

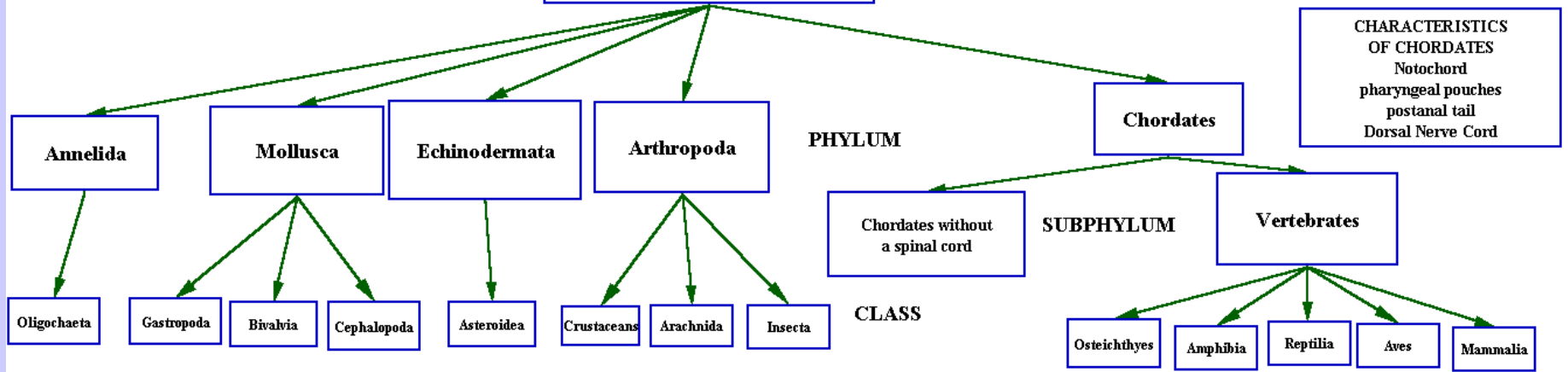
# Frog Dissection



# INVERTEBRATES

# ANIMALIA KINGDOM

# VERTEBRATES



**CHARACTERISTICS OF CHORDATES**  
Notochord  
pharyngeal pouches  
postanal tail  
Dorsal Nerve Cord

**CHARACTERISTICS OF VERTEBRATES**  
Chordate characteristics PLUS  
Bones or cartilage surrounding dorsal nerve cord (vertebrae)  
Cranium (skull) to protect brain  
Endoskeleton made of bone or cartilage  
Closed circulatory system  
Ventral heart

