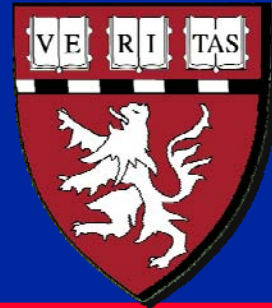


**Massachusetts Institute of Technology
Harvard Medical School
Brigham and Women's Hospital
VA Boston Healthcare System**



2.79J/3.96J/20.441/HST522J

TISSUE TYPES

M. Spector, Ph.D.

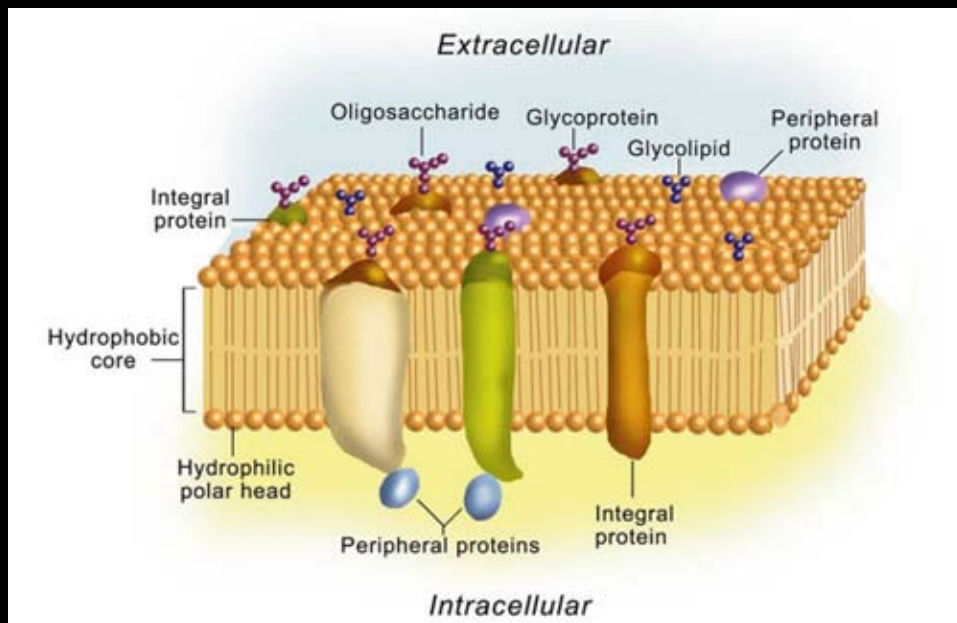
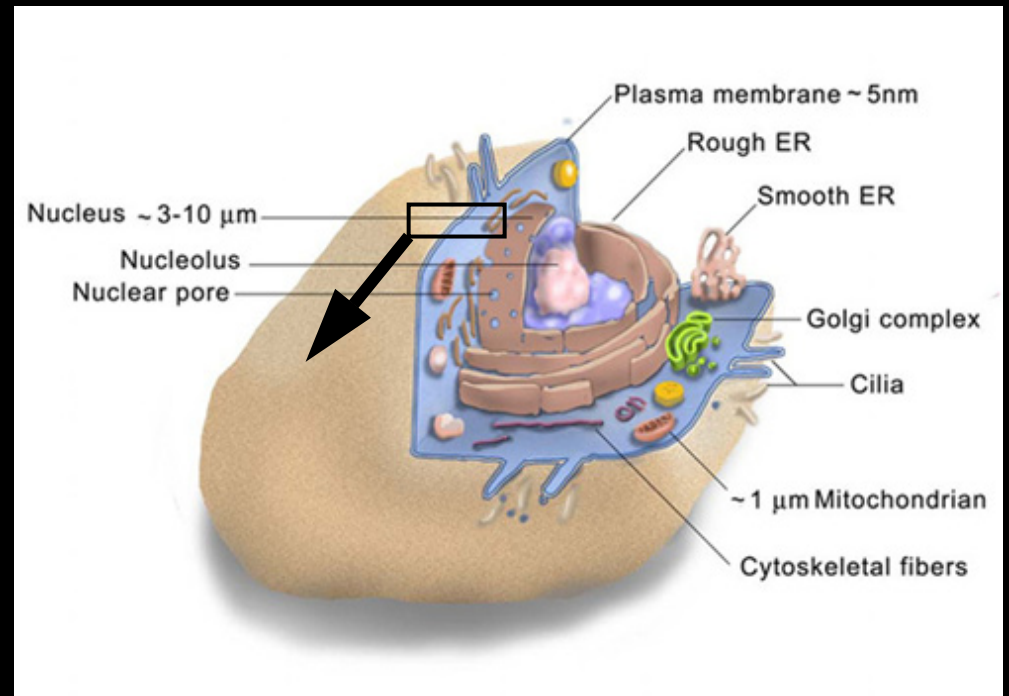
DEFINITIONS

