

# Enhancing Hands-On Laboratory Learning Through Technology

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Benjamin Wenner  
Department of Animal Sciences



**THE OHIO STATE UNIVERSITY**

COLLEGE OF FOOD, AGRICULTURAL,  
AND ENVIRONMENTAL SCIENCES

# Overview

- Background
- The “Problem”
- Perspective
- Current Practices
- Future Ideas



# My Teaching Role

- Animal Sciences 3130 (nutrition)
  - Required course, often only nutrition for veterinarians during 8 years of college
- Summer feed analysis course (3133)
- Summer intensive advanced dairy nutrition
- Required laboratory course (3200)
  - Enhance learning from lecture-based classes

# My Lab Background

- Homeschooled lab experience in HS
  - Learned by reading instead of seeing
  - Dissections by typed instructions
  - Developed a distaste for labwork/microscopes
- College transition difficult
  - Exercise-driven, repetition w/out application
  - Found animal science labs to be more hands-on
  - Experienced an early “flipped classroom”

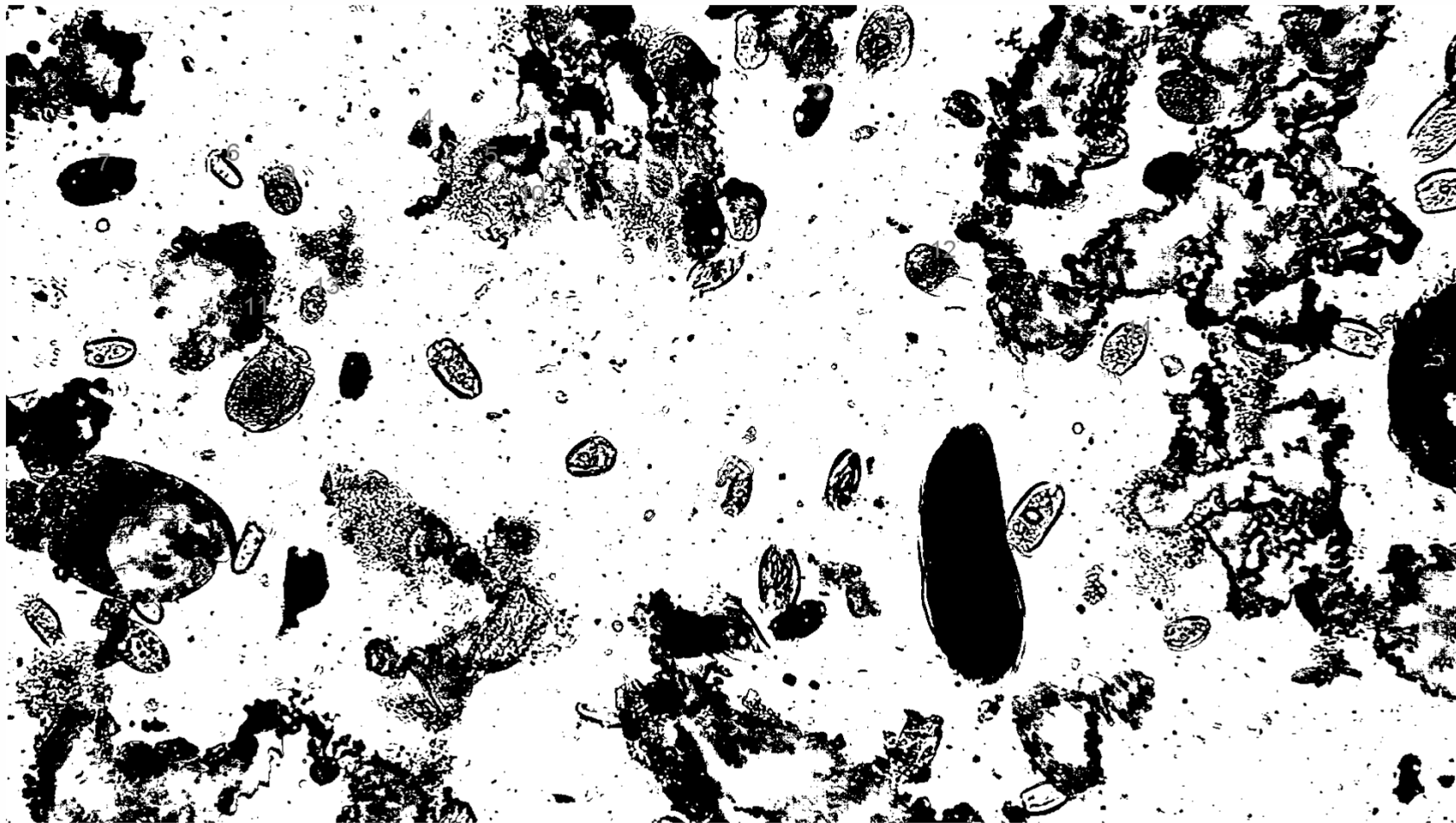


# My Dissertation

- Needed to record protozoal swimming patterns
  - Traditionally done by hand or microscope camera (tedious, expensive)
- Idea to use digital camera mounted to scope



# Protozoa Video



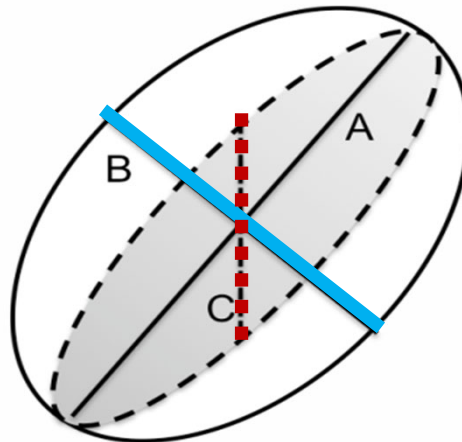
# The Discovery



Cells fitted to an ellipse demonstrated non-cylindrical and quantified by how much



A + B

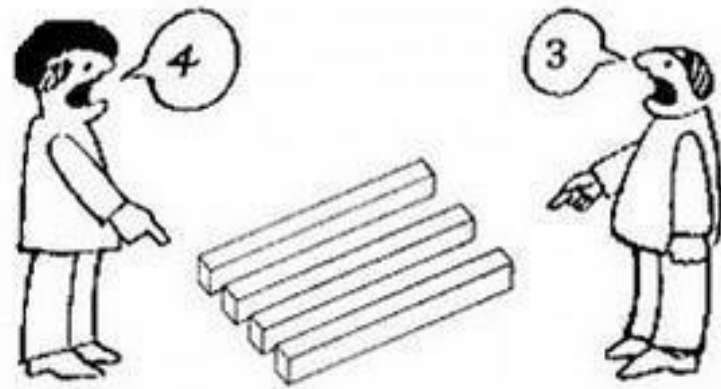


A + C



# Digital Technology is...?

- Affordable
- Transformational
- Complicated
- Frustrating
- Dynamic