**JAWLESS  
FISH**

**BONY  
FISH**

**CARTILAGENOUS  
FISH**

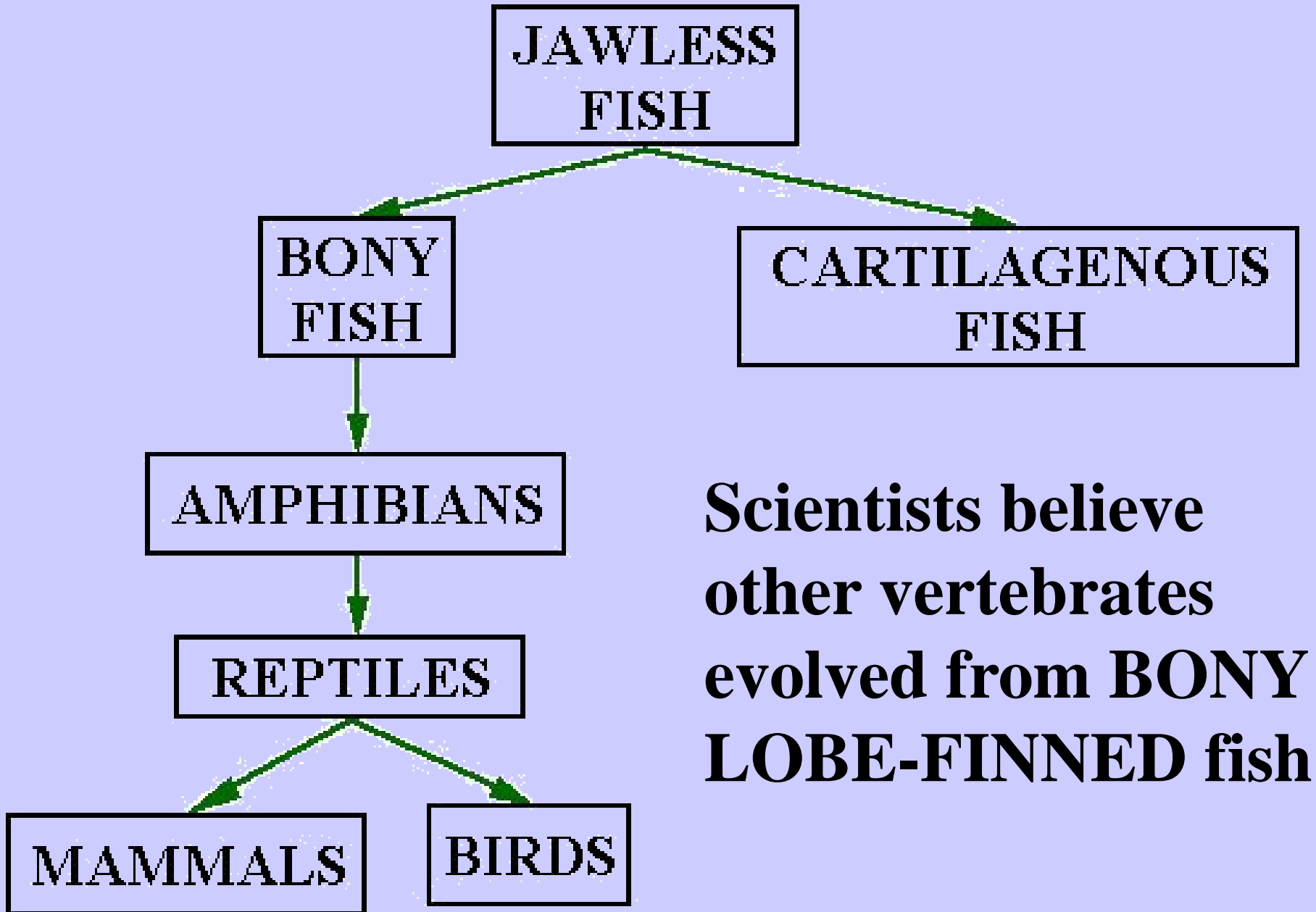
**AMPHIBIANS**

**REPTILES**

**MAMMALS**

**BIRDS**

**Scientists believe  
other vertebrates  
evolved from BONY  
LOBE-FINNED fish**



# TURNING TETRAPOD

The evolution of terrestrial tetrapods from aquatic lobe-finned fish involved a radical transformation of the skeleton. Among other changes, the pectoral and pelvic fins became limbs with feet and toes, the vertebrae became interlocking, and

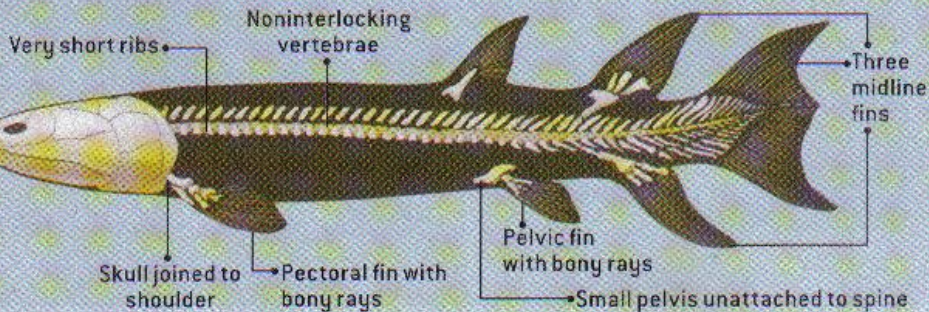
the tail fin disappeared, as did a series of bones that joined the head to the shoulder girdle (*skeletons*). Meanwhile the snout elongated and the bones that covered the gills and throat were lost (*skulls*).

## EUSTHENOPTERON

A lobe-finned fish

Short snout with many bones

Opercular bones covering gills and throat

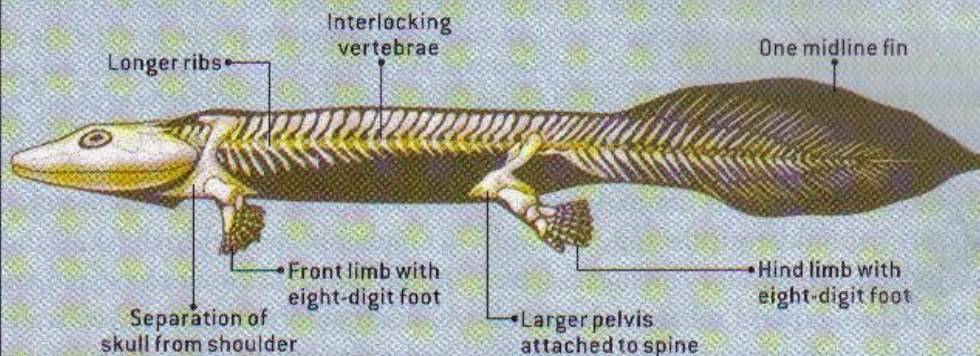


## ACANTHOSTEGA

An early tetrapod

Longer snout with fewer bones

Absence of opercular bones

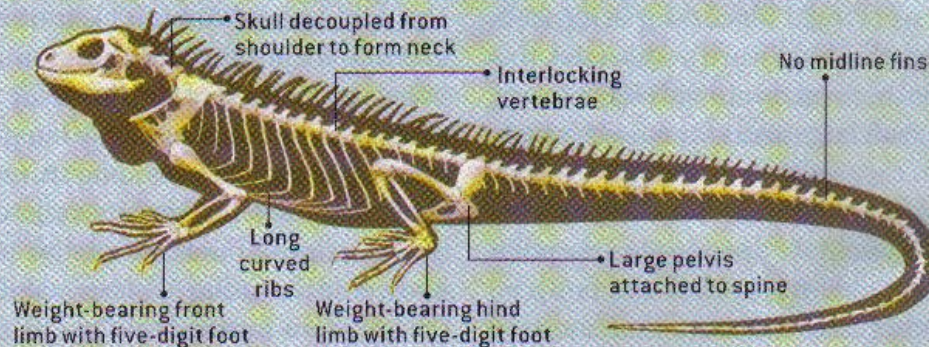
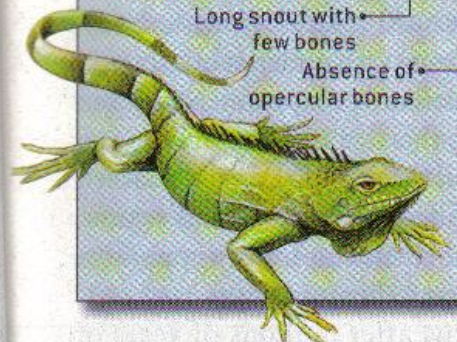


## IGUANIA

A modern iguana

Long snout with few bones

Absence of opercular bones



# TIK-TAALIK

## Intermediate between fish and early tetrapods



- **Fins have basic wrist bones and simple fingers**
- **Earliest fish with a neck**
- **Discovered by Neil Shubin and Ted Daeschler in 2004**