On-line Medical Dictionaries

<http://cancerweb.ncl.ac.uk/omd/>

<http://medical-dictionary.thefreedictionary.com/>

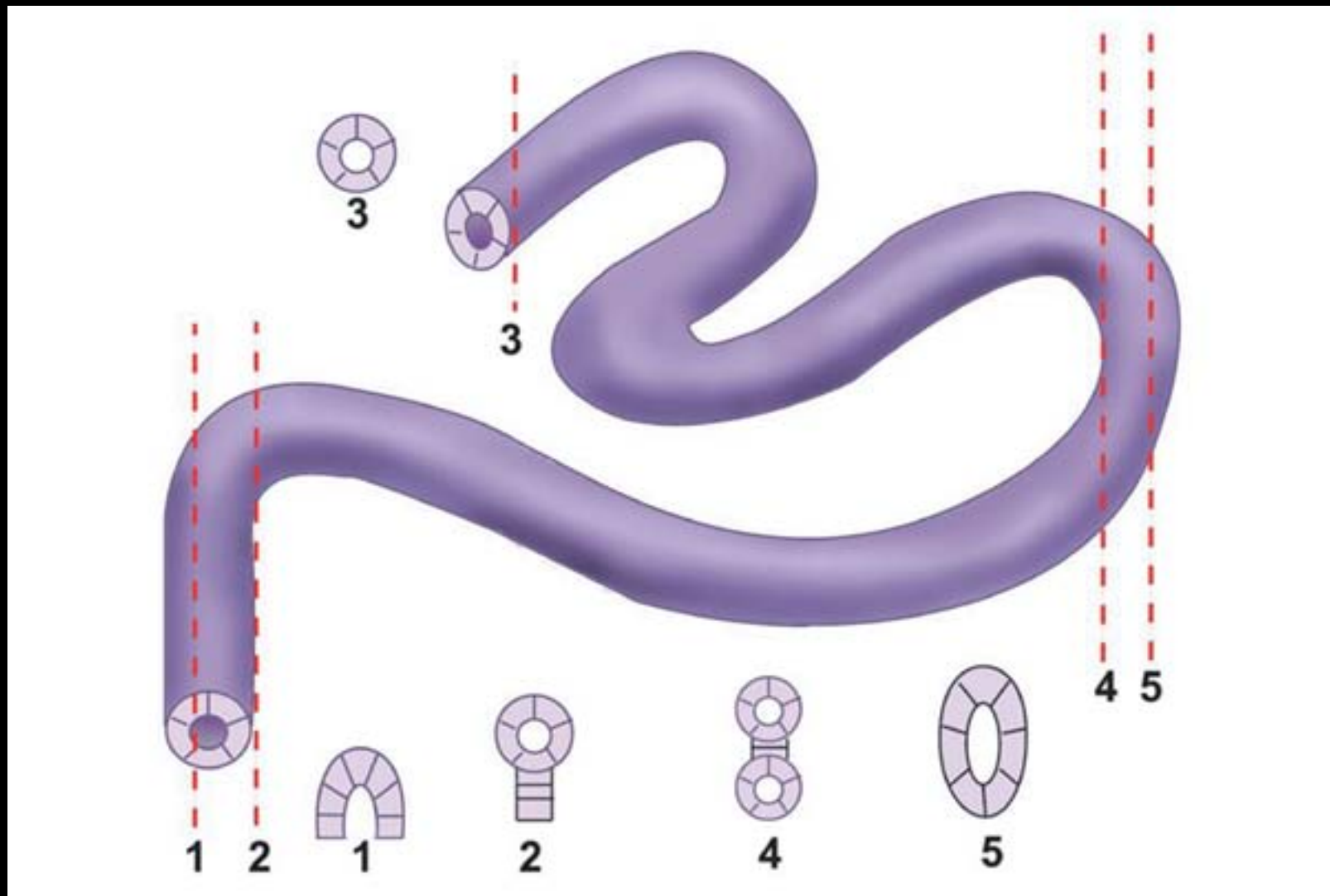
The Cell and Its Membrane Molecules



Figures by MIT OpenCourseWare.

Viewing Histological Sections

Effects of the Plane of Sectioning



TISSUE CLASSIFICATION

Connective Tissue

Epithelia

Muscle

Nerve

TISSUE CLASSIFICATION

Connective Tissue

**Extracellular matrix
continuous; and in some
tissues also cell continuous**

Epithelia

Muscle

Nerve

**Cell continuous
Muscle and nerve cells are
surrounded by a basal lamina
Basal epithelial cells are
attached to a basement
membrane
Basal lamina=basement
membrane**

BASEMENT MEMBRANE

Continuous sheet, 50-300 nm thick

No cells contained within the BM; it is a nonliving structure

Principal protein constituents

Laminin

Type IV collagen

Type XVIII collagen

Basement Membrane

Diagram removed due to copyright restrictions.

Image removed due to copyright restrictions.
Diagrams of muscle, epithelial sheet, and
kidney glomerulus structures.

Scanning Electron Micrograph of the Cornea of a Chick Embryo

E: Epithelial cells
BL: Basal lamina
C: Collagen fibrils in
the underlying CT

Photo removed due to copyright restrictions.

Connective Tissue

Image removed due to copyright restrictions.

Sketches from Illustrated Physiology, AB McNaught
and R Callander, Williams and Wilkins, 1967

Connective Tissues

Image removed due to copyright restrictions.
See <http://cal.vet.upenn.edu/projects/histo/Index.htm>

Loose and dense connective tissue from a cow's planum.

Loose Connective Tissue

Dense Connective Tissue

Images removed due to copyright restrictions.

Connective Tissue: Adipose Tissue (Fat)

Images removed due to copyright restrictions.

Connective Tissue: Bone

Image removed due to copyright restrictions.