- Fragile
- Empowering
- Expensive



Point of View



Previous Experiences

# Dry Matter

- Dry matter is the percentage of a feed (e.g. corn) that is leftover after removing the water
  - Typically we dry feeds in the oven
  - Weigh before, weigh after
  - Corn is ~10% water, so 90% dry matter



# Shrink

- Shrink in livestock feeding occurs whenever feed is lost or “disappears”
  - Typically dry matter loss (moisture-free)
  - Happens from trucking losses, birds, rodents, mold, weather (rain, snow)
  - If we deliver 20 tons of soybean meal but bin is empty at 18.5 tons, shrink was 1.5 ton (7.5%)

Remember...

So what did we say shrink is?

# Shrink Video

- Shrink is when livestock feed “disappears”
- Percent shrink important for farm efficiency



# Teaching a Required Lab (3200)

- Topics: histology, anatomy, physiology, microbiology, nutrition, animal health
- Skills: **dissections, microscopy**, bacterial cultures, bloodwork, feed handling
- Builds on previous coursework (prev. years)
  - Differences in retention, experience, skills
- Groups of 24-25 students (typically in pairs)
  - Disparity in partner preparation, motivation

# Informal Polling of Students

- Favorable towards video recitations
  - Allow flexible “attendance”
  - Able to take better notes, review
  - But... format was a struggle (file size/playback)
  - Prefer a few short videos over 1 full-length
- Few read supplementary PDFs or instructions
  - “If it isn’t on the test, I didn’t look at it.”
- Many could test well on content pre-lab
  - But unclear how they would use it in lab

