



Non-Traditional Publication

A Handbook for Lightboard Technology in the Kinesiology Classroom

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ABSTRACT

Educational Practices in Kinesiology 2(1): 1-18, 2022. Presenting pedagogical content on a digital platform is commonplace in the 21st century classroom. Now, presentations are given virtually to students who are learning both synchronously and asynchronously. With students learning from a distance, faculty must find means to elevate their delivery to foster engagement on an easily disconnected platform, thus winning the competition for their attention. Use of Lightboard technology meets the need to deliver innovative teaching and learning, but it is also simple for the faculty to use. This manuscript outlines the process of setting up, managing, and producing media from a Lightboard studio. We provide the framework needed to propose funding for this resource, building plans, as well as capture and edit tutorials to lessen the burden on faculty wishing to bring this technology to their campus. This fully online medium supports any classroom instruction (face-to-face, hybrid, and online), and with proper planning, can save the faculty's time on reviewing concepts in and out of class periods. Lightboard studios are often shared across the campus community, potentially leading to long wait times for recording and impaired flexibility for rapid content production. In this resource, we document how smaller units (colleges, departments, and programs) can justify investing in this innovative technology.

KEY WORDS: digital presentation; learning glass; video lecture; virtual chalkboard; practical guide

■ INTRODUCTION

Pedagogy is changing with advancements in teaching technology, enabling students to learn without physically sharing space with the educator. This distanced learning is becoming a necessity across colleges and high schools as students need more flexibility in pace and access to content. However, technology can potentially create a disconnect between students and instructors, leading to disengagement. Maintaining student engagement has been linked to improved achievement, persistence and retention (Casuso-Holgado et al., 2013). Considering there is little to no in-person

contact between professors and students in online learning platforms, faculty may be tempted to put the onus to manage engagement with the course content on students. Fortunately, there are technical modalities that may bridge the online disengagement gap.

Tactics to develop a learning community in an online classroom are not the same as face-to-face modalities. Some researchers have evaluated engagement by student performance in traditional face-to-face courses compared to post-lecture assignments. Data taken from 100,000 undergraduate students over a span of four years suggest that traditional online courses did not promote student success (as measured by grades) to the same degree as in-person deliveries (Bettinger et al., 2017). Potentially more disturbing are the findings that taking a course online statistically hinders student grades in future courses; probability of online student enrollment in the next year drops by nearly ten percentage points (Bettinger et al., 2017). With the growing number of students requesting the ability to learn online (e.g., non-traditional, athletes), pedagogists need to identify effective virtual techniques that are easy to use and promote student engagement.

The kinesiology classroom may not appear to be the most obvious place to deliver online learning as most content requires critical thinking, case-evaluation, and problem-solving real-world scenarios. Instructors within the kinesiology realm have confronted this assumption and successfully delivered online learning modules for exercise testing and prescription (Brahler et al., n.d.), online, problem-based learning on exercise and health (Duncan, 2009), and web-facilitated, hybrid, and online learning modalities (Xin et al., 2015). Xin et al. (2015) found that undergraduate exercise science majors completing an exercise psychology course outperformed their peers when traditional face-to-face instruction was supported by online content (learning management system, supplemental reading and learning materials, etc.) compared to hybrid (65% face-to-face and 35% web delivered content) and fully online modalities. Instructors and institutions must recognize, however, that these online learning management systems are most often designed to provide 'management' more than 'learning' (Castañeda & Selwyn, 2018).

Kinesiology professionals must implement pedagogical practices that enhance student learning outside the classroom. The use of short videos and screen recordings may assist the learning process by supporting the instructor-to-learner relationship (Martin & Bolliger, 2018). Screen casting took a major step forward with the invention of the Lightboard. Lightboard learning technology was first introduced by Dr. Michael Peshkin at Northwestern University. Dr. Peshkin felt the need to develop a teaching modality that embodied the best of available teaching tools, while also addressing their respective deficiencies (<https://www.lightboard.info/>).

A Lightboard is constructed of a chalkboard sized sheet of glass that is surrounded by lighting. Using fluorescent markers, the lecturer writes on the glass, making the text appear to float in the air. A camera is placed perpendicular to the board, about 20 feet back to capture both the board and the

lecturer (**Figure 1**). Using open-source software (such as Open Broadcast Software; <https://obsproject.com/>), the image is flipped so that the writing faces the correct way for the viewer. The Lightboard studio should also have a confidence monitor placed below the camera so that the presenter can see the video projection while recording.