Connective Tissue: Cartilage

Hyaline Cartilage: Trachea

Elastic Cartilage: Epiglottis

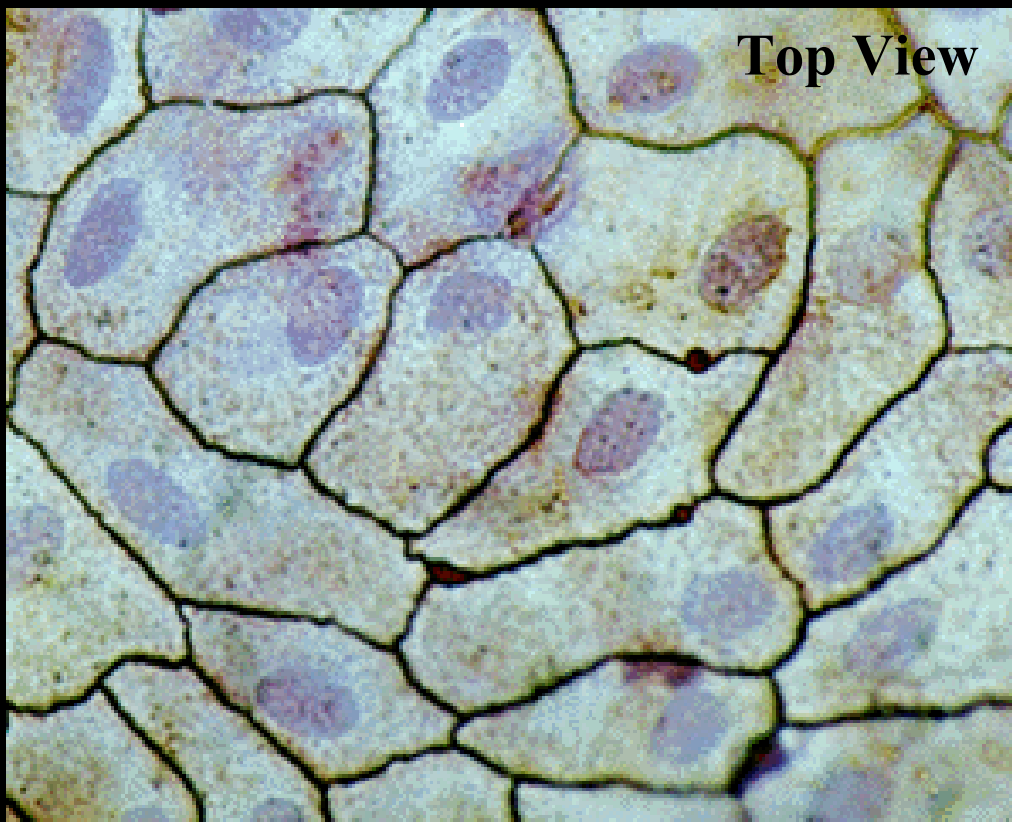
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See <http://cal.vet.upenn.edu/projects/histo/Index.htm>

Fibrocartilage

Cartilage identification is principally based on morphology; rounded cells in a lacuna; ECM is type I collagen (fibrocartilage) or type II cartilage (hyaline), with (elastic) or without elastin.

Simple Squamous Epithelium

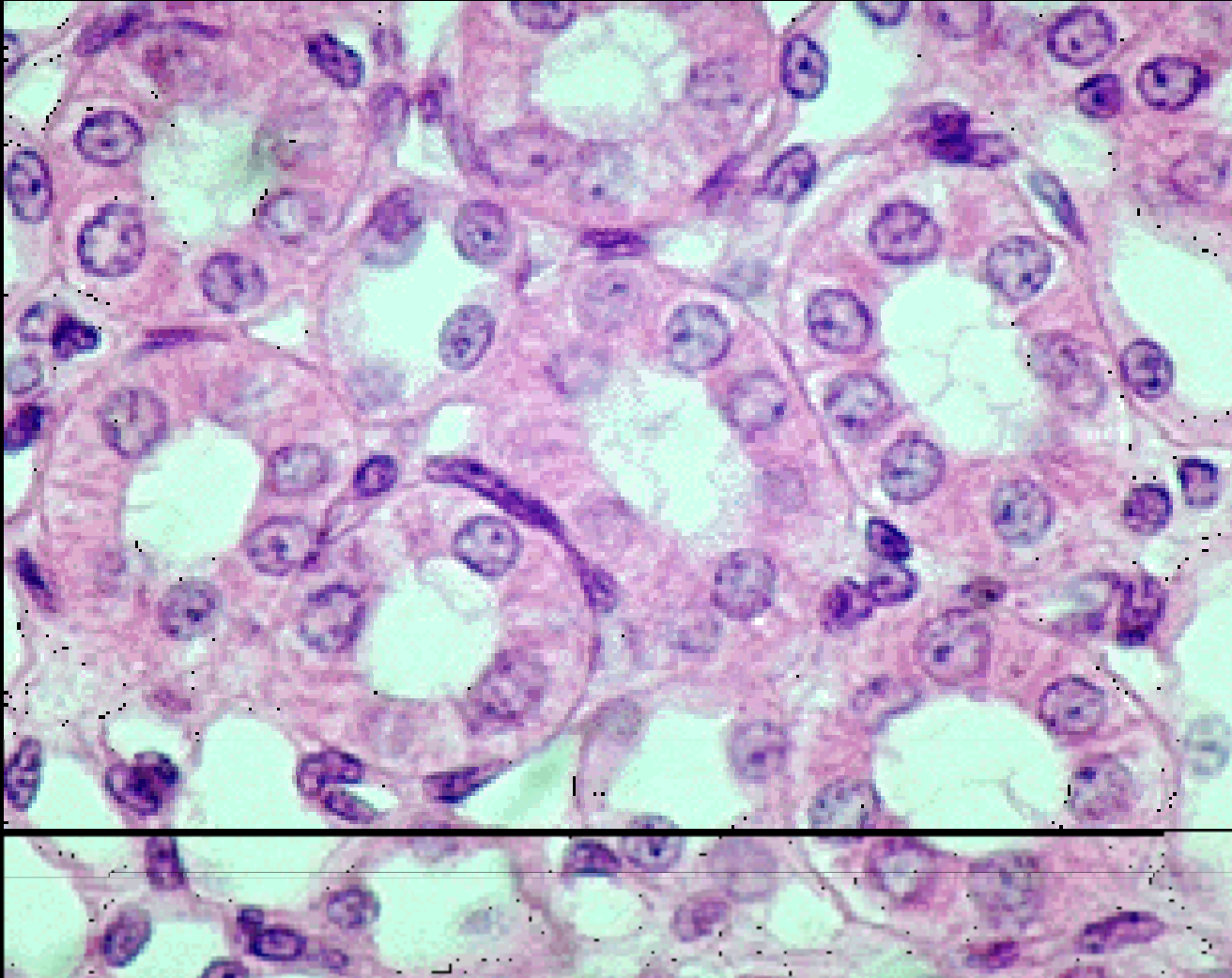
(chick blastodisc at about 33 hours of incubation)