# **AMPHIBIAN CHARACTERISTICS**

**Moist, thin skin without scales**

**Aquatic larva changes to terrestrial adult**

**Feet without claws**

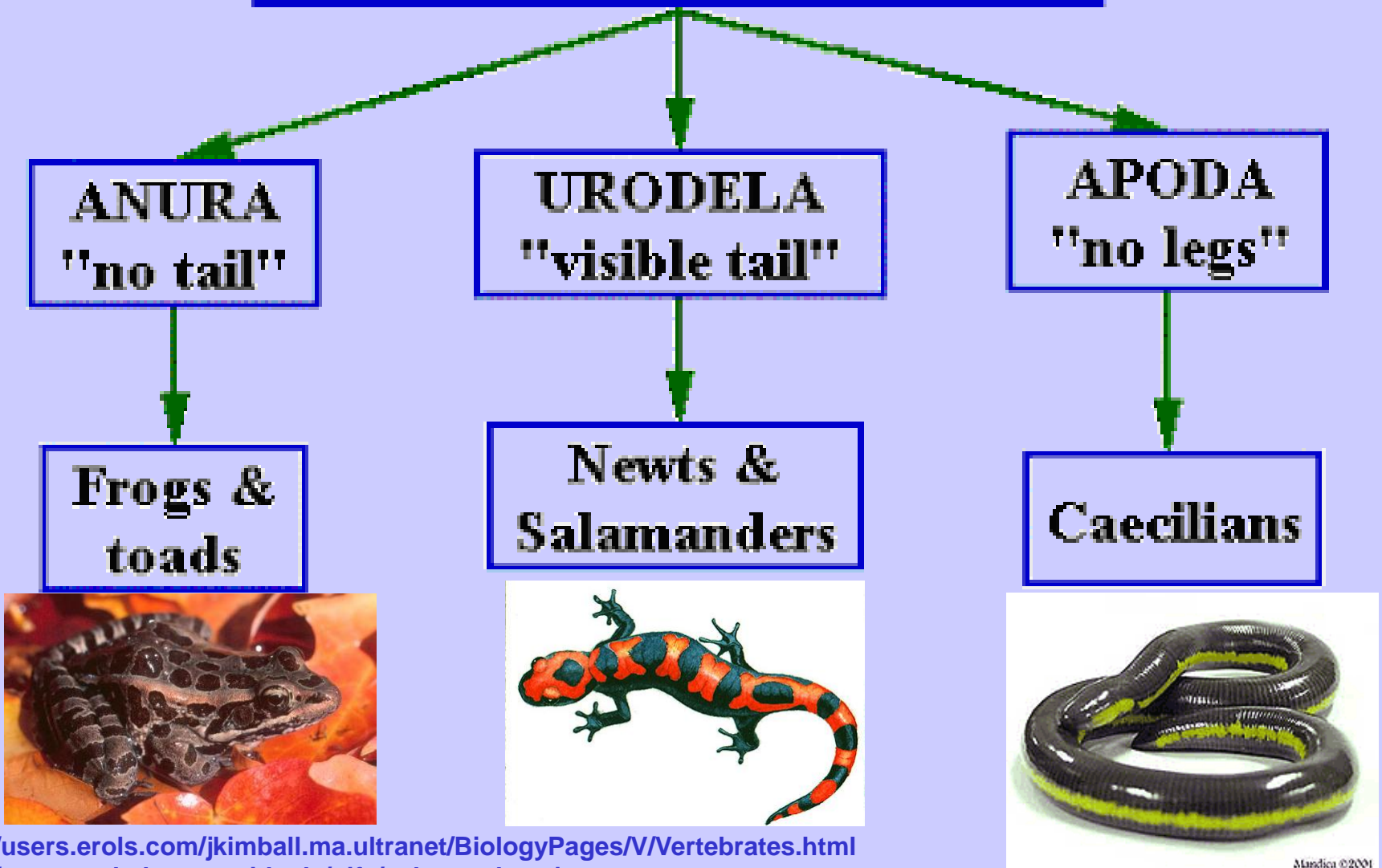
**Respiration with gills, lungs, skin, mouth**