Figure 1. Example Lightboard studios on Western Kentucky University's campus.

The Lightboard may be an impactful tool in a remote class setting as it bridges the gap between the shortcomings of other technology. Recording PowerPoint slides with the ominous “floating head” or writing on a whiteboard (breaking eye-contact and/or covering content) can distract students from learning. One study reported that students perceived PowerPoint recordings as too long and not necessarily helpful, limiting their impact in a flipped classroom setting (Fung, 2017). With a Lightboard, the presenter maintains student attention in shorter videos, similar to the style seen in the Khan Academy resources. Mini lectures can be recorded with high quality equipment, edited to include text, pictures, and annotations using easy post production techniques. Presentations can also be created so that there is no need to edit once recorded. Once customized, videos are posted so learners can view the resource as many times as needed. Lightboard lessons take on the strength of Khan-Style lectures, but supplement with eye contact, body language, and focus content to that which is relevant for course specific learning outcomes.

Growing in popularity across the country, this device can be used by faculty to flip their classes, create supplementary material, and increase student involvement. Faculty also create advisement tutorials, lab demonstrations, and even stream a live feed to students across the world. This technology can be directly embedded in courses in the form of student projects and demonstrations. Beyond the classroom, stakeholders may use this medium to compete in international, virtual research competitions and developing student recruitment resources.

In this manuscript, we outline the major steps involved in building and producing media from a Lightboard studio. Other helpful connections are embedded throughout to refer the reader to additional resources. After reading this article, you should understand how to set up and run a Lightboard studio in your campus facility. This resource is intended for faculty and administrators in Kinesiology or related fields. Examples are also provided related to delivering Lightboard media to learners (see Resource 1). Studio developers do not have to have a strong background in technology but should be comfortable learning new software skills.

■ METHODS

Classroom Management

Time investment in developing video resources is highly reliant on the quantity one wishes to create. In general, a faculty member could aim to produce short videos, ranging from five to ten minutes to avoid disengagement by the student. The presenter should add in the relative preparation time needed to plan the content, five minutes to turn on the studio equipment, the duration of the video (typically multiplied by two if a few takes are required), and approximately five to ten minutes to edit and export the media file (note, this is highly reliant on the type of post-production ‘magic’ the instructor wishes to add).

Equipment

The authors chose to build a studio rather than purchase a package to maximize financial resources and customization. Step-by-step guides to setting up the studio, capturing and editing videos are provided in Resource 2.

Student Instructions

Delivery to students can take many forms. Videos can be used for (1) pre-class learning wherein students are expected to understand content from the video so that in class time can be spent on more difficult concepts or application activities; (2) review of in-class presentation content so material can be revisited as often as needed; (3) make-up material if in-class content is not fully covered or the instructor needs to move instruction online.

Regardless of the application, simply sharing a link to the video with the students with a short explanation of its purpose will suffice. Instructions to students may be framed as (1) watch this video before arriving to class; (2) this video covers the content we discussed in class today, consider revisiting it as you study for the quiz; (3) our in-class session is being moved to an online platform, watch this short grouping of videos when reading the required text.

Table 1. Lightboard Equipment List.