Simple squamous epithelium, which generally occurs as a thin sheet-like layer allowing for minimal resistance to diffusion, is also been called "pavement" epithelium, because it can look like like paving stones as seen from above. Examples include the linings of the peritoneal, pleural and pericardial cavities. Other places simple squamous epithelium can be found include: the glomerulus of the kidney, the walls of capillaries, and the alveoli of the lungs.

Simple Cuboidal Epithelium

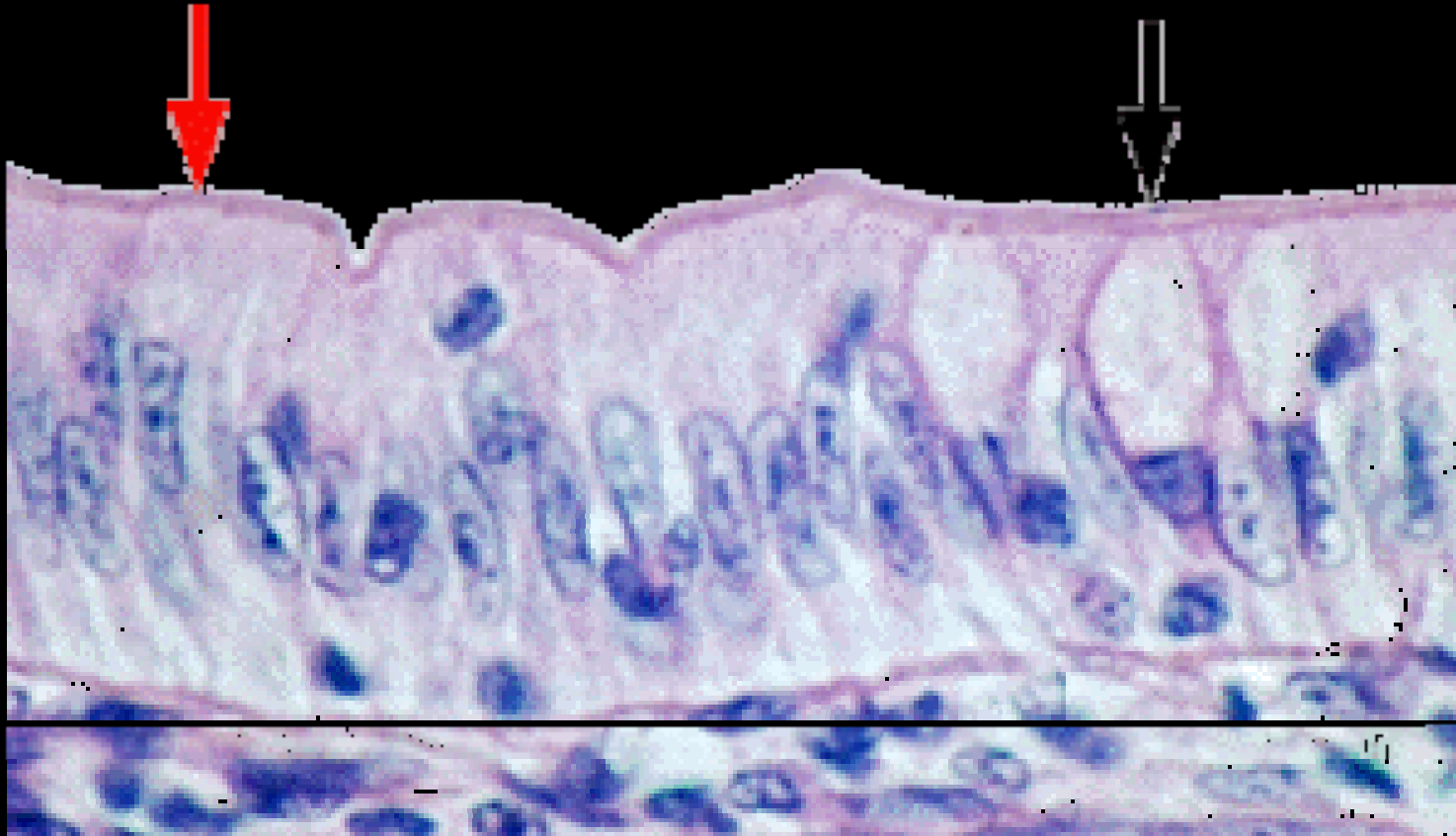
(collecting ducts in the medulla of a mammalian kidney)



This type of epithelium is thicker than simple squamous epithelium, so it does not allow for passive diffusion as readily.

