

High Level Design Document

Design Project Working Title: Microcirculation Microlesson

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Instructional Problem/Need

At Noorda School of Osteopathic Medicine, one of the big problem areas students struggle with is in physiology, specifically cardiovascular physiology. The purpose of this course is to begin the process of breaking down cardiovascular physiology into digestible units, starting with microcirculation, or the movement of blood in the smallest blood vessels in the circulatory system.

Goal

There should be noticeable improvement in student test scores in physiology classes. Preferably, students will be surveyed or otherwise asked if this instruction helped improve their comprehension of microcirculation.

To achieve these goals, students should be able to:

1. Identify important structures within the microcirculation system.
2. Describe the patterns of fluid movement within the microcirculation system.
3. Differentiate the microcirculation system from other components of the cardiovascular system.
4. Analyze the processes shown in relevant medical images or diagrams.
5. Apply gained knowledge in multiple choice exams.

Objectives

The main content learning objectives are:

1. Identify the vessels that comprise the microcirculation.
2. Compare the fundamental structures of microcirculation to “macrocirculation.”
3. Describe the four principle mechanisms by which fluids and dissolved solutes move between the blood and the interstitium.
4. Explain the composition of the extracellular matrix.
5. Analyze the most important functions of the extracellular matrix.

Target Participants

The participants are first- and second-year medical students at Noorda School of Osteopathic Medicine (pre-clinical years).

In general, the participants are motivated to achieve high grades because A) high grades usually reflect high comprehension, which is essential in becoming a great doctor, and B) the participants will be able to match into more selective residencies with higher grades.

The participants seem to have a general pattern of learning preferences, in that they don't like consuming highly long or dense material in one go. They prefer bite-sized pieces. To meet these needs, the plan is to proceed with microlearning, scaffolding, and spaced learning so students absorb the knowledge over time but are not overwhelmed with it all at once. This is a very tech-heavy school, where most of their lectures are in video format, so a virtual format will be used to match this school's style.

To meet disability compliance, closed captioning will be accurate, a written transcript will be provided, and all visual design choices will meet contrast accessibility standards.

Course Outline

Topics

The course will delve into structure, then function. The entire lesson is covering microcirculation, but the main topics will be the structures of the microcirculatory system, the principal pathways for how material is exchanged between blood and the interstitial space, and the structure and role of the extracellular matrix.

Modality

This course module will be created in Articulate Storyline and offered as a supplementary material the next time students take the cardiophysiology unit. It will be offered online, as most of this school's lectures and other videos are shown online.

Technology

The students will need to be able to access their regular LMS (Canvas), as the course will be uploaded there. Other than that, the entire course can be completed within Review 360 of Articulate Storyline.

Assessments

Learning will be assessed with exams at the end of the course. They will be mostly multiple-choice in a structure that represents medical board questions, but some visual quiz questions will be included where students can identify and explain structures in given images.

Module Outline

Prerequisites

It would be helpful if learners had a basic understanding of physiology. Specific to this lesson, however, students should already have some knowledge of “macrocirculation,” the basic definitions of structural components like arterioles, capillaries, venules, etc., what endothelial and epithelial membranes are (and how they differ), and the transport mechanisms of an epithelial structure.

Introduction

The plan is to a welcome voiceover, then a voiceover introducing, “We’re going to zoom in today,” paired with an animation/automatic layer change that shows a magnifying glass hovered over a human being exterior, then the interior organ system, then a specific organ, then a group of vessels, and then an individual cell.

Purpose

This voiceover will be showcased at the beginning of the course, highlighting that this is a reinforcing mini-lesson to refresh their knowledge on microcirculation.

Interest/Motivation

Physiology is a very difficult subject for the students who are eager to score better, so that could be motivation in itself, but this course will also be very interactive and colorful. Instead of just showing a picture of a group of vessels with text next to it and/or a voiceover, students will be able to click around and learn/re-learn at their own pace. Included will be medical pictures and diagrams with markers (with titles/descriptions) and layer triggers, so they can explore different systems more visually. Learners should be able to seek this information by clicking, opening, etc. vs. just having it exist passively on a page.

Some animations will also be incorporated, especially to show the blood movement and different pathways.