Item Description	Purpose	Estimated Cost
Steel Lightboard Frame	Holds glass	750.00
Glass Edge Extrusion Kit	Holds presenter lighting system	375.00
Glass Mounting Hardware Kit	Bolts connecting glass to frame	120.00
Presenter Lighting System 4x6	Lights around glass on presenter	750.00
Lightboard Marker Tray	Holds markers next to glass	34.00
Shipping for Lightboards	Shipping	139.00
Panasonic Camera	Camera to capture video presentations	1249.00
Glass	4x6ft - 3/8" Clear tempered glass with polished edges	615.00
Curtain Tracks	Used to split the room and reduce reflection	150.00
Black Backdrop (10x20)	Behind glass and presenter	43.00
Backdrop Stand (10ft)	Stand used to split the room (presenter and computer)	47.00
Heavy Duty Clamps (6 pack)	Management of backdrops	8.00
Magewell USB Capture HDMI Gen2	Receives and splits HDMI input from camera to monitors	299.00
Display Stand	Wheeled stand that holds confidence monitor	55.00
Confidence Monitor	TV monitor seen by the presenter when recording	140.00
Microphone System	Wireless microphone worn by presenter	99.00
Expo Neon Dry Erase Markers	Markers for writing on the glass	34.00
Camera Tripod	Tripod to hold camera	227.00
Glass Cleaning Cloth (by 2 packs)	Clothes used to clean glass after recordings	14.00
Surge Protector (x2)	Central plug-in source for electronics in the studio	60.00
Extension cord	Purchase as needed	30.00
Male HDMI to Male HDMI	Used to connect camera to Magewell USB Capture	16.00
XLR Cable	Connects wireless microphone receiver to camera	16.00
Edge Lighting Kit	Edge Lighting	279.00
Second Screen for Computer	Provides image for confidence monitor while allowing operator to have full function of the computer	204.00
HDMI Splitter	Receives camera HDMI, splits to computer and external monitor	30.00
2-3 HDMI Cords		20.00
Mini Display Port to HDMI	From Mac to USB splitter	14.00
2 Backdrops	For behind camera to kill reflection	38.00
Curtain Rings (x2)	To hold curtain behind camera (allows sliding to walk through)	17.00
Cord Covers (based on need)	Lowers tripping hazard over cords along studio	60.00
Wrinkle release	To get wrinkles out of backdrops if they cannot be ironed	14.00
Lint Roller w/ Extendable Handle	To clean backdrops	21.00
Squeegee	To clean glass if preferred over cloths	13.00
Sandbags for Curtain Rods	Anchors curtain tripods and prevents tipping	15.00
Camera Filter	Filters LCD reflection from confidence monitor on glass	32.00
iMac	Need a computer with a solid-state drive to run Adobe Creative Cloud	1968.00
Multiport USB Hub	Needed to convert HDMI (video port) to USB C on Mac	75.00
Adobe Premier Pro	Annual purchase of video editing software	240.00
Estimated 2021 Total		8310.00

Implementation in a Kinesiology Classroom

Exercise physiology is a core course within most kinesiology curriculums. This subject requires the understanding of basic physiological responses at rest and subsequent adjustments made to the stimulus of exercise. Often, this course may feel ‘rushed’ if instructors need to cover most of the major physiological systems, acute and chronic training adaptations, environmental conditions, and special populations. In these cases, in class diagrams, figure descriptions, and the like are often limited to a single explanation and short windows for questions so that the next topic can be introduced. When this is the case, students are met with a single opportunity to copy the instructor’s drawings and annotate specific details; this style of teaching can be described as massed practice (Glenberg, 1979), or learning that occurs less frequently and over longer periods of time.

Adopting the practice of face-to-face instruction with online learning appears to be the optimal deployment of information in a kinesiology classroom. Instructors may consider developing Lightboard videos that replicate laboratory demonstrations, diagram formations, and figure descriptions that were typically reserved for classroom learning. These Lightboard videos could be viewed before and/or after the class to support content retention through the practice of distributed learning (repetition of content either across time or platforms; (Glenberg, 1979). As an example, the instructor may assign reading over the full oxidation of a glucose, present diagrams in class that progress students through the process and provide follow up Lightboard videos on the content. See example media linked on the author’s YouTube channel (see **Figure 2**).