Simple Columnar Epithelium

(small intestine)



Since columnar cells are quite thick, they do not readily allow passive diffusion. As a result, these cells use active transport to move nutrients through them from the intestine to the blood. This is what we commonly call "absorption." To help with this, they have numerous microvilli on their apical (luminal) surface, which increases their surface area to allow for greater absorption.

Simple Columnar Epithelium

Image removed due to copyright considerations.
See <http://cal.vet.upenn.edu/projects/histo/Index.htm>

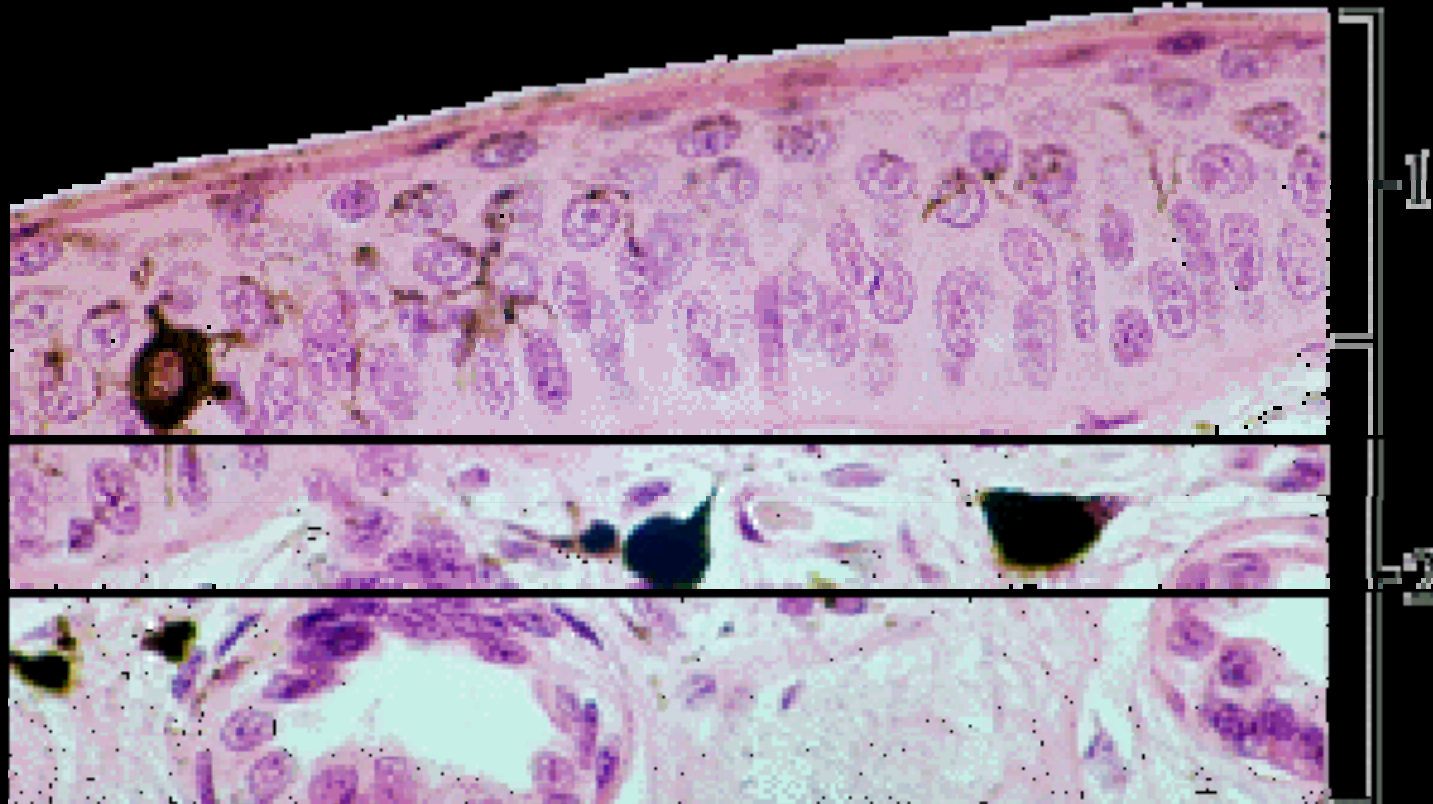
This is a section through the edge of a gallbladder. There is a layer of simple columnar epithelium overlying the connective tissue as indicated by the arrows.

Stratified Squamous Epithelium

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See <http://cal.vet.upenn.edu/projects/histo/Index.htm>

This is an example of stratified squamous epithelium from the esophagus of a cat. Arrows show nuclei of the outermost layer. This is normal for mucosa. Most stratified squamous cells in other areas, such as skin, lose their nuclei by the time they approach the outermost layers.

Stratified Squamous Epithelium (epidermis)



The cells of the basal layer of the epidermis (closest to the dermis) are cuboidal to columnar in shape. These cells are actively mitotic, producing new cells that get pushed upward into the overlying layers. As these cells are pushed up, they become flatter and longer taking on the typical squamous shape. When the cells reach the top, they are sloughed off and replaced by cells from below. The dermis which underlies the epidermis is composed of a dense, irregular connective tissue, which we will see again later.

Pseudostratified Columnar Epithelium

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See <http://cal.vet.upenn.edu/projects/histo/Index.htm>

This is an example of ciliated pseudostratified columnar epithelium from the trachea. The arrows indicate the layer of cilia on the surface of the pseudostratified columnar cell layer.