**Closed 2 loop circulation**

**Ectothermic (cold blooded)**

**Eggs without shells or multicellular membranes**

# AMPHIBIANS



# FROG

**LATIN meaning**

**KINGDOM** ANIMALIA

**PHYLUM** CHORDATA

**SUBPHYLUM** VERTEBRATA “backbone”

**CLASS** AMPHIBIA “double life”

**ORDER** ANURA “without a tail”



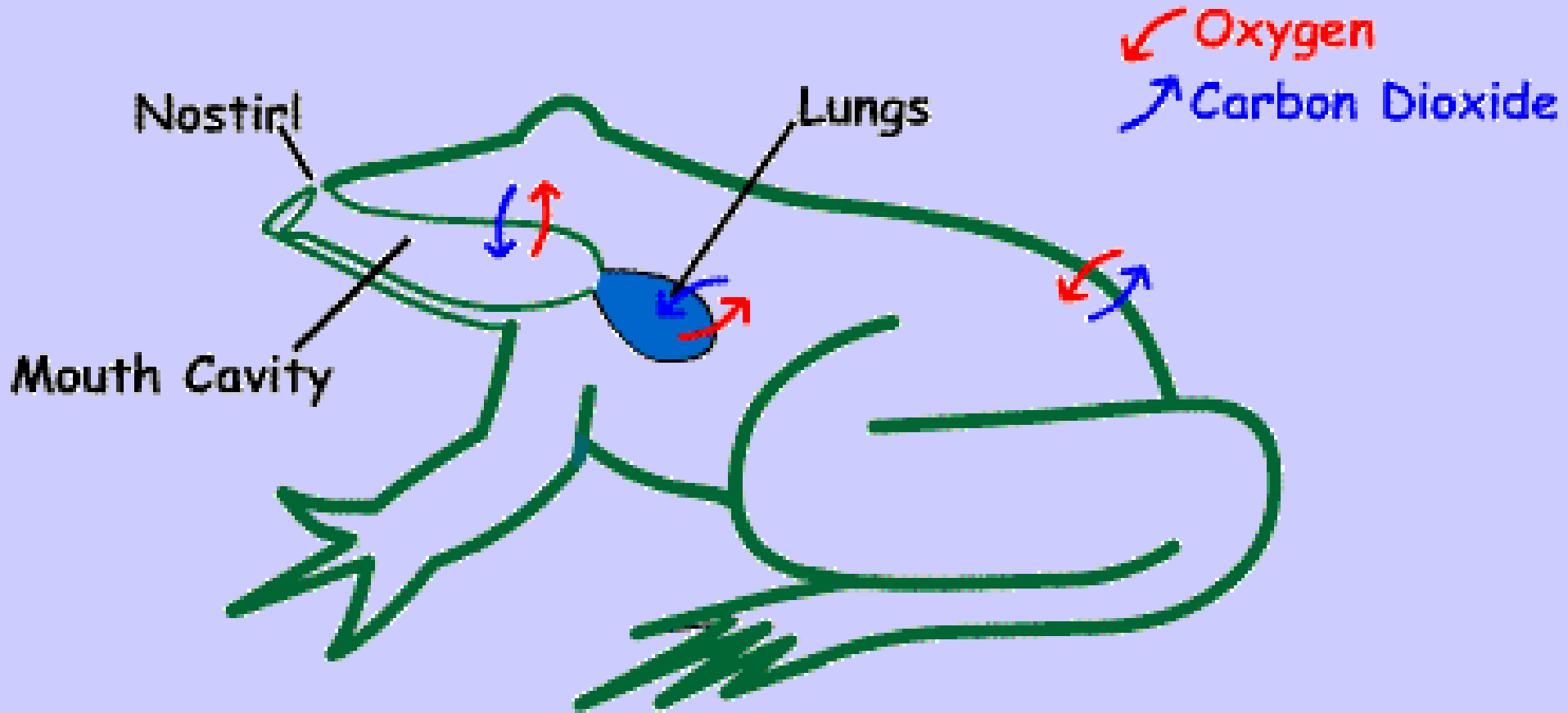
**Thin, moist skin – no scales**

**Mucous glands make it  
“slimy”**

**Camouflage- for protection**

**Some have poison glands**



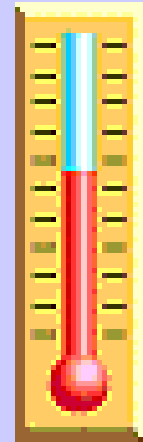


**BREATHING THROUGH SKIN is called  
CUTANEOUS RESPIRATION**

# ECTOTHERMIC

## “cold blooded”

**Body temperature is dependent on surrounding environment**



# HIBERNATION/ ESTIVATION



**FAT stored in FAT BODIES provides energy**

Images from:

[http://www.enc.org/Classroom\\_Calendar/CC\\_Units/Unit\\_Images/185.jpg](http://www.enc.org/Classroom_Calendar/CC_Units/Unit_Images/185.jpg)