# Students/Instructor “Islands”

- Student pairs fall behind in lab
  - Catching up without help is difficult
  - Helping shifts instructor ratio from 1:24 to 0:22



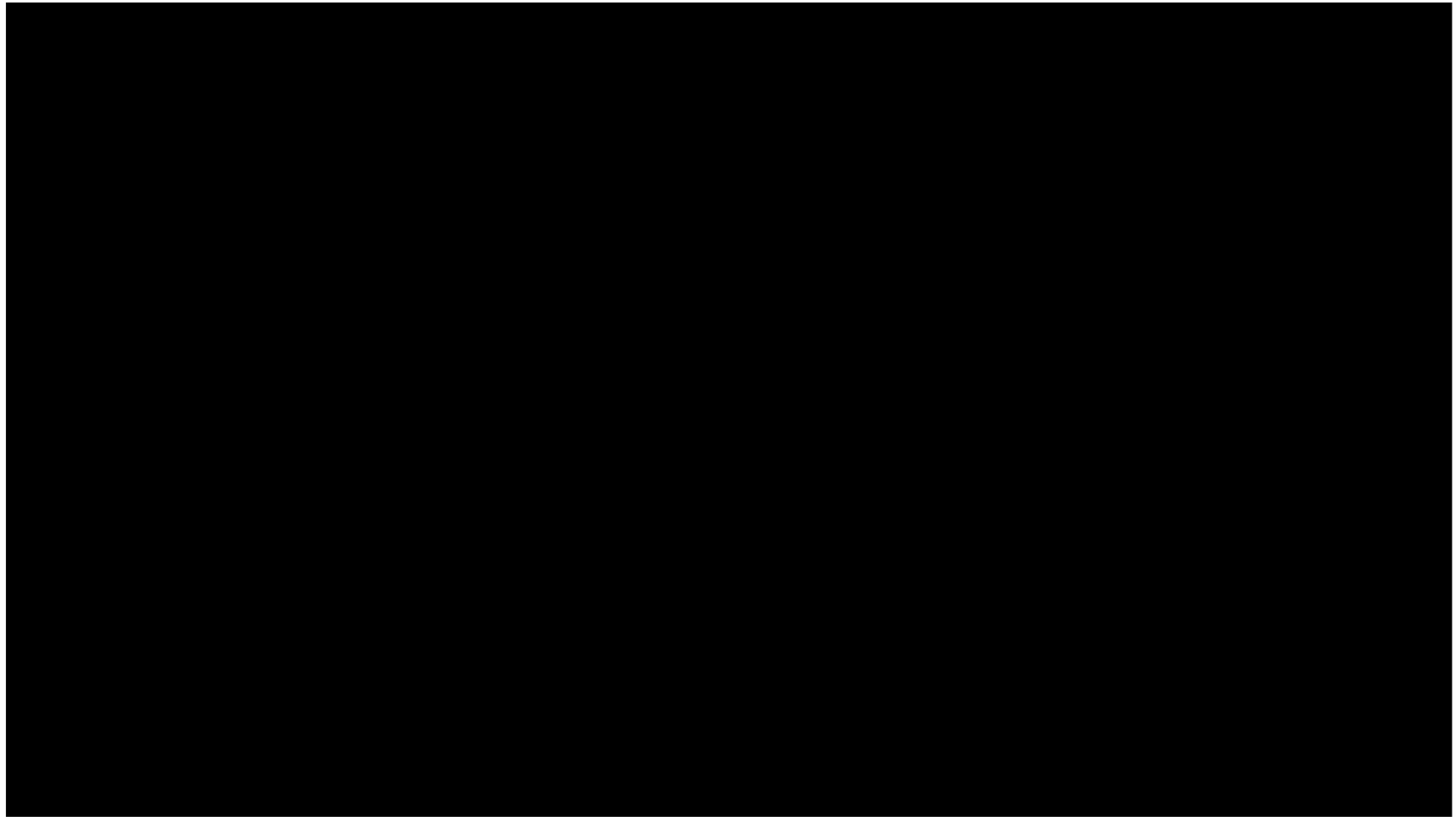
# Digital Microscope

- Connect to TV in lab (or classroom)
  - Demonstrate techniques
  - Discuss cell types, alignments
  - Answer questions of student by showing class
- Transport by cart to other classrooms
- Useful in variety of other courses/topics
- Also useful in teaching new undergrads in research methods