Intestinal Epithelium

Photos removed due to copyright restrictions.

BM: basement membrane

Lu: lumen

Cp: capillary

Co: collagen fibrils

SM: smooth muscle cell

M: mitochondria

NF: nerve fibers

**KR Porter & MA Bonneville, Fine
Structure of Cells and Tissues (1973)**

Ciliated Epithelium

Photo removed due to copyright restrictions.

C: cilia
SER: vesicles
F: fibroblasts
El: elastic fibers

**KR Porter & MA Bonneville, Fine
Structure of Cells and Tissues (1973)**

Convolutd Tubule of the Kidney: Epithelium

Photo removed due to copyright restrictions.

**KR Porter & MA Bonneville, Fine
Structure of Cells and Tissues (1973)**

SEM of the Kidney

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Kidney: Epithelium

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US: urinary space

**KR Porter & MA Bonneville, Fine
Structure of Cells and Tissues (1973)**

Transmission Electron Micrograph of a Rat Kidney Glomerulus

Photo removed due to copyright restrictions.

**From R Kessel and R. Kardon,
Tiss and Org, p.233 (1979)**

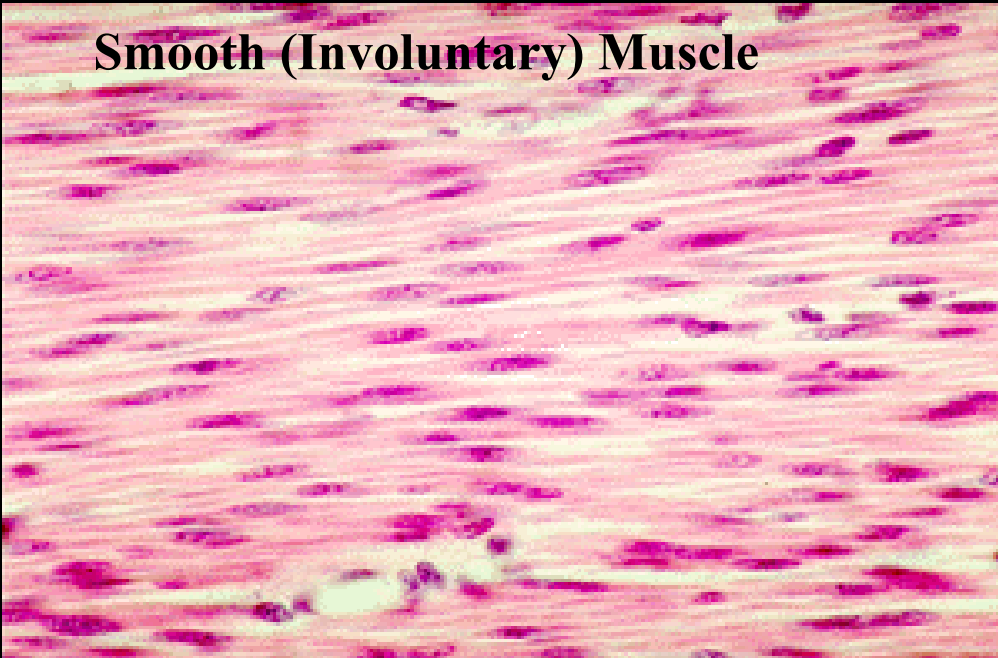
Muscle

Drawings removed due to copyright restrictions.

1. Smooth muscle
2. Cardiac muscle
3. Voluntary muscle fiber.

Muscle

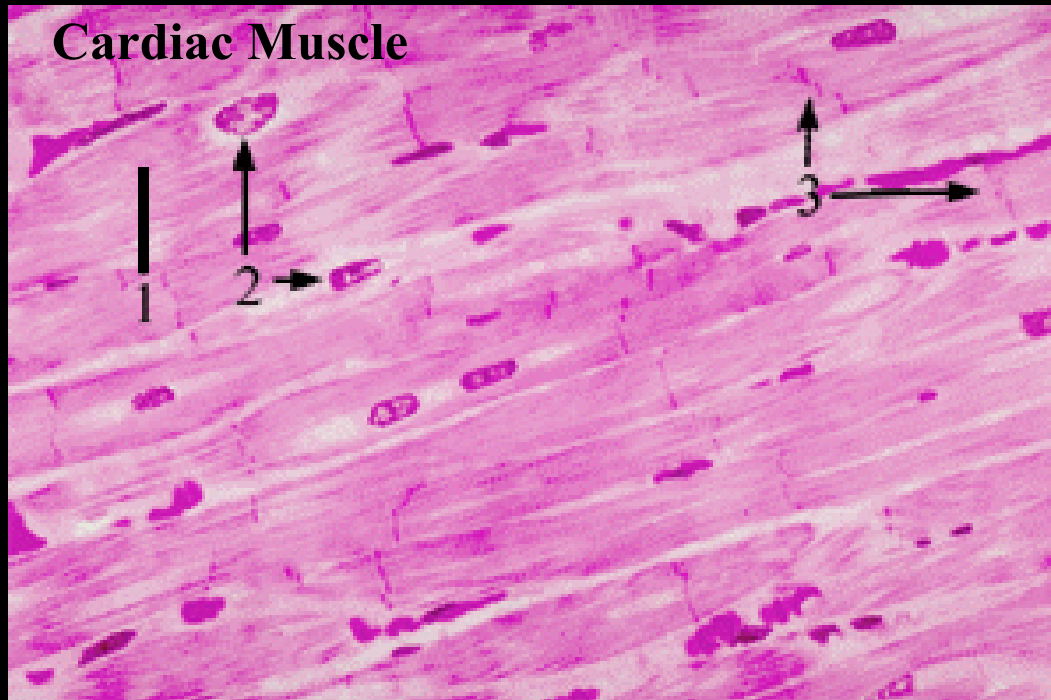
Smooth (Involuntary) Muscle



Striated (Skeletal; Voluntary) Muscle



Cardiac Muscle



Cardiac Muscle

Photo removed due to copyright restrictions.