<http://www.reptilis.org/pyxi/image5.htm>

# Nictitating membrane (3<sup>rd</sup> eyelid) "swim goggles"



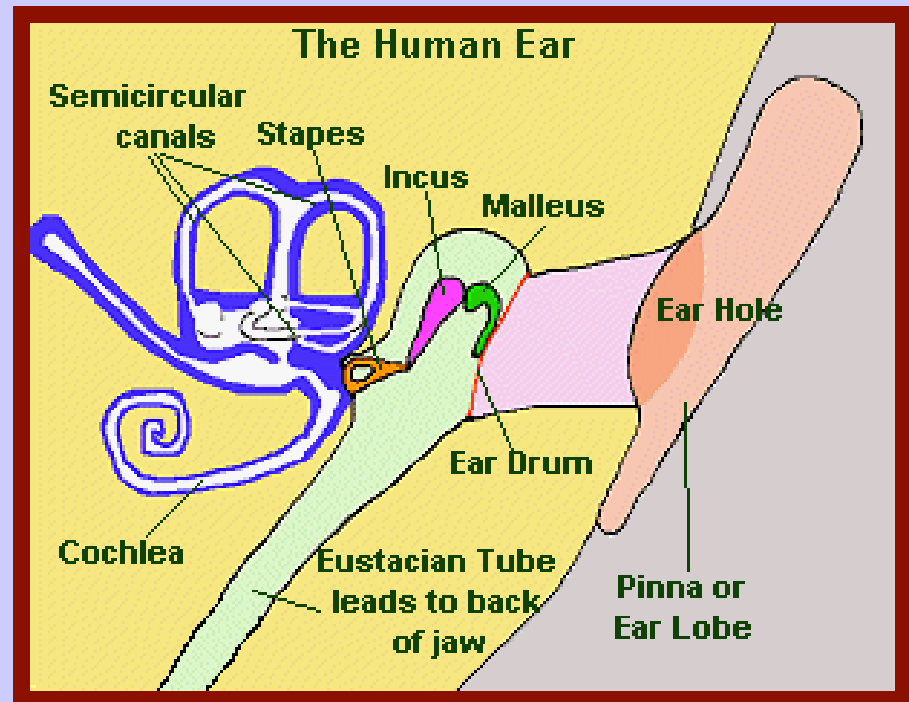
Nostrils = external nares

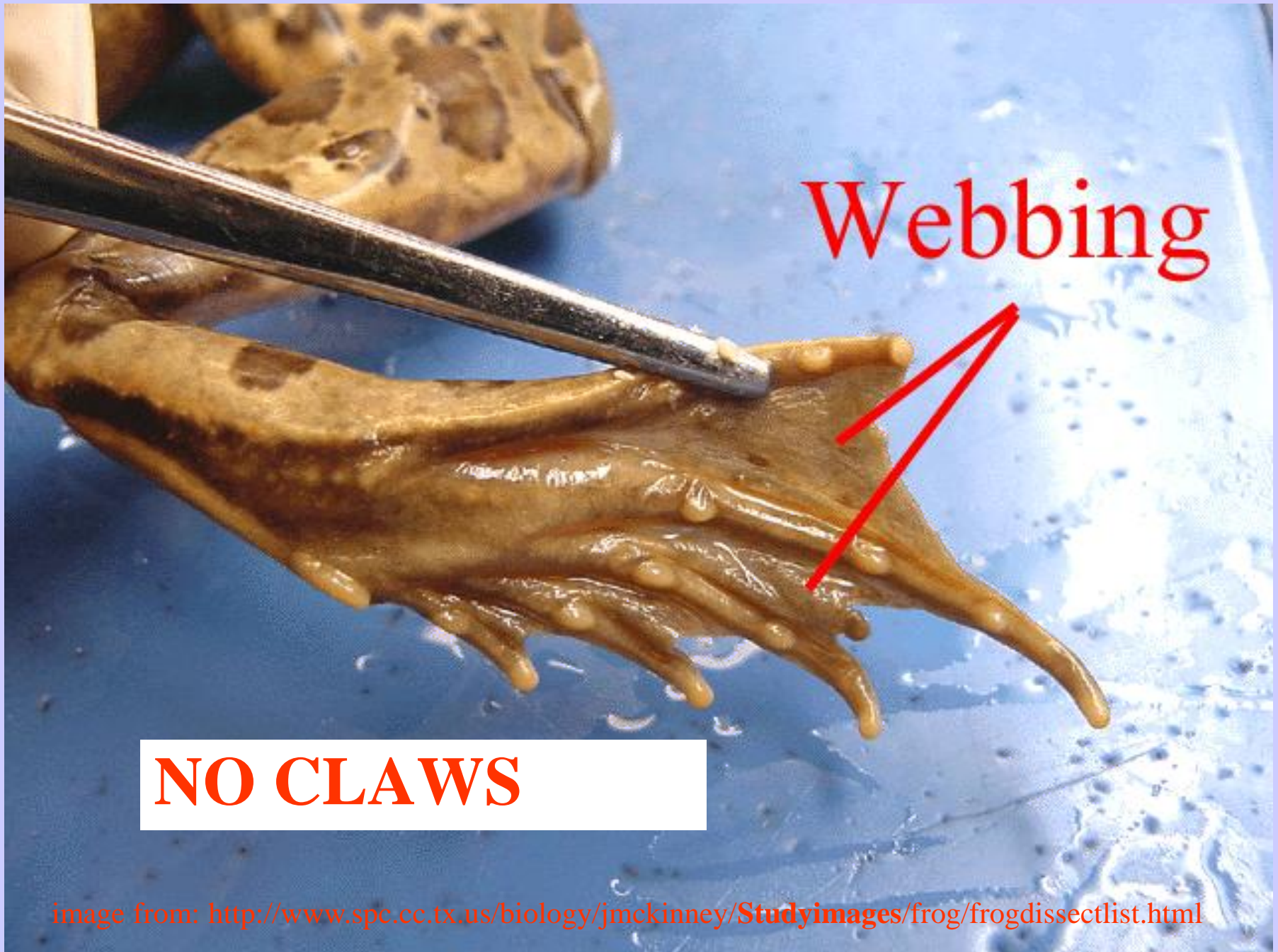
All tetrapods (amphibians, reptiles, birds, and mammals) have a middle ear with a tympanic membrane (= eardrum).



# The major difference in the middle ear:

- Amphibians, reptiles, birds have a single ear bone (= **columella**)
- Mammals have three middle-ear bones





Webbing

**NO CLAWS**

image from: <http://www.spc.cc.tx.us/biology/jmckinney/Studyimages/frog/frogdissectlist.html>



