules

Op Amp Rule (0) ok - neg feedback thru transistor

(1) $V_n = V$



Good Practices

Movie players

Tell students: if the video looks bad

- try a different browser



- download video & try a different player.

“Flipping” method of teaching physics and other technical subjects

JOHN GOREE

THE UNIVERSITY OF IOWA

6

Outcomes

Outcomes

Student learning:
improved

Student satisfaction:
improved, or not, depending on:
- what you do in the class
- how much more time you demand

Student Satisfaction

Basic Physics – partially flipped

Student Satisfaction

Basic Physics – partially flipped

“Love the flip video.”

Four students liked videos

“Flip videos are interesting.”

“I liked the flip video because it helped me to connect what we learned in class to real-life applications.”

“The flip vids prepare me for class.”

Student Satisfaction

Basic Physics – partially flipped

“Love the flip video.”

Four students liked videos

“Flip videos are interesting.”

“I liked the flip video because it helped me to connect what we learned in class to real-life applications.”

“The flip vids prepare me for class.”

Two didn't

“Flip videos could be improved a little bit to make them more beneficial when it comes to class material.”

“The flip videos weren't very helpful.”

Student Satisfaction

Electronics – fully flipped

Poll, at midterm, which do students prefer (N = 9):

- 8 continue with flip videos
- 0 switch to traditional lectures
- 1 no preference

Comment re. increased discussion & examples during class:
“extremely beneficial”

Student Learning

Electronics
Midterm exam statistics

Average score increased $p = 0.02$

76% fully flipped 2015 (N = 9)

56% traditional 2014 (N = 21)

Student Satisfaction

Not every instructor achieves improved satisfaction:

Student Satisfaction

Not every instructor achieves improved satisfaction:

Missildine et al., *Journal of Nursing Education* (2013)

Experiment, comparing:

flipping, classtime used for

- case studies
- simulations of clinical practice

vs traditional lecture.

Results: with flipping,

- Exam scores were *higher* ($p = 0.003$)
- Students were *less satisfied* ($p < 0.001$)
(They perceived they had to do **more work**.)

End

“Flipping” method of teaching physics
and other technical subjects

JOHN GOREE

THE UNIVERSITY OF IOWA

7

Outline

- Flipping - what is it?
- Problems flipping solves
- Good practices
- **How to do it:**
 - **Hosting, equipment and software**

Hosting

Blackboard, ICON, or similar

- Password protected
- Track student viewing

Login Here

[Change Text Size](#) [High Contrast Setting](#)

You are not logged in

Log in using your University Network ID or Healthcare Login ID and password. Next, click the Login button below.

Forgot Password? Emory users can visit [ENID](#) or call the Help Desk at 404.727.7777.
Non-Emory users should contact their site managers.

USERNAME:

PASSWORD:

Equipment

Equipment

Camera

Microphone

Mic quality is crucial

This is where you are



Equipment

USB microphone (built-in mic is not recommended)



Equipment

Camera atop computer monitor:

built-in (FREE)

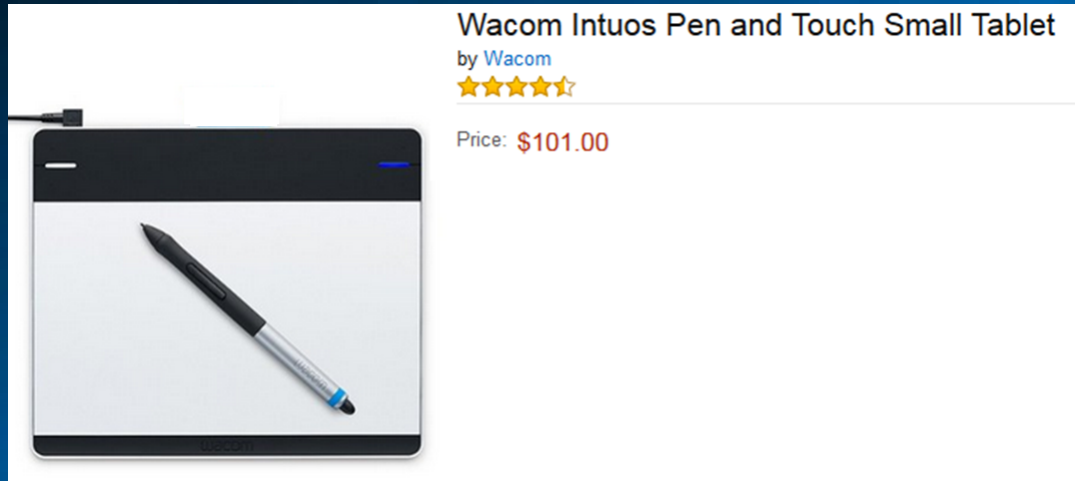


USB (typically \$60)





Equipment

Tablet device - only if you want to “whiteboard”





Software

Lecture capture:

-  Camtasia \$180
-  PANOPTO FREE UI license

Software

Lecture capture:



-  Camtasia \$180
-  PANOPTO FREE UI license

Screen shots & cropping

- Microsoft Paint FREE

Software

Lecture capture:

-  Camtasia \$180
-  PANOPTO FREE UI license

Screen shots & cropping

- Microsoft Paint FREE

Drawing (for whiteboarding with tablet):

- SmoothDraw FREE

How to learn Camtasia

Camtasia Studio 8 Tutorials

You can explore, create and share faster than ever before with Camtasia Studio 8. Whether you're a new or existing user, our tutorials are here to help you get the most out of your Camtasia Studio experience.

Getting Started

The very basics of using Camtasia Studio 8. This series starts by preparing your project and ends with recording and sharing a finished video project. (Includes a sample script and recording to video.)

Title	Length
01: Prepare, Script, Audio	2:26
02: Record Your Screen	2:35
03: Saving Files and Project Management	2:49
04: Explore the Editor	5:10
05: Apply SmartFocus to Zoom and Pan	5:49

www.techsmith.com/tutorial-camtasia-8.html

How to learn Camtasia

Camtasia Studio 8 Tutorials

You can explore, create and share faster than ever before with Camtasia Studio 8. Whether you're a new or existing user, our tutorials are here to help you get the most out of your Camtasia Studio experience.

Getting Started

The very basics of using Camtasia Studio 8. This series starts by preparing your project and ends with recording and sharing a finished video project. (Includes a sample script and recording to video.)

Title	Length
01: Prepare, Script, Audio	2:26
02: Record Your Screen	2:35
03: Saving Files and Project Management	2:49
04: Explore the Editor	5:10
05: Apply SmartFocus to Zoom and Pan	5:49

www.techsmith.com/tutorial-camtasia-8.html

Demonstration

Summary

Outcome

- Improves student learning & satisfaction

What is Flipping?

- Short videos viewed before class.
- Discussion or other activity during class.

How much time does it take?

For easy migration, use what's familiar:

- your old handwritten notes or slides
- the same classroom
- hosting with Blackboard, ICON, or similar

End