SC: Schwann cell
CT: connective tissue

**KR Porter & MA Bonneville, Fine
Structure of Cells and Tissues (1973)**

Nerve

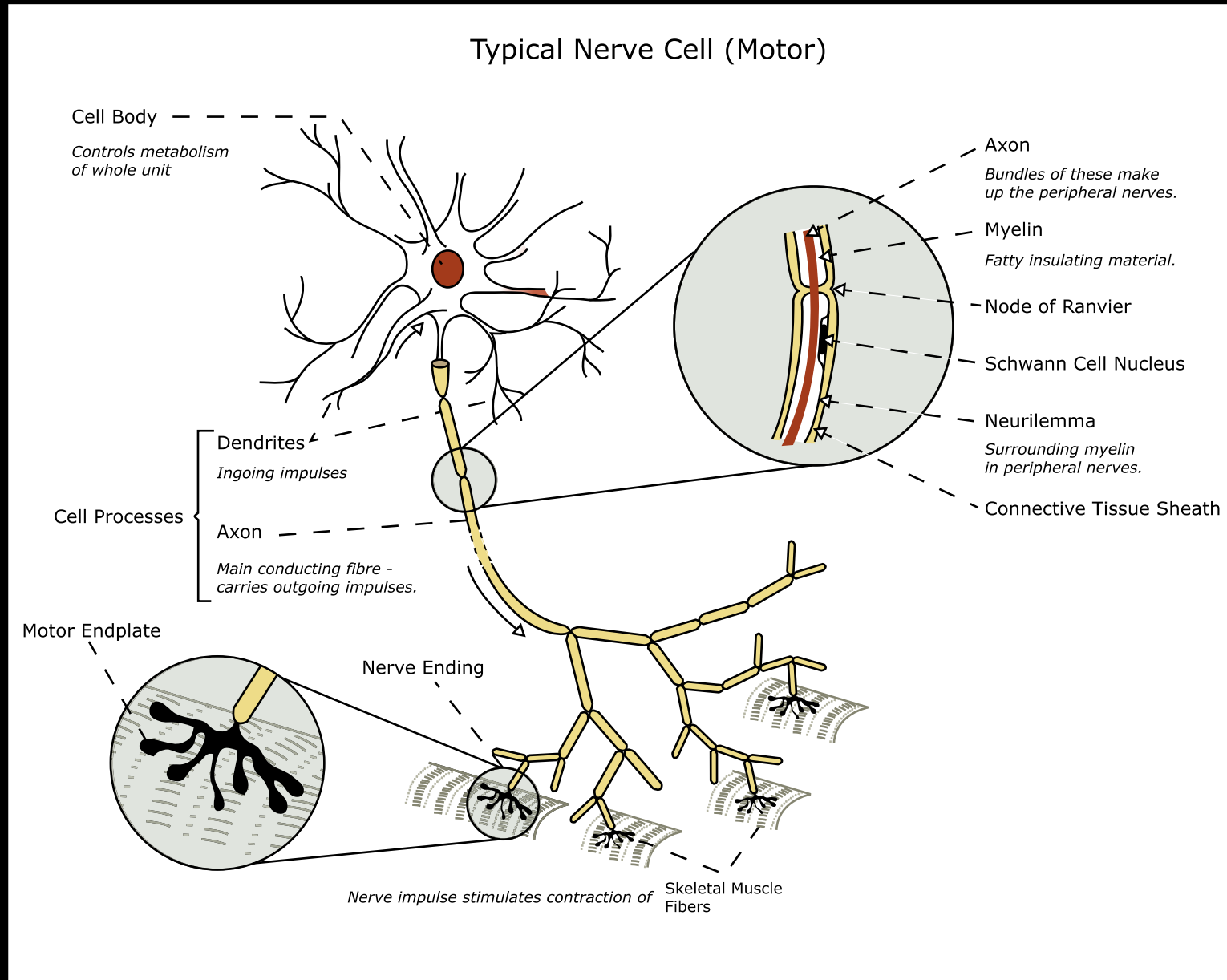
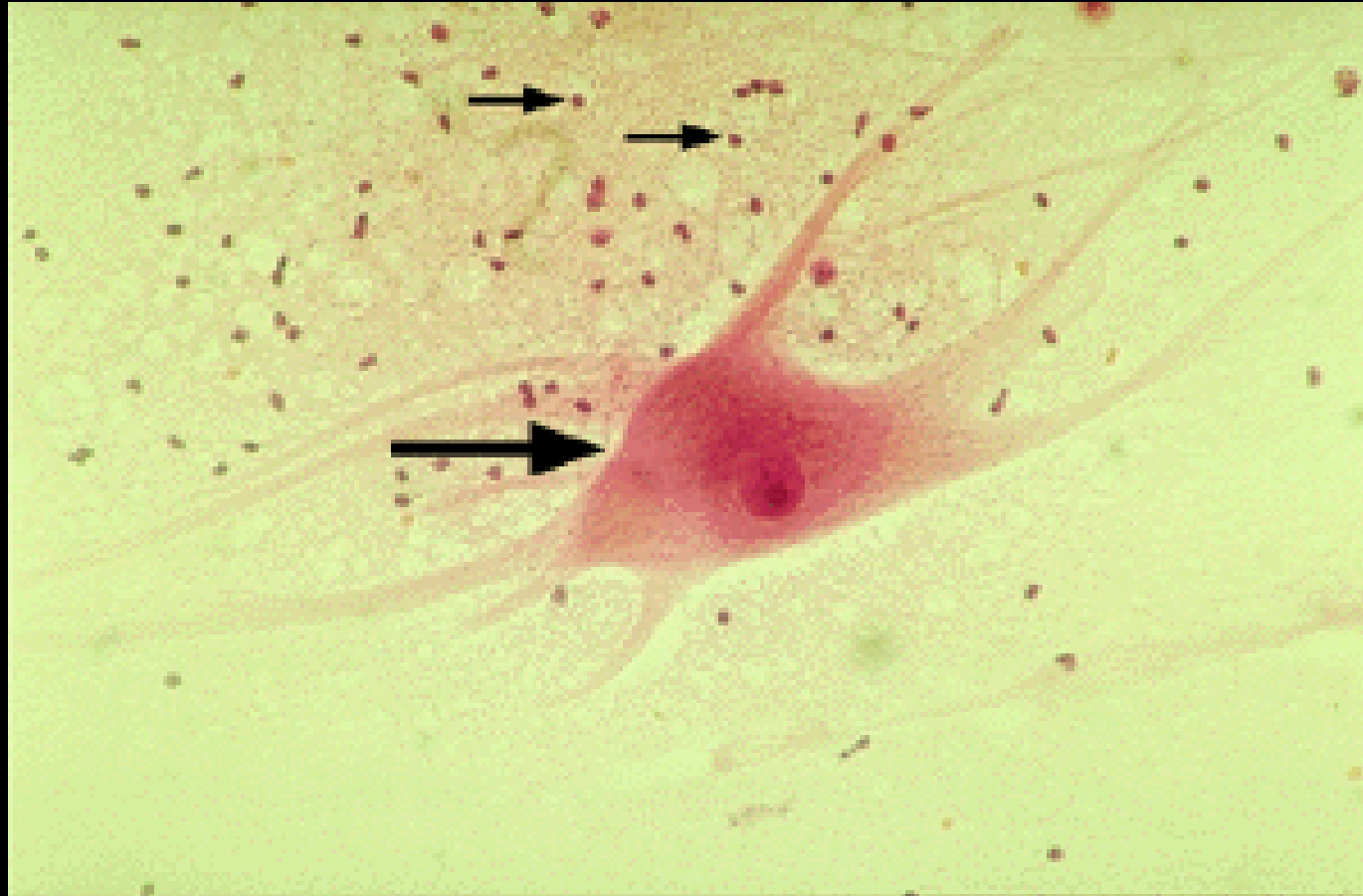