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# Microscope Example



# Video Editing

Adobe Rush available  
free for faculty/staff

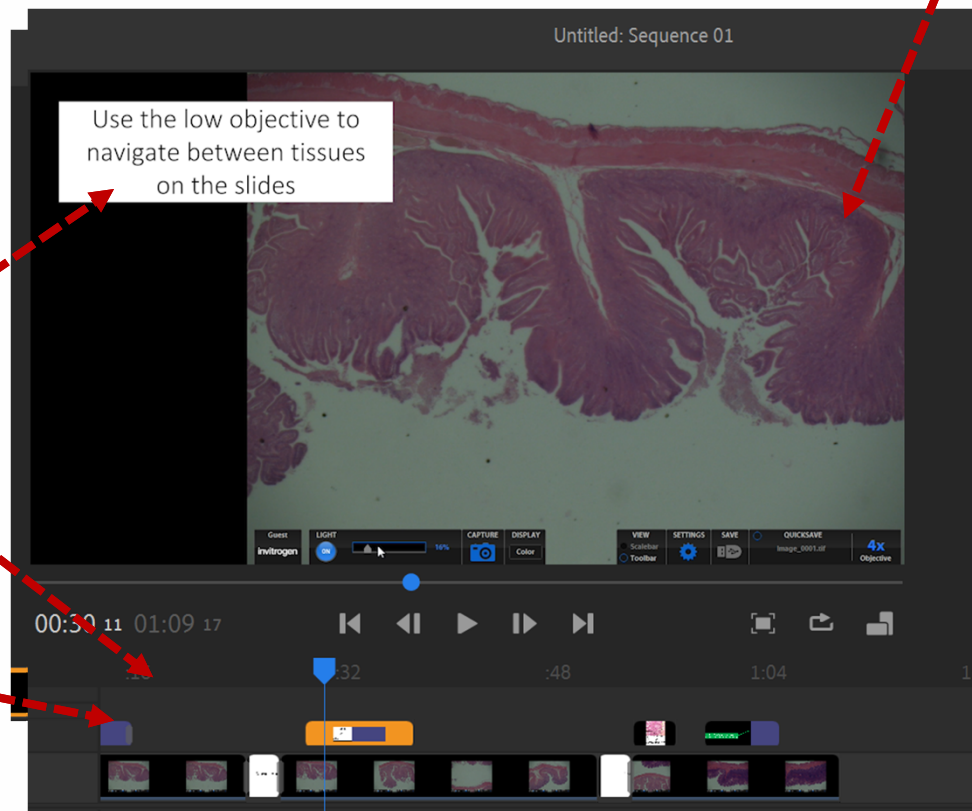
Video (and pictures) can be  
enlarged, cropped, rotated

Also:  
1) Title slides  
2) Transitions  
3) Pictures  
within video

Add text boxes

Trim video  
length

Record  
voiceovers



# iPads in the Classroom

- Content and delivery
  - Students can prepare content to cement concepts
  - Consistency in approach important to students
- iPads promote the flipped classroom
  - Preparation enables instructor/student interaction
  - Promote social engagement and problem-solving
- Digital note-taking
  - Linking of files/audio
  - Searchability, sharability
- Technology comfort improves performance

Diemer et al., 2012; Bishop and Verleger, 2013;  
Deaton et al., 2013; Scibora et al., 2018

# iPad Video Recording

- iPad “podcaster”
- Includes: mount, brackets, audio
- Roughly \$700 (plus iPad)
- High image quality/good audio
- Manipulate files from iPad
- Depending on desired quality could do this with just iPad



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# Chicken Dissection

- Sample this later: [go.osu.edu/3200Chicken](https://go.osu.edu/3200Chicken)



# iPad Screensharing

- Apple TV adapter enables screensharing in lab
  - Airplay (screen mirroring) application
- Benefits:
  - Students can show their question
    - Either live video or still images
  - Returns instructor ratio to intended
  - Engages students in community
    - Social interactions improve memory



