In this "Lab Guide", we will be looking at tissues.

YOU WILL NEED THE IMAGES IN YOUR TEXTBOOK! Our lecture book has an excellent section on the tissues, including summary tables. Of course, there are usually extra textbooks in lab, but there are not enough for everyone!

Take a look at the Wordlist for this lab. Pretty detailed, isn't it? I also have some links on the website to some online resources that may help, but these are not mandatory.

PLEASE NOTE: Your group will be needing a microscope at the workstation. All of the steps in this guide are designed to be done at the workstation. DO NOT use a microscope that is already set up in the room, being used as a demo. Instead, get a new one from the microscope storage, get out a power cord, plug the cord into the microscope, and use the microscope at your station!

The Steps found in this "Lab Guide" should be done in the order they are found.
Step 1. Remembering important concepts from the epithelial videos

Have someone in your group read the following out loud, while the others read along:

This step assumes you have either read the book, or watched the Online Lab Videos covering histology. If not, do so before taking this step. You can come back to it later!

Let's talk about the lab practical, and what everyone has to do to get ready.

For each tissue type, there are 4 things you should know, or be able to do.

1. ID the tissues.
2. Explain what the tissue does in a general sense.
3. Give some examples of where you might find them. Students do not have to name every place in the body; just be aware of the instructor's examples.
4. Identify any special cells that is associated with the tissue, or other special structures or characteristics. Terms like "goblet cell" and "osteon" should be noted.

Different instructors want different things in a tissue lab. Students should make sure it is clear what the instructor wants them to know. The next few questions help define this for this lab. If the answer is "none" or "our instructor doesn't want this", we should write that down.

Now, answer the questions on the next page.
Q 1. What are the 4 basic tissue types? Next to each, write a short description of what role they play in the body, taking especial note of anything the instructor has pointed out.

1.

2.

3.

4.

Q2. There are 3 basic cell types found in epithelial tissues. Name them, and draw one below each name:

Q3. Describe the difference between these 2 terms: Simple & Stratified? Make a drawing to help explain.
Q4. **What are the epithelial tissue types that our instructor wants us to know?** Cross out any on the list below that your instructor doesn't need you to know. **Next to any that are left, write a short description of what role they play in the body.**

Simple squamous

Stratified squamous

Simple cuboidal

Stratified cuboidal

Simple columnar

Stratified columnar

Pseudostratified columnar

Transitional

Q5. **Where are these tissues found?** Go back to Q4. Under each, write down a short list of where you might find each of the tissues, concentrating on anything your instructor told you. Use more paper if needed.
**Step 2.** Remembering important concepts from the connective tissues videos

*Have someone in your group read the following out loud, while the others read along:*

*This step assumes you have either read the book, or watched the Online Lab Videos covering histology. If not, do so before taking this step. You can come back to it later!*

Let's talk about the lab practical, and what everyone has to do to get ready.

For each tissue type, there are 4 things you should know, or be able to do.

1. **ID the tissues.**

2. **Explain what the tissue does in a general sense.**

3. **Give some examples of where you might find them.** Students do not have to name every place in the body; just be aware of the instructor’s examples.

4. **Identify any special cells that is associated with the tissue, or other special structures or characteristics.** Terms like "goblet cell" and "osteon" should be noted.

Different instructors want different things in a tissue lab. Students should make sure it is clear what the instructor wants them to know. The next few questions help define this for this lab. If the answer is "none" or "our instructor doesn't want this", we should write that down.

**#2** Now, answer the questions on the next page.
Q 6. What are the general functions of connective tissues? (there is more than one answer, and more than one way to say it. Make sure you are focusing on what your instructor wants you to know)

Q 7. Understanding basic CT concepts by “answering a question with a question”!

Have someone in the group read the following directions aloud, while the others read along:

The following 8 questions **build on each other**. The answer to a question may be in a later question, or the answer may have been in a proceeding question.

Here is a overly-simple example of how this works:

#1. Which of these is a farm animal?
   Horse
   Bat
   Fish

#2. Horses all have ______ legs.

#3. Horses, pigs and chickens are all:
   Ungulates
   Beasts of burden
   Farm animals

Now, answer the following 8 questions regarding CTs (beginning on next page). Move quickly, and don't get bogged down on one question, realizing you will see all the connections once you are done!