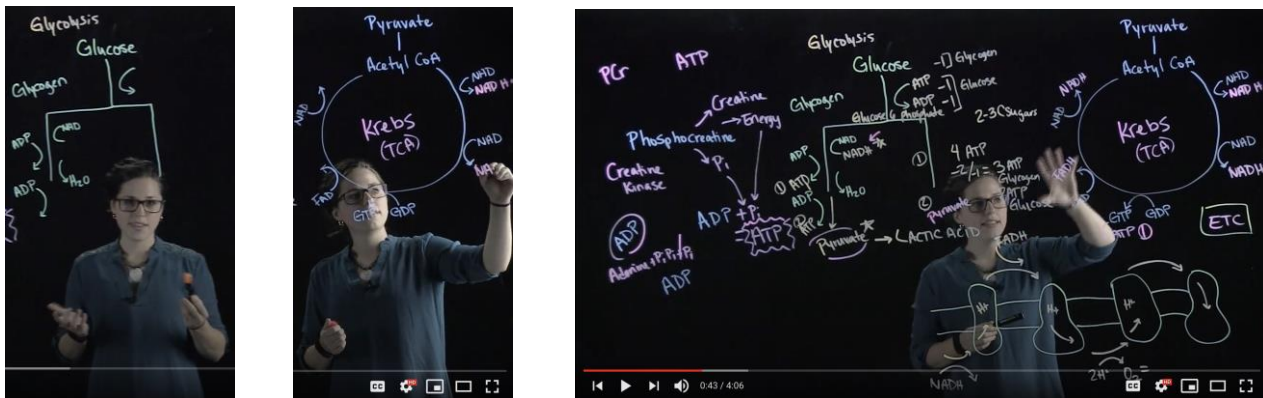


Figure 2. Example Lightboard videos on glycolysis, Krebs’ cycle, and electron transport chain delivered to sophomore level exercise physiology students.

■ DISCUSSION

In a remote classroom setting, learning is often presented through tools such as screen casting a PowerPoint presentation or recordings of the professor lecturing with a whiteboard. With many universities across the world utilizing online learning, content must be delivered efficiently to ensure a positive learning experience for students, but also reduce the burden for faculty. Delivering

learning in the virtual realm can impact higher education (Robinson, 2020), potentially replacing many courses traditionally taught face-to-face to minimize costs for the institution. Though some learning curve is present, adapting instruction to utilize technology may facilitate greater information retention. Using technology has the potential to make teaching and learning more engaging (Bedenlier et al., 2020), promote participation and involvement in courses (Salaber, 2014), and student engagement and self-directed learning (Chen et al., 2010; Rashid & Asghar, 2016). When connection within the classroom is impractical, visualization of the instructor through Lightboard technology may satisfy students' need to socially connect with others and facilitate continued learning. One research team found video communication in online courses helped students see the instructor as "more real, present, and familiar," to a similar extent as face-to-face (Borup et al., 2012). This connection to the instructor, content, and field-specific constructs support the learning theory of connectivism (Goldie, 2016). If instructors deliver educational videos on platforms like YouTube, learners can connect not only with the educator, but also fellow viewers through video comments.

The Lightboard technology enables high quality content to be delivered to students with relative ease. This medium provides low cost, open access content for students on platforms for which they are familiar. Faculty who integrate Lightboard technology remove many learning barriers for students, such as classroom distractions (media can be viewed in comfortable settings), fear of falling behind in lecture (videos can be paused and re-watched), or learning in a single domain (e.g., the visual domain through textbook reading). This style of pedagogy leans into distributed instructional strategies, which has been shown to elicit superior learning in kinesiology-related spheres when compared to massed education (Dobson et al., 2017). Faculty can also gather data on how many users view the resource as well as other statistics offered by the media platform.

Delivery of Lightboard videos should be systematically aligned with textbook reading and face-to-face instruction. One method of combining the modalities of learning is with reading note pages. It is fair, unfortunately, to assume that students struggle identifying important concepts if they are seeing it first in a textbook. Providing guided notes focuses student attention on what is deemed important to the instructor; this activity also promotes the practice of active reading skills (see Resource 1). The instructor may then choose to add video links to Lightboard media that covers concepts in their own words to supplement language from the text.

Holding students accountable to completing note pages and viewing assigned media before class is often a struggle. Instructors may consider developing untimed 'reading checks' (delivered as quizzes on learning management platforms) that also guide students toward higher levels of learning by requiring understanding and comprehension of content. This trio of activities fosters student-directed learning by establishing expectations of pre-class responsibilities. Students will in turn have the opportunity to grow as confident, independent learners (Katz, 1996). Students may

bring completed note pages to face-to-face meetings to take additional notes on concepts or to ask questions that were conceived while working independently.

Challenges can exist when using this technology. Faculty must pay special attention to studio location to ensure quality audio and video capture. Considerations to make include a studio room away from busy hallways, investing in quality audio capturing devices and lighting, and having a reliable means to store a vast number of video files. Not all faculty will see the value in using the Lightboard studio in their course, often citing that they do not teach STEM subjects and often do not write on the classroom whiteboard. In these instances, faculty can be reminded of the value of high-quality audio, video, and editing devices, but more importantly, the potential to increase student engagement outside of the classroom. Faculty can also consider creating welcome videos, announcements, and explain homework assignments in the studio.

Cost may be the most prohibitive consideration with the Lightboard studio. If cost is the principle concern, consider following this [guide](#) to making a lightboard for less than \$100 (Griffiths, 2016). Space can be another hindrance if your unit does not have an office space long enough to host the studio. An alternative may be the [tabletop package](#) sold by Revolution Lightboards™; these can be used in your personal office for less than \$2,000.