Figure by MIT OpenCourseWare. After McNaught and Callander, Illustrated Physiology, Williams and Wilkins, 1967.

Nerve



An isolated nerve cell - neuron (large arrow) - from a mammalian spinal cord showing and the nuclei of the surrounding neuroglial cells (small arrows). Note the numerous cytoplasmic extensions emanating from the neuronal cell body and the size of the neuron compared with the neuroglial cells.

Peripheral Nerve: Rat Sciatic

Photo removed due to copyright restrictions.

Molecular Cell Biology,
J Darnell, *et al.*, 1990

Nerve

Image removed due to copyright considerations.
See <http://cal.vet.upenn.edu/projects/histo/Index.htm>

This is a myelinated nerve from the thoracic wall. A indicates the myelin sheath around the actual nerve fibers (B).

Peripheral Nerve

Photo removed due to copyright restrictions.

**KR Porter & MA Bonneville, Fine
Structure of Cells and Tissues (1973)**

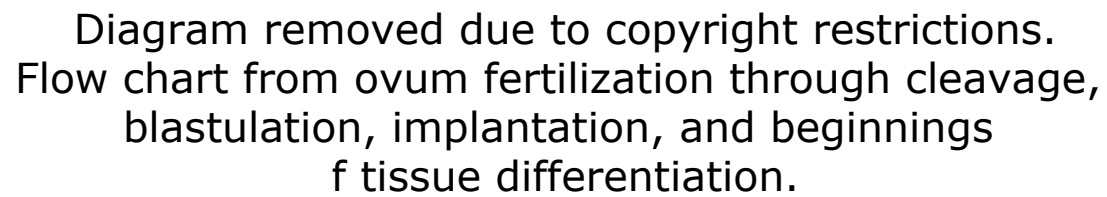


Diagram removed due to copyright restrictions.
Flow chart from ovum fertilization through cleavage,
blastulation, implantation, and beginnings
f tissue differentiation.



Embryonic Stem Cells

Embryonic Germ Disc

- **Ectoderm** becomes:
 - Epithelia of *external* surfaces
 - Nervous system tissues
- **Mesoderm** becomes:
 - Muscular tissues
 - Connective tissues
 - Urogenital system
 - Lining of body cavities and blood vessels
- **Endoderm** becomes:
 - Epithelia of most *internal* surfaces
 - Some glands (e.g. thyroid, pancreas, liver)

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20.441J / 2.79J / 3.96J / HST.522J Biomaterials-Tissue Interactions
Fall 2009

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