Mayfield et al., 2012;  
Hurst et al., 2013

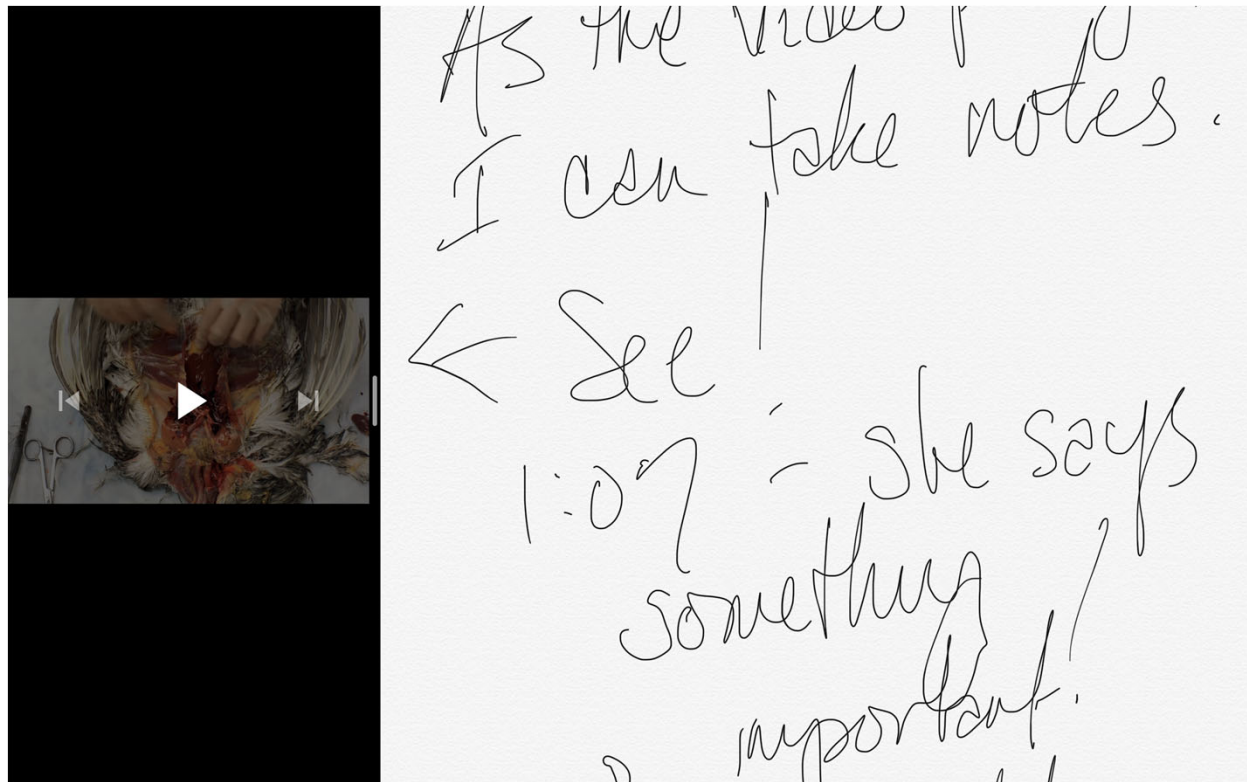
# iPad Notetaking

- Students too often try to transcribe a lecture
  - Missing the main points
- Preparation helps them interact over regurgitate
- Handwritten notes strengthen memory
  - Force writing of concepts/ideas, not verbatim
- But... limited searchability of paper notes