# EXIT OPENINGS

DIGESTIVE WASTE (feces) =  
ANUS

EXCRETORY & REPRODUCTIVE EXIT =  
UROGENITAL PORE

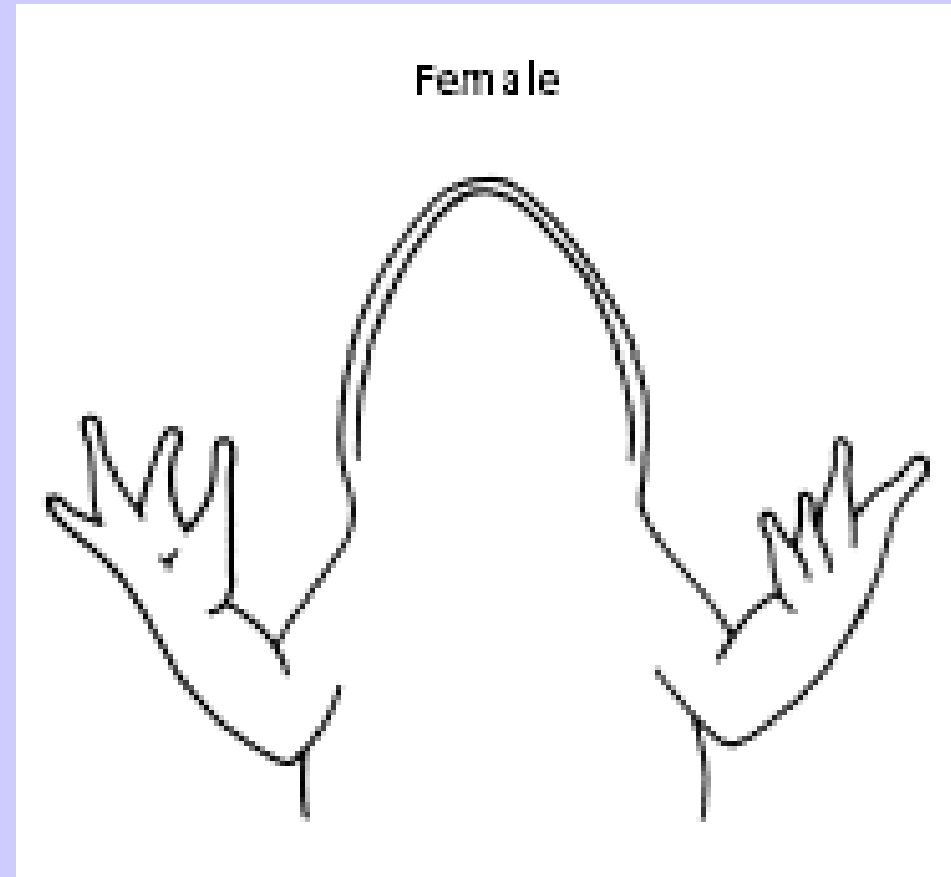
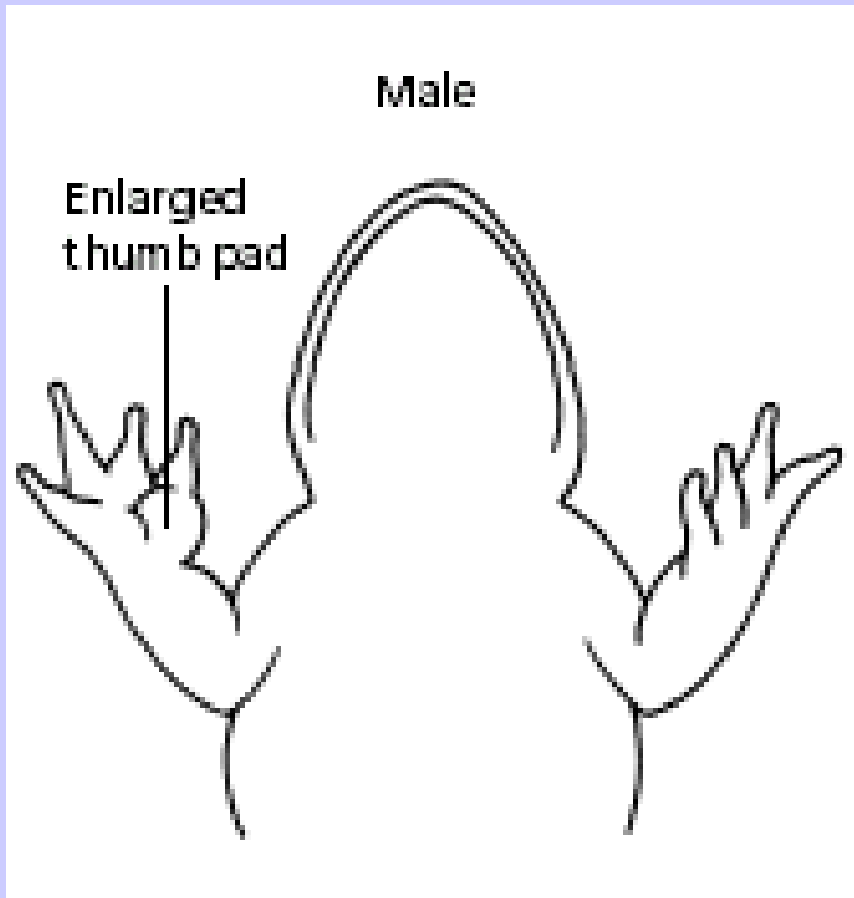
(Urine & eggs OR Urine & sperm)

# EXIT OPENINGS

OPENING SHARED BY  
EXCRETORY,  
REPRODUCTIVE,  
& DIGESTIVE =  
VENT



# What sex is it?



Images from:

[http://sps.k12.ar.us/massengale/frog\\_dissection.htm](http://sps.k12.ar.us/massengale/frog_dissection.htm)

Image by: Riedell/VanderWal©2006



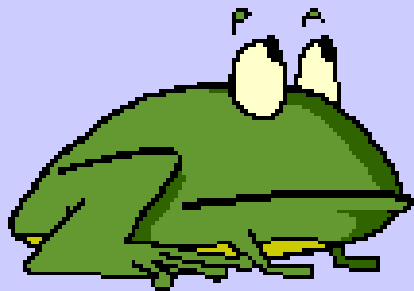
# AMPLEXUS

## "firm embrace"



Sperm and egg released @ same time and place  
Increases chances of external fertilization

Image from:  
<http://www.animationlibrary.com>  
<http://www.geocities.com/animalbio/biology.htm>



