

Histology Personal Trainer: Identifying Tissue Types Using Critical Thinking and Metacognition Prompts [†]

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INTRODUCTION

Tissue-type histology is a foundational lab exercise for many courses... and our students hate it. In anatomy and physiology, where more obviously applicable labs are just around the corner, students struggle to grasp this basic content. At this institution, a Hispanic-serving, two-year community college, scores are historically lowest on the histology exam and many students drop the course after this exam. Attrition is a problem nationally as well; while community colleges train about 60% of healthcare workers, attrition rates in anatomy and physiology courses are nearly 50% (1). Upon closer investigation of this exam, we found students were attempting to memorize the provided field of view, rather than identifying tissue hallmarks, and therefore struggled to apply their skills during the exam.

Metacognition has been studied as a vehicle for increasing student engagement (2). Students who are aware of their strengths and weaknesses as learners, test-takers, and peer group members are more likely to monitor their learning strategies and gauge their readiness for a task (2). The ability to self-address misconceptions in STEM students becomes apparent when they can identify whether or not their ideas are plausible in a scientific context (3). Metacognitive interventions in biological classrooms are often designed for students to reflect on exam preparation and performance (4). In this activity, we address student misconceptions with metacognition prompts during the activity, allowing students to evaluate their skills as investigators as opposed to test-takers.

This one-hour activity guides students through a clues checklist to identify tissue types in histological samples using a microscope while exercising their observation and comparative skills. Afterwards, students reflect on the activity

to identify what clues or strategies worked, and also what clues or observations they missed and why. Students *and instructors* are able to more accurately identify misconceptions and adapt before a high-stakes exam.

PROCEDURE

This activity requires that a microscope view be projected and the use of slide sets that includes: Set 1: nervous tissue vs. areolar tissue, Set 2: hyaline cartilage vs. elastic cartilage, Set 3: transitional epithelium vs. stratified columnar epithelium, and Set 4: pseudostratified epithelial vs. simple columnar epithelial tissue. Slide labels are covered. Students are seated in six groups of four with two light microscopes and four slides per microscope. Before this activity, students are expected to understand the proper use of microscopes, be able to focus on a slide, and measure the field size. These skills can be included in this activity if you have a longer lab period (two hours minimum). The students should have a basic understanding of the tissue types, including where they are located and basic functions. This information is organized using the Histology Tissue Worksheet (Appendix 1). At the beginning of the activity, the students are provided the Histology Handout (Appendix 2) and the Histology Examples with Clues Worksheet (Appendix 3). For the last stage of the activity, students are provided the Cool Down Reflection Form (Appendix 4). For flow of activity, see Figure 1.

Warm-up

The instructor demonstrates proper microscope use and projects slide 1 on a screen. Students work in pairs to load slide 1 (nervous tissue) onto their microscopes. Students practice making observations about the slide using the Histology Handout (Appendix 2) and the Histology Examples with Clues Worksheet (Appendix 3) *before they try to guess the tissue type*. The students discuss these characteristics with their partners. The instructor leads a class discussion about the observations made and what clues point toward the correct answer. The tissue type is not yet revealed.

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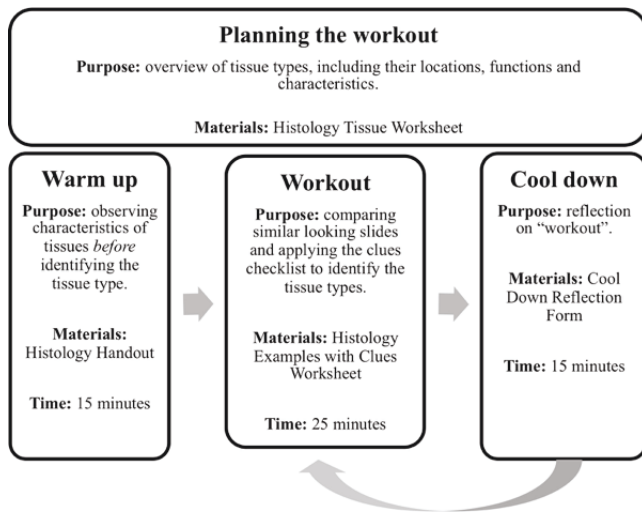


FIGURE 1. Flowchart of activity.

Workout

The workout consists of two circuits. In the first exercise, students work independently, taking turns using the microscope to view the next slide. Students use the Histology Examples with Clues Worksheet (Appendix 3) and record their observations on the Histology Tissue Worksheet (Appendix 1). For example, with nervous tissue, they can identify the lines as fibers and discern cells from matrix. After the students finish evaluating the slide, they compare their observations with their partners and then work together to come up with the correct tissue type. The instructor reveals the correct answers and leads a short discussion about the key clues on the Histology Examples with Clues Worksheet (Appendix 3).

In the second circuit, students discuss in pairs how the structures they have viewed inform the function of the tissue. The students are asked to compare the tissue on the slide with the images on the Histology Examples with Clues Worksheet (Appendix 3). Students discuss similarities and differences between primary and secondary tissues, layers, types of nuclei and background material. With nervous tissue, they now see they can distinguish it from areolar tissue based on the structure and function of the cells (dendrites and axons of neurons). The instructor circulates around the room to assess student knowledge and assist as needed. With the class, the instructor reviews the slide examples and the clues that hinted at the correct answer.

Cool down

For the final part of the activity, students are asked to complete a reflection exercise (the Cool Down Reflection Form, Appendix 4). They answer open-ended questions guiding them to reflect upon whether they got the correct answer, what clues they used, their confidence level, what they learned, and what they would do differently to prepare themselves. They discuss their answers in groups before turning them in.

CONCLUSION

According to students' reflections ($n=24$), "Histology Personal Trainer" increased depth of student engagement, as well as student motivation and confidence. One student reflected, "I feel more confident about the way in which I am able to connect the various labeled parts on a figure to its function." Another said, "It helped build a methodology to viewing and interpreting the tissues... having comparative slides really helped to see the differences. Which is really hard to see when everything looks like dots and squiggles in the beginning. I felt like a tissue detective!"

Furthermore, this activity helped students identify alignment between the lab activity and the assessment, commenting, "It helped me narrow my focus of study for the exam," and "I am now able to figure out how to break down large pieces of information into various categories and not feel overwhelmed when I study them."

Additionally, this activity aligns with the Human Anatomy and Physiology Society (HAPS) learning outcomes, including contrasting the tissue types, classifying the tissues based on distinguishing structural characteristics, using proper microscope technique, and correlating structure and function (https://www.hapsweb.org/page/API_Outcomes). Student scores increased as well after this activity was implemented; historically the histology exam average was 44.6%, but it increased to 74.9% for this 24-student cohort. Additional studies are planned to determine whether this intervention resulted in statistically significant improvements.

SUPPLEMENTAL MATERIALS

- Appendix 1. Histology tissue worksheet
- Appendix 2. Histology handout
- Appendix 3. Histology examples with clues worksheet
- Appendix 4. Cool down reflection form

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