Mueller and Oppenheimer, 2014

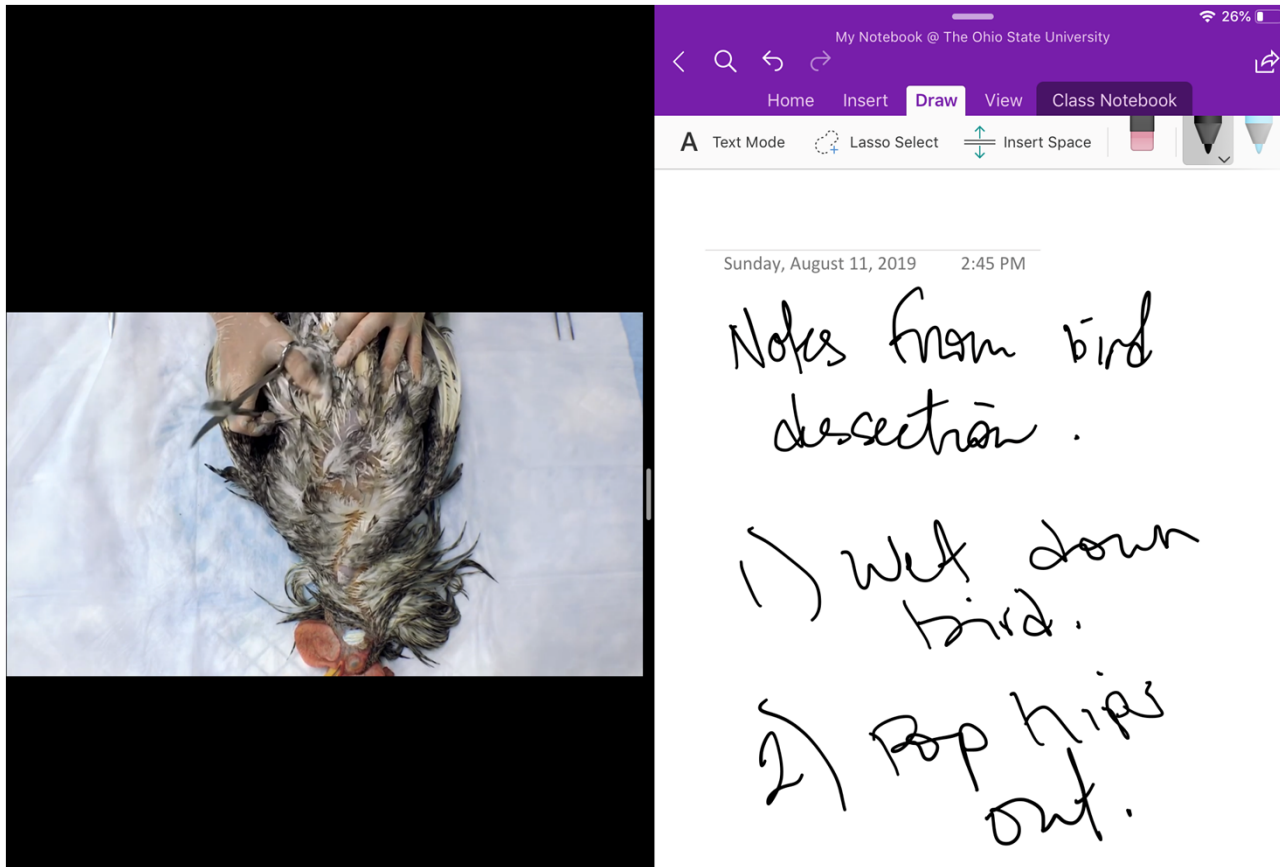
# iPad Notetaking

- Notes, Apple's free app will not allow draw over pictures, difficult to embed any links