A possibility is to use branching scenarios so students can pick an area they’d like to learn first and take the course in the direction they’d prefer, to some extent. To do this, a dial could be offered that the learner would twist in the direction of what topic they want to cover, or perhaps a network of buttons/some sort of interactive flowchart that the learner can click through.

Body of Lesson

Storyline Articulate will be used for this entire lesson, along with Canva to create some images.

First, definitions will be provided, especially if the learners aren’t sure/don’t remember what microcirculation means. The explanation will be that microcirculation is the part of the cardiovascular system that starts when an artery enters an organ and transitions into arterioles, ending when venules transition to veins. As an example, a picture of the vessel networks will be displayed, along with added markers on the different structures. With arrows and animations, a voiceover might be incorporated after the markers are visited (to reduce cognitive load, I will

make the main page as text-light as possible) that states how arterioles feed capillaries, capillaries drain into venules, and venules transition into veins.

The professor wants a brief tangent/explanation of why common microcirculation diagrams include metarterioles and precapillary sphincters, so that will be included in its own layer, separate from the “main” explanation.

In ending the definitional portion of microcirculation, it will be emphasized that this region is where blood and tissues have a chance to interact and exchange nutrients and waste products. During this sequence, there might be little pop-ups of blood and nutrients and ions and the like.

Since this course will cover structure and then function, the next section will proceed into explaining that there are three types of capillaries. This will likely be a branching scenario or a multiple layered page so the learner is forced to learn about each one separately. There is the fenestrated capillary, discontinuous capillary, and continuous capillary. These all transfer different levels of material, like fluids, proteins, etc.

The next section will the four pathways for material exchange between blood and the interstitial space: transcellular diffusion, diffusion via pores and clefts, bulk flow, and transcytosis. This will include animations of movement, blood/fluid flow, etc.

Then, the content will shift in its focus on explaining the interstitial space previously mentioned. In this area, there's the extracellular matrix, which is composed of collagen, elastic fibers, and ground substance. Ground substance, a proteinaceous gel, is the most important point here. The professor suggested using the creation of Jello to explain how gel is created in cells, so a fun aside will be incorporated.

Then, I'll explain the functions of the extracellular matrix now that the structure is covered. That is the last topic covered.

Gaining Attention

I think this will be a great opportunity for interactivity. I can include several branching scenarios where learners go down pathways to learn about pathways (ha), and also many markers and interactive triggers that pop up when the learner is directed to click on different areas of an image.

I also think/hope that the animations and visuals I will add/create will add a lot of color and life to the topic, so the learners can actually see some of the processes in real time.

Learning Strategies

I plan on using some reinforcement, giving learners the opportunity throughout the course to click on definitions, descriptions, etc. of terms in case they forget or want to refresh for a new topic.

One learning strategy I will be using heavily is visualization. I will be using many visual image examples to demonstrate what the students are learning through text/voiceover. I will also use animations as a similar modeling strategy.

I might potentially have little pop questions at the end of each section as a way for the learner to recall information, or I might have questions asking the learner what the next possible step in a process is *before* it's revealed, invoking inquiry-based learning, so they can come to some answers on their own.

Practice

I may include knowledge checks at the end of important sections. I also will include targeted assessment questions in the final quiz.

Feedback

I will probably allow around two attempts for any of the pop quizzes and then include feedback in answers. I'll link/refer to the page the information was on and give a brief summary/image of what the answer was.

Conclusion & Summary

I will likely provide a regular summary page with bullet points about each main topic as well as the specific images associated with them. The main topics I plan on highlighting are that microcirculation is made of arterioles, capillaries, venules, and lymphatic capillaries, what the four principal pathways of material movement between blood and the interstitial space are, and the structure and function of the extracellular matrix.

Closing the Lesson

I will remind them that physiology is a difficult subject and they've already made great strides by reviewing this information. I'll tell them that we can move forward one step at a time to avoid becoming overwhelmed and before they know it, they'll be learn so much more than they ever thought possible.

Assessment

I plan on using knowledge checks at the end of important sections (multiple-choice, pick one/pick many, etc.). I will have similar questions testing the most significant content in a quiz at the end. The quiz will be graded, but the knowledge checks will not.