The questions begin on the next page. If you can't answer something quickly, move to the next question, looking for the answer.
1. There are 2 basic components in connective tissues. Name them, labeling the drawing below:

   Generalized Connective Tissue

2. We define the cells found within CT as "mature" versus "immature". What are the suffixes we use to distinguish the two?
   - Immature cell ends in suffix ____________
   - Mature cell ends in suffix ____________

3. What are the 2 main components common to the "Extracellular Matrix" of all CTs? Circle the two from the list of options below. Be careful...some of the "wrong" answers might also be found in the matrix, but they are not one of the "2 main components"!!!

   Cytoplasm  Electrolytes  Serum  Chromatin
   Proteins  Calcium salts  Organelles  Hormones
   Histamine  Immune cells  Antibodies  Ground substance

4. The "Ground substance" of CTs extracellular matrix often contains a lot of (choose one):
   - Collagen
   - Adhesive glycoproteins
   - Reticulin
   - Elastin
There are many different proteins found in the matrix of CTs. But, 3 of them are "fibrous" proteins, helping to give the matrix its structure. Name them:

1.

2.

3.

Fat is the common term for __________________tissue

MATCH the cell type with the description: Put the number of the descriptive term next to the cell name. For example, the "fat storage cell" should have a "1" next to it!

<table>
<thead>
<tr>
<th>Cell Name</th>
<th>Description:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fibrocyte _____</td>
<td>1 - fat storage cell</td>
</tr>
<tr>
<td>Osteocyte _____</td>
<td>2 - mature bone cell</td>
</tr>
<tr>
<td>Chondroblast _____</td>
<td>3 - blood tissue stem cell</td>
</tr>
<tr>
<td>Hematocytoblast ___</td>
<td>4 - immature cartilage cell</td>
</tr>
<tr>
<td>Adipocytes _____</td>
<td>5 - mature cell found in areolar tissue, dense regular tissue, and many others</td>
</tr>
</tbody>
</table>

Mast cells release a chemical called ___________ which causes blood vessels to dilate and edema to occur
Q8. **What are the connective tissue types that our instructor wants us to know?** Cross out any on the list below that your instructor doesn't need you to know. You are going to need the spaces below each term later!

- Areolar (Loose Regular)
- Adipose
- Blood
- Dense Regular (White, Collagenous, Fibrous)
- Dense Irregular
- Cartilage
- Compact Bone
- Spongy Bone

List others not found on above list that you have to know:
Q9. Where are the CTs tissues found? Go back to Q8. Under each, write down a short list of where you might find each of the tissues, Include the role they play. Concentrate on anything your instructor told you. Your book will have examples, also. Below is an example for "adipose" (Compare this with your instructor wants for adipose, before you write it down on Q3!!!!)

Adipose - Fat (energy) storage, and protection. Found under skin (subcutaneous fat) and surrounding most visceral organs.

Q10. Name the cells of Connective Tissue. Go back to Q8, and under each tissue named, write the names of any cells that makes the tissue. Limit yourself to the name of the "mature" cells (the names that end in "cyte"). Below is an example for "adipose" (Compare this with your instructor wants for adipose, before you write it down on Q3!!!!)

Adipocytes: fat-storage cells

Q11. ID the cells and matrix of Connective Tissue. Read all the instructions below before proceeding!

There is a wall chart in the lab entitled "Connective Tissues". If you are in the lab, go to the wall chart and, for each tissue present, identify the cells and the matrix (just by pointing). We have included a photo of this wall chart on the next page of this document for you to make notes, or use if the wall chart is tied up!

For some of the tissues, this will be difficult. Start with blood, which should be fairly easy. Then, try the cartilages, bone, and areolar. If you can't do it for reticular, dense regular, and elastic, do not worry; just ask your instructor for help later.

If you cannot identify the cells and matrix on one or more, ask your instructor for help in lab!!!!!

Please skip "embryonic"

WARNING: Be careful identifying the matrix of adipose tissue!
CONNECTIVE TISSUE

LOOSE or AREOolar. This tissue contains collagen (1), elastic (E), and reticulin fibers, as well as various cells in a gel-like matrix. It is found around organs, underneath the skin and muscle membranes, and around blood vessels. 1200 X.

ADIPose. This tissue contains large, rounded, spherical cells (adipocytes) that store fat in large vacuoles. Their nuclei are pushed to the edge of the cells. Found under skin, around organs, in subcutaneous and breast. 400 X.

RETICULAR. This tissue consists of a network of reticular fibers that form the framework for soft organs. Found in the skin, breast, and lymph nodes. 1200 X.