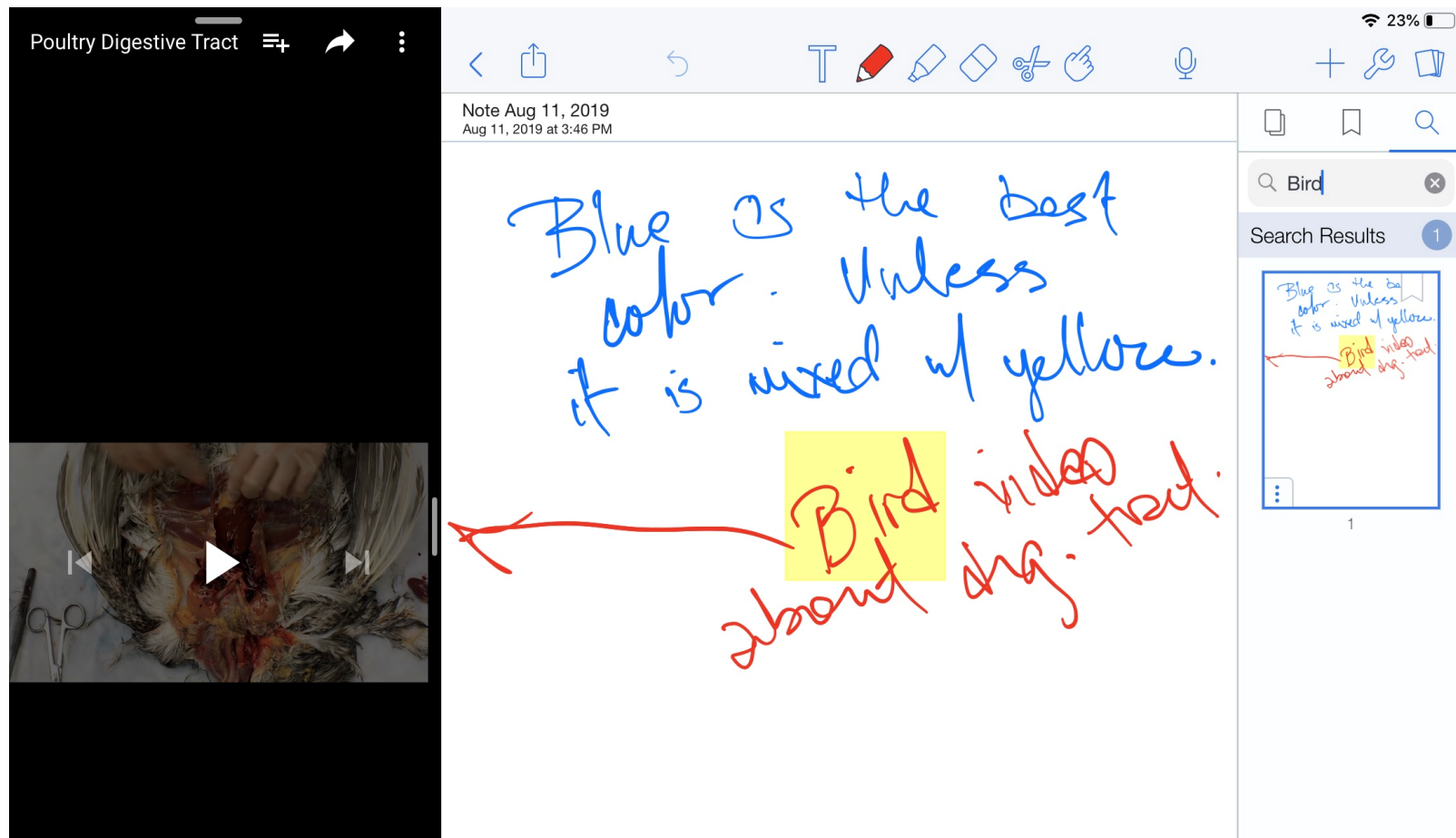
# iPad Notetaking

- OneNote within Microsoft Office, links to Outlook



# iPad Notetaking

- Notability allows better handwriting searchability



# Paperless Labs

- Tablets also useful for data collection
  - Capture handwritten notes (can put in Ziplock)
  - Transfer to lab reports (Excel or Word)
  - Upload to Carmen
- Carmen post-lab assignments in 3200
  - Set up as “Quizzes”, **provide file templates**
  - Some questions require a file upload (restrict)
  - TAs can easily speed grade a question by previewing the uploaded files

Hesser and Schwartz, 2013

# Paperless Labs

4:18 PM Sun Aug 11

Book

Home Insert Draw Formulas Data Review View

Select Objects Lasso Select Draw with Touch

$fx$  85/100 = 0.85 or 85%

	A	B	C	D	E
1	Item	Wt	Dry Weight	%DM	
2	Hay	100	85	85/100 = 0.85 or 85%	
3	Corn	45g	40g	= 40/45 = 88.9%	
4	Barley	50g	45g	=	
5	Cottonseed	15g	14g	=	
6					
7					
8					
9					
10					
11					
12					

Sheet1

# Summary

- Incorporating technology into your course doesn't have to be expensive
  - Arrival of iPads in our classrooms – opportunity
  - Comes with responsibility to use wisely
- Preparing media for a “flipped classroom” is an investment of time (learn the technology!)
  - But over several years should pay dividends
- Help students practice with their devices
  - Ultimately will help them remember your content