**TONGUE** attached at front not back like yours!

# PHARYNX

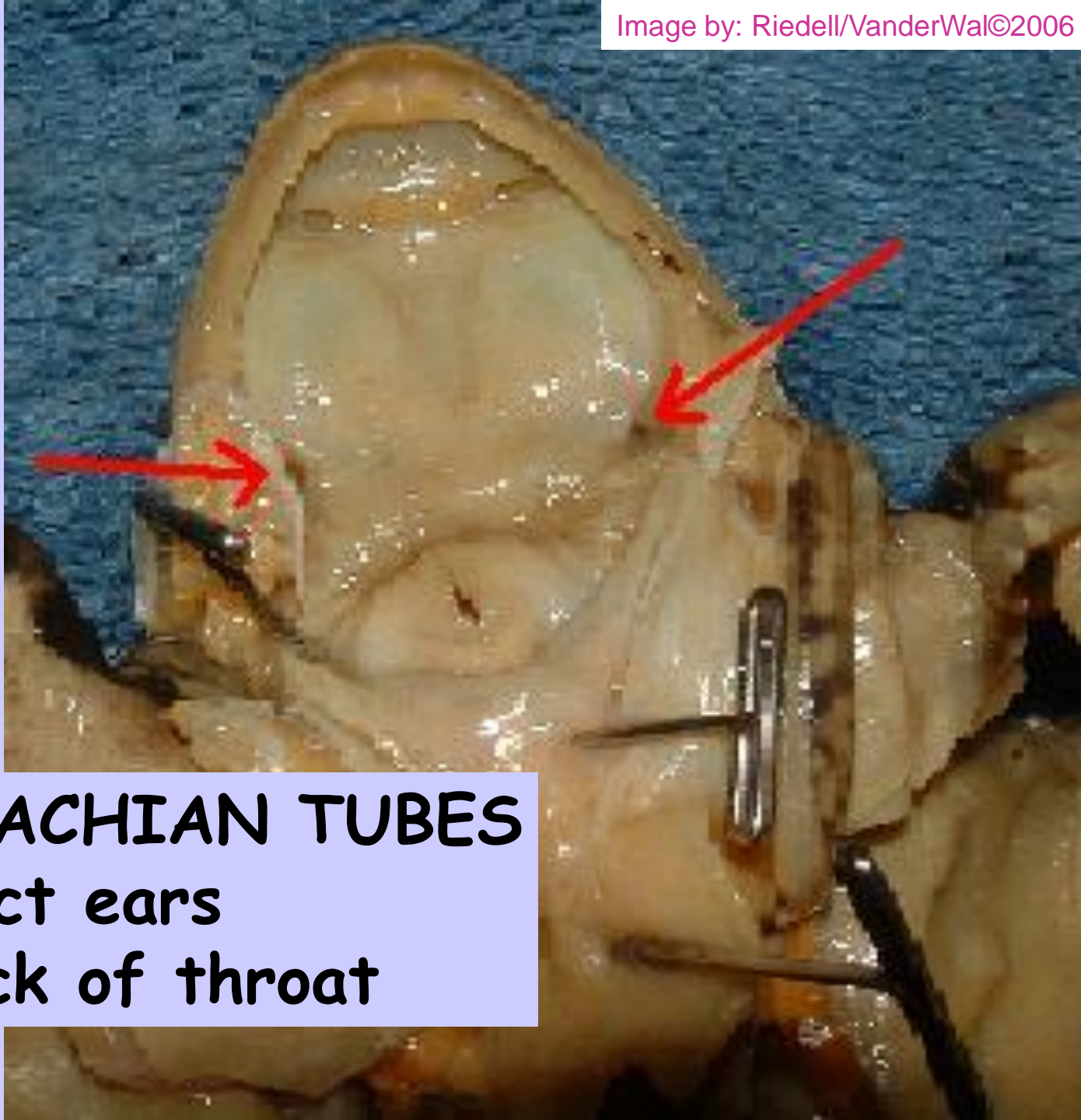
Muscular

Back of throat

Pulls food into

digestive system

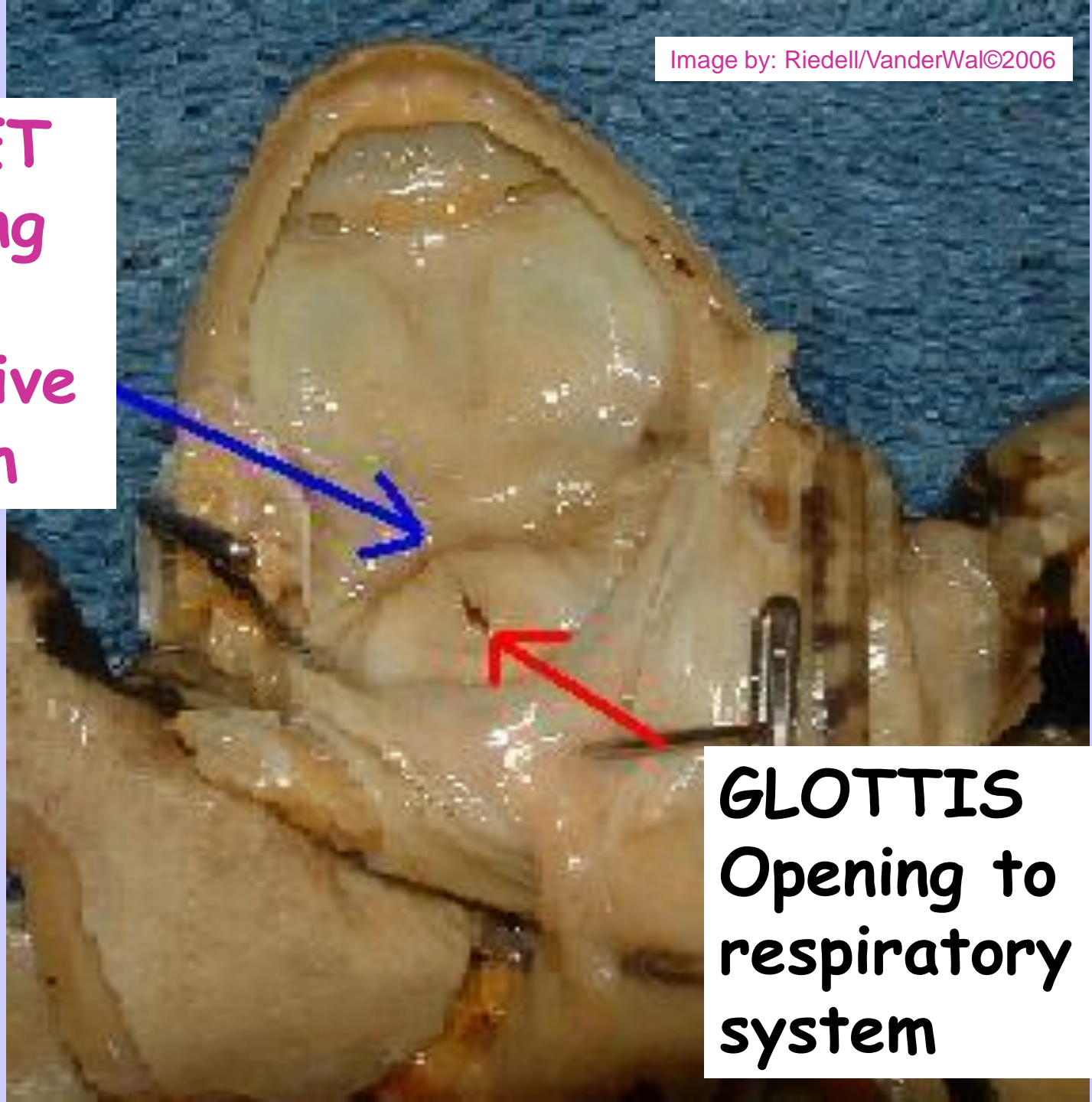




**EUSTACHIAN TUBES**  
Connect ears  
to back of throat



**GULLET**  
Opening to  
digestive  
system



**GLOTTIS**  
Opening to  
respiratory  
system