ELASTIC. This tissue has more elastic fibers (1) than collagenous fibers. Elastic fibers are found between cells. Present in walls of the aorta, trachea, esophagus, and bronchi. Shows is the wall of the human aorta. 1200 X.

DENSE or COLLAGENOUS (regular). Parallel collagenous fibers with sparse intercellular substances. Found in tendons, ligaments, and skin. 1200 X.

DENSE or COLLAGENOUS (irregular). This tissue has an irregular array of collagenous fibers, some elastic fibers, and reticulin. Found in tendons, subcutaneous of digestive tract, and fascia. 1200 X.

HYALINE CARTILAGE. This tissue is composed of collagenous fibers and chondrocytes (1) in lacunae (2). Found in cartilage of ribs, nose, trachea, and cartilage of hyaline cartilage. 1200 X.

ELASTIC CARTILAGE. This tissue is similar to hyaline cartilage. It has many chondrocytes (1) and elastic fibers and is normal cartilage. 1200 X.

FIBROCARTILAGE. This tissue contains collagenous fibers (1) but more than elastic fibers. Found in fibrocartilage. 1200 X.

BLOOD. This tissue consists of blood plasma and formed elements (cells, platelets). 400 X.

BONE. This tissue is composed of calcifying cells, collagenous fibers, and osteocytes. Haversian system is shown in human bone. 300 X.

EMBRYONIC (mesenchymal). This tissue is found primarily in the embryo and gives rise to all adult connective tissue. Shows mesenchymal cells (1) and fine fibers (2). 1200 X.
**Step 3.** Remembering important concepts from the muscle and nervous tissues videos

Q 12. What are the general functions of muscle tissues? (there is more than one answer, and more than one way to say it. Make sure you are focusing on what your instructor wants you to know)

Q 13. What are the general functions of nervous tissues? (there is more than one answer, and more than one way to say it. Make sure you are focusing on what your instructor wants you to know)

Q 14. Which types of muscle tissues do you need to ID on the microscope??

Q 15. What do we call muscle cells??

Q 16. Choose from the list below. Both Skeletal Muscle and Cardiac Muscle are _____________ muscle tissue.

   - Visceral
   - Voluntary
   - Non-contractile
   - Striated
   - Multi-nucleated with many nuclei

Q 17. Choose from the list below. Since they are both striated, I need to look for _____________ on cardiac tissue to tell them apart.

   - Nuclei
   - Intercalated Discs
   - Myofibrils
   - Z-lines

Q 18. Peristalsis is caused by which tissue?
Q 19. What do we call the nervous cells that transmit signals (or information)??

Q 20. Neurons have a lot of long projections coming off their body. These are called (choose one):
   - Dendrites
   - Soma
   - Myofibrils
   - Satellite cells
Step 4. Putting tissues in context: tissues versus tissue layers

This may be done later to save time in lab! If you are past the first hour, skip this until later, and go to STEP 5.

Have someone in your group read the following out loud, while the others read along:

Opening Paragraph (WE WILL BE REFERING TO THIS LATER):

The term 'Visceral organs' is not an exact term. It usually refers to the abdominopelvic and thoracic organs involved in Digestion, Reproduction, Respiration, Excretion.

Most visceral organs can be thought of as a tube. As a substance is moved through the tube, the tube either extracts stuff from the tube (absorption), or it puts substances into the tube (secretion, or excretion. We'll talk about the differences between those 2 terms later!).

The open area inside the tube is called the 'lumen'. It will be white...or at least very light in color. Sometimes there will be some debris in the lumen.

Surrounding the lumen are 'tissue layers', which are a collection of tissues, with a specific task. The exact nature of each "tissue layer" depends on the organ itself. Many (but not all) visceral organs have the tissue layers seen on the image below. Look at the layers in the image.

Not all visceral organs have these 4, but they are common. We'll see them in a lot of organs.

As mentioned, each 'tissue layer' has more than 1 tissue, and has a very important function. For example, if an organ has a mucosa, it is a wet layer that helps the organ absorb from the lumen & secrete into the lumen. The submucosa often contains blood vessels, so absorbed substances can be carried to the rest of the body, and glands for secreting. The muscularis helps move substances through the tube. The serosa covers the organ, helping to protect it and attaching the organ to other structures.
#2

Now answer the following questions:

Q21. What is the difference between saying "organ" and "visceral organ"? Which of the following are a "visceral organs"? Put a "check mark" next to the ones that are visceral organs. (HINT: the "Opening Paragraph" told you to consider which ORGAN SYSTEMS are involved):

- Small intestines
- Trachea and Lungs
- Esophagus & Stomach
- Bladder & Urethra
- Uterus & Vagina

Q22. Discuss in your group: Relate what we learned in the "opening paragraph" to the organs you checked above.