Accessibility and equity should be a consideration when using the Lightboard. If your institution does not have a media repository that will provide closed captions, consider uploading your files to YouTube as their software auto-generates captions for those who are hearing-impaired. If students do not have reliable or fast internet at home, they can download videos to their device to watch later.

Future investigations should consider how Lightboard created media impacts the Community of Inquiry framework model; this framework considers learning components such as cognitive, social, and teaching presence as factors that impact student learning within an online setting (Kim & Gurvitch, 2020). Though this framework has been evaluated in the soft sciences (which includes kinesiology; Hersman & Schroeder, 2017; Martin & Bolliger, 2018), none have specifically evaluated the special characteristics of kinesiology and online learning models. Lightboard technology may serve as an immediate branch between online learning and the social presence factor associated with the Community of Inquiry framework.

Technology is fast evolving, extending its reach into educational spaces. Though there seems to be a never-ending supply of novel educational applications or resources, faculty may find comfort using teaching methods that resemble modalities they are accustomed to. The Lightboard studio may be a source of familiarity, but also innovation as traditional lecture content can be delivered without geographical constraints or undue faculty burden.

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■ RESOURCES

Resource 1

Below is an example note page created by the author that aligns with the author's adopted course text. Links embedded direct the learner to Lightboard created media. Note that many of the images that are often included from the note page have been removed to avoid any copyright infringement.

Storing Energy: High-Energy Phosphates (p. 58)

- The immediately available source of energy for the body is _____ (___)
 - Created by joining an adenosine and _____.
- Reliance on ATP for almost all bodily functions
 - $ATP + H_2O + ATPase = ADP + P_i + \underline{\hspace{2cm}}$

This happens quickly!

** You won't always see H_2O in the equation because it is known that it is a hydrolysis reaction.

**ATPase is the enzyme

- Process of taking ADP and P_i to re-create ATP is called _____.
 - Phosphorylation requires a considerable amount of _____.
 - Requires energy to create energy...
- Phosphorylation can be categorized by
 - Oxidative phosphorylation- uses the aid of _____.

Substrate level phosphorylation – operates independent of O_2 The Basic Energy Systems

Cells can generate ATP through any one or combination of three metabolic pathways:

- 1.
- 2.
- 3.

(**Label each as aerobic or anaerobic)

ATP-PCr System

Watch ATP PCr: <https://youtu.be/mTzXt6c2dzM>

- The _____ of energy systems.
 - Cells contain another high-energy phosphate (different from ATP) = _____
 - PCr donates P_i to _____ to form ATP (see image below)
 - The release of energy from PCr is catalyzed (separates P_i from creatine) by the enzyme _____

- Simple and fast...
- Rate limiting enzyme = _____
 - Enhanced when ____ or ____ concentrations increase
 - Inhibited when ____ concentrations increase.
 - The rate limiting enzyme is acting via _____ feedback.
- **Substrate-level** = phosphocreatine (PCr)
 - Can occur in presence of oxygen, but the process _____ requires oxygen.

Ask yourself later: Which example will more heavily rely on the PCr system?



ATP Across Exercise Time... Intense Exercise

- Notes from Graph (right column page 59): Limited stores...

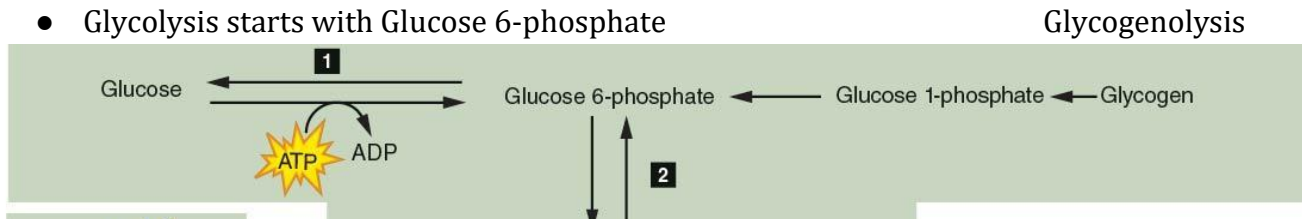
As exercise progresses beyond a few seconds (>15s), other energy systems (_____ and _____ systems) will dominate ATP production (re-creation).