# MAXILLARY & VOMERINE TEETH



# INTERNAL NARES

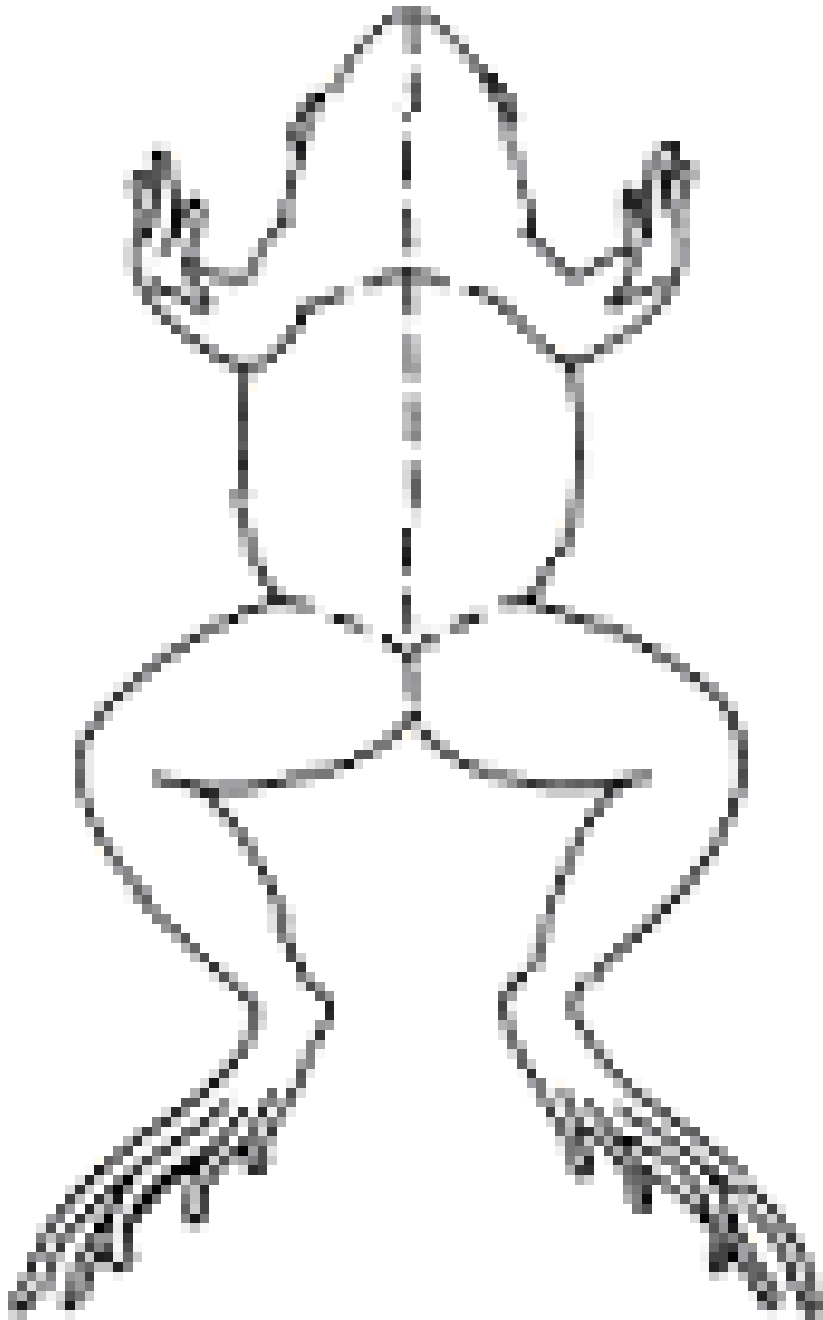


Image by: Riedell/VanderWal©2006

Allows frog to breathe  
with mouth closed!



[http://whatdidyoubringme.homestead.com/files/Tshirts/Herp/amphibian/images\\_lg/Frog251.jpg](http://whatdidyoubringme.homestead.com/files/Tshirts/Herp/amphibian/images_lg/Frog251.jpg)



**Cut through skin first**

**Then abdominal muscle**