- Can they all be described "as a tube"?
- Do they move things?
- Do they secrete and or absorbed something?

*If you have questions about this, ask your instructor.*

Q23. The opening paragraph mentioned 4 commonly seen tissue layers found in many visceral organs. Name them, moving from the lumen outward, and write down their functions next to their name:

1.

2.

3.

4.

Q24. Answer these:

- Circle all of these that the small intestines might absorb into the bloodstream:
  - Bacteria
  - Nutrients in food
  - Water
  - Pollen

- Circle something the stomach might secrete into its lumen, using glands:
  - Digestive enzymes
  - Blood
  - Urine

- Circle something the uterus might move through its lumen, using muscular action:
  - Mucus
  - Baby
  - Urine

- Circle something the uterus might secrete into its lumen, using glands:
  - Mucus
  - Baby
  - Sperm
Q25. Which can be thought of as a "mini-organ", a tissue or a tissue layer? WHY??
(HINT: the "Opening Paragraph" told you the difference between the two!)

We just got done looking at epithelial tissues in lab. Where might we find them? Well, all the tissue layers may have some epithelial tissues. But they are especially visually obvious in the mucosal layer, where it is often stratified squamous (for protection) or columnar (for absorption & secretion), and the submucosa, where we'll see a lot of glands.

Look at the image below, going through the numbered steps (first "1", then "2"):

Places on a typical visceral organ, where epithelial tissues are often visually easy to see:

1. mucosa has a lot of epithelial tissues
2. submucosa has a lot of epithelial tissues, especially in glands

#4 Now answer the following questions:
Q26. Label the following on the image below. While doing this, indicate “a layer” by highlighting its boundaries:

Lumen
Mucosa
Submucosa
Muscularis
Serosa

Q27. Below is a crude drawing of what we saw in the last question. Label the following on the image below:

Lumen
Mucosa
Submucosa
Muscularis
Serosa
Apical surface
(draw a line over it....more or less)
Basement Membrane
(draw a line over it....more or less)

Q28. On the drawing, indicate where we might find the following, by placing the number in the correct layer:

1. Columnar cells that are absorbing
2. Goblet cells secreting mucus
3. Glands secreting into the lumen
4. Stratified squamous cells protecting against bacteria in the lumen
5. Muscle tissue moving substances through the lumen
Q29. Below is a close up of the same organ. Compare it to the images on the previous 2 pages. Label the following on the image below. While doing this, indicate "a layer" by highlighting its boundaries:

Lumen
Mucosa
Submucosa
Muscularis
Serosa

Apical surface (draw a line over it....more or less)

Basement Membrane (draw a line over it....more or less)

ALSO:
On the drawing, indicate where we might find the following, by placing the number in the correct layer:

1. Columnar cells that are absorbing
2. Goblet cells secreting mucus
3. Glands secreting into the lumen
4. Stratified squamousal cells protecting against bacteria in the lumen
5. Muscle tissue moving substances through the lumen
Q30. The images in the boxes labeled "A through H" are close-ups of the "visceral organ" photo near the bottom. They are at various powers. Can you determine where they come from, MORE OR LESS, on the photo of the visceral tube? Try drawing a box on the tube where you think they might go.

For example, this image: would go in the box marked "A" on the photo.
Step 5. Tissue ID Microscope Stations

There are several microscopes set up in the room. Each has a tissue slide.

You do not have to do the stations in order; if someone is at a station, go to another.

PLEASE NOTE: some of the stations are meant to be studied together!!

For each, make a drawing of the tissue, note which power you are looking at. Come up with a descriptor term for each ("it reminds me of donuts", "it looks like clouds", etc.)

Make a note regarding location. You can use the answers you made to earlier questions. This way, you'll have a study guide for the Lab Practical in one place!

Jot down any important info your instructor wants you to know, including cell names.
**Stations 1 & 2:** these 2 tissues should be studied together!