Glycolytic System

Watch “Glycolysis”:

<https://www.youtube.com/watch?v=hq1ZLEySwoY&list=PLk2ufUt0R52ssCsQjIQd6kvKRRDoiCbvh&index=38&t=11s>

- Glycolysis = liberation of energy from breaking down of _____...
- “-lysis” = _____
- Glycolysis has more steps than PCr system
- Glycolysis starts with Glucose 6-phosphate



This is a snapshot of the top of glycolysis to emphasize the beginning stage.

Regardless of if you start with a glucose or a glycogen, each must be converted to _____ to start glycolysis.

- If you start with a glycogen → glucose-6-phosphate, you invest ___ ATP
- If you start with a glucose → glucose-6-phosphate, you invest ___ATP

Glycolysis takes place in the cell's _____.

Glycolysis takes several steps to break down a sugar into _____.

- Pyruvic acid (or pyruvate) can then be converted to _____.

In total, the process of Glycolysis produces **4** ATP from 1 molecule of glucose or glycogen. HOWEVER, we have to remember the ATP investments!

- Glucose: 4 ATP – ___ ATP = ___ ATP yield
- Glycogen = 4 ATP – ___ ATP = ___ ATP yield

Though ATP yield from PCr and Glycolysis is minimal, their combined actions allow the muscles to generate force even when _____ is limited.

End-product(s) of Glycolysis

- **Pyruvic acid** (or pyruvate) (if sufficient oxygen is present) –or-
- _____ (if insufficient oxygen is present)

Fate of Pyruvate...

- Goes into oxidative phosphorylation
- Converted to lactic acid

****If maximal effort continues (lots of lactic acid created), the muscle protects itself by slowing down the process creating the lactic acid = Glycolysis is inhibited****

Watch Creation of Lactic Acid:

<https://www.youtube.com/watch?v=43zKOBjtm2c&list=PLk2ufUt0R52ssCsQiIQd6kvKRRDoiCbvh&index=34>

Glycolysis rate limiting enzyme:

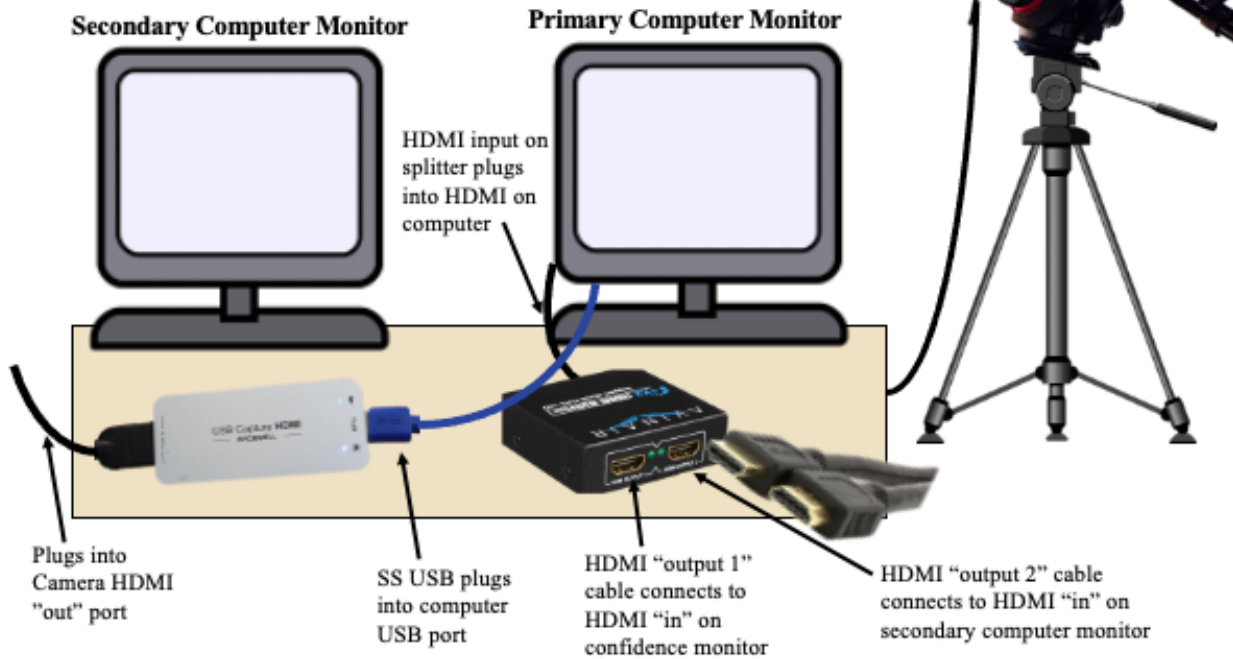
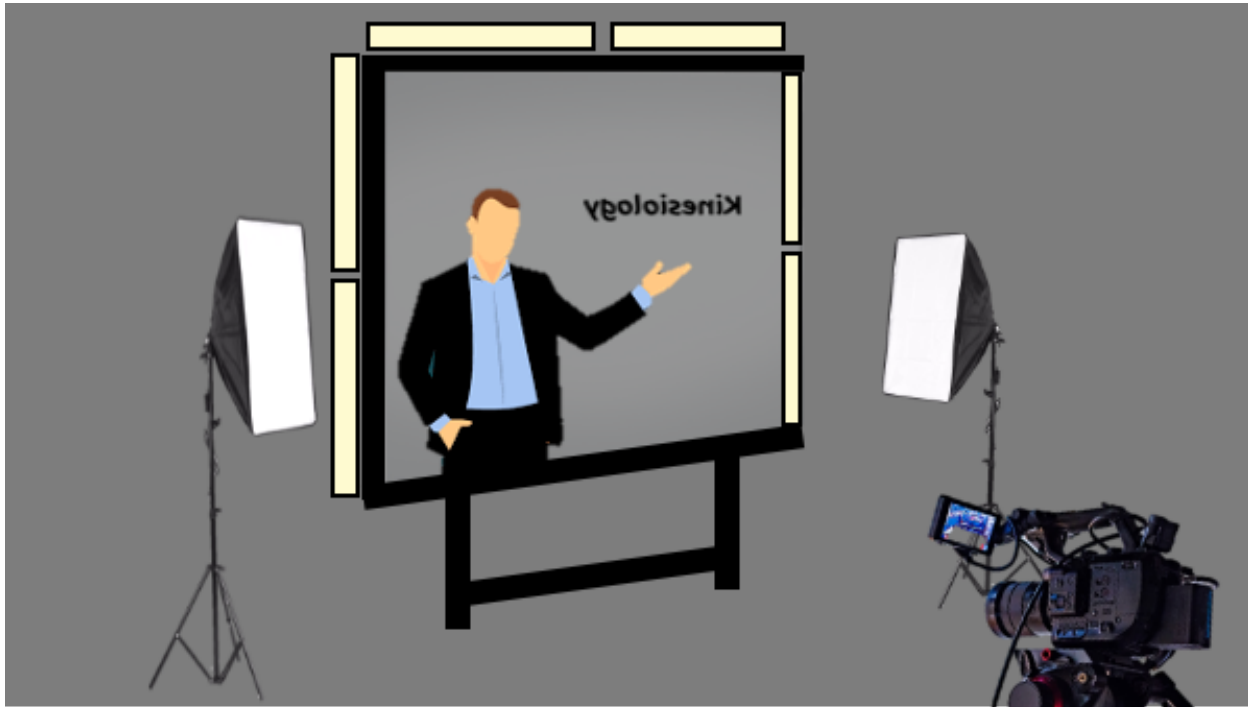
- _____ (PFK)
 - PFK is enhanced (speeds up) in the presence of _____ and _____.
 - PFK is inhibited (slows down) by presence of _____.

The _____ & _____ energy systems alone cannot supply all the needed energy needs for all-out activity lasting > ____ minutes.

- Prolonged exercise relies on the third energy system, the _____ system.