<table>
<thead>
<tr>
<th>Tissue Type</th>
<th>Station 1</th>
<th>Station 2</th>
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<tbody>
<tr>
<td>General Tissue Classification:</td>
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<tr>
<td>Descriptor Term:</td>
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<td></td>
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<tr>
<td>Write down some representative locations for this tissue</td>
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<tr>
<td>Drawing box</td>
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**SPECIAL QUESTION:** name the structures where both these tissues are found. What do these cells do (absorb, secrete, transmit info, cause movement, connect, protect, store energy, other??)
Stations 3 & 4 - look at 2 tissues that are in different classes

<table>
<thead>
<tr>
<th>Tissue Type</th>
<th>Station 3</th>
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SPECIAL QUESTION: What sort of connective tissue is station 4? Loose, or dense?
<table>
<thead>
<tr>
<th>Tissue Type</th>
<th>Station 5</th>
<th>Station 6</th>
</tr>
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<tbody>
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</table>

**SPECIAL QUESTION:** Go to a higher power on both slides (go back to original power for the next group). Can you see the cell nuclei on station 5? Now go back to the lower power, and re-examine.
### Stations 7 & 8 - compare 2 tissues that are sometimes confused

<table>
<thead>
<tr>
<th>Tissue Type</th>
<th>Station 7</th>
<th>Station 8</th>
</tr>
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**SPECIAL QUESTION:** pseudostratified columnar will have ____________ on the apical surface. We often see a __________ border on simple columnar's apical surface. Both types may exhibit __________ cells dispersed throughout.
Stations 9 & 10 - compare 2 tissues that are sometimes confused

You will also be using # 10 on the next page!

<table>
<thead>
<tr>
<th>Tissue Type</th>
<th>Station 9</th>
<th>Station 10</th>
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<td></td>
</tr>
<tr>
<td>Descriptor Term:</td>
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</tbody>
</table>

Write down some representative locations for this tissue

Write down any extra information your instructor wants you to know, including cell names, special proteins, other key words, etc.

Drawing box

SPECIAL QUESTION: Both these tissue types have visible ____________ in the cytoplasm. But cardiac tissue also has _________________ discs.
**Stations 10 & 11 - compare 2 tissues that are sometimes confused**

Notice that the slide at station 10 looks similar to that on Station 11.

In fact, the slide at Station 11 has BOTH tissues on. Find a place on the slide where there are both. Can you see striations?

<table>
<thead>
<tr>
<th>Tissue Type</th>
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<tr>
<td>General Tissue Classification:</td>
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<tr>
<td>Power:</td>
<td></td>
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<tr>
<td>Descriptor Term:</td>
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</tbody>
</table>

Write down some representative locations for this tissue

Write down any extra information your instructor wants you to know, including cell names, special proteins, other key words, etc.

| Drawing box | |

**SPECIAL QUESTION:** Why does this slide have both tissues? What organ is it taken from that would have both?
**Stations 12 & 13 - look at 2 tissues that are in different classes**

The pointer on Station #13 indicated the tissue you are interested in. What other tissue types are visible on slide 13? Label them in your drawing below.

<table>
<thead>
<tr>
<th>Tissue Type</th>
<th>Station 12</th>
<th>Station 13</th>
</tr>
</thead>
<tbody>
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</table>

Write down some representative locations for this tissue

Write down any extra information your instructor wants you to know, including cell names, special proteins, other key words, etc.

Drawing box

**SPECIAL QUESTION:** To tell connective and epithelial tissues apart, it is always good to look for the lumen. Can you find the lumen on both slides? Label it on your drawings.
Stations 14 & 15 - look at 2 tissues that cannot be confused with any other

<table>
<thead>
<tr>
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<th>Station 14</th>
<th>Station 15</th>
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SPECIAL QUESTION: Make sure you name all the parts of the bone slide your instructor wants you to know!
Demo Station at the front of the room -

There are 5 slides.

First slide: Small intestine @ low power
Find the lumen, mucosa, submucosa, muscularis externa, and serosa

Second slide: Small intestine
What special cell is indicated by the pointer?

Third slide: Cardiac muscle
What special structure is indicated by the pointer?

Fourth and Fifth slide: Hyaline cartilage & compact bone.
What special structure is indicated by the pointer?
Step 6. Muscle Tissue and Neuron Models

There are 4 models in the room. We will be looking at all 3 in more detail in later labs. For right now:

1. be able to ID them.
2. Find the striations on cardiac and skeletal muscle models.
3. Find the intercalated discs on the cardiac model.
4. Find the body, dendrites, and axon on the neuron model.

The End!