Resource 2

Setup the Studio:



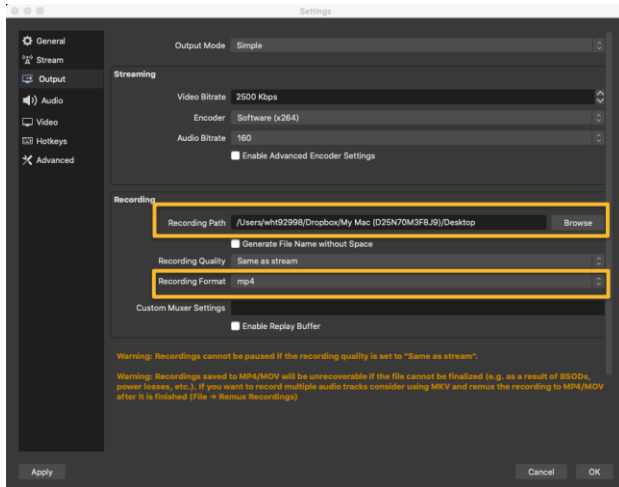
Video Capture:

For presenter:

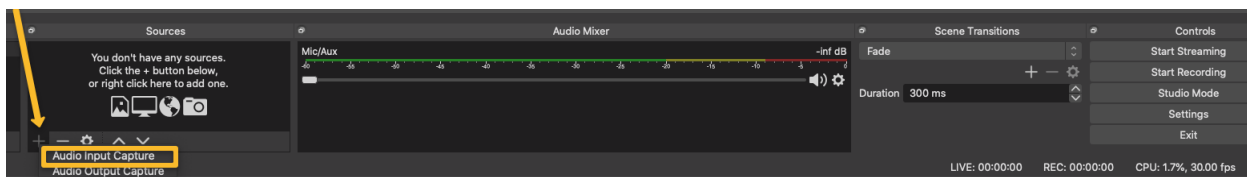
- When recording make sure to wear solid color clothes without any logos or wording. Due to the need for the image to be mirrored, logos and wording will be backwards.
- Give a 3-5 second pause at the beginning and end of each recording to give defined editing points for each video.
- Write to the side instead of in front of your body. This way the writings and drawings are easily readable for the students.
- Look directly into the lens of the camera when talking to your students.
- When needing to erase while recording, use a dry microfiber cloth to reduce streaking and smudging. However, we suggest avoiding “live erasing” as removing marker from the glass is not as easy as what one would experience using a dry erase board.



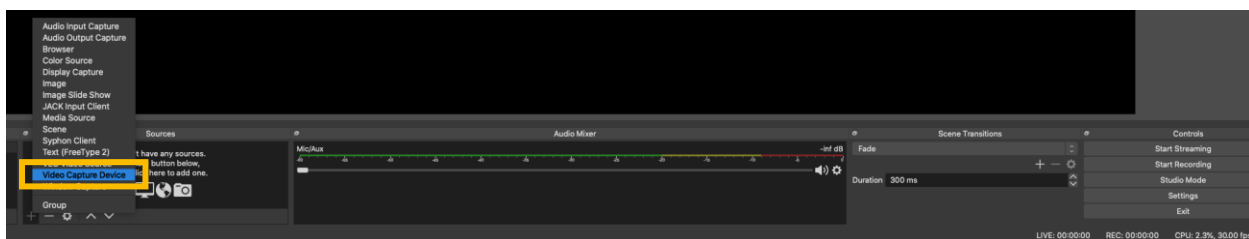
Setting up OBS for recording:



- Save to a location you will find after recording.
- Adjust recording format from mkv to mp4 to edit in software other than OBS.



- Click “+” sign and add “Audio Input Capture”
 - Find your audio input desired, often it will be tagged to USB and/or HDMI
- If your audio is picking up a lot of background noise, you can consider adding some noise suppression:
 - Right click on the audio input
 - Click “filters” and then the “+”
 - Add “noise suppression” between 5-10 db to start. Beyond 20 db may bring about some unwanted sound gaps.



- Click “+” sign and add “Video Capture Device”
 - Find your video input desired, often it will be tagged to USB and/or HDMI
- To rotate the image, right click on the video source and click “Transform”
 - Select “rotate image horizontally”

Postproduction Process:

We have developed a YouTube channel with some basic “how to” videos related to editing video in Adobe’s Premier Pro.

Access the playlist here: <http://youtube.com/playlist?list=PL0sTilAVNggjg44Sl4aVMBHX2yumaHT4X>

Other helpful resources:

Faculty may consider using [YouTube](#) as a repository for media, as there are privacy options, such as “unlisted,” that prevent individuals from finding the resource with the search engine. YouTube offers tutorials on how to [create and manage playlists](#) as well as how to [change a video’s privacy](#). You may also [create your own closed captions](#) for videos uploaded to YouTube Studio.

Another option for video hosting, [Vimeo](#), is a robust and affordable option. This platform is advertisement free and has more options for security that allow the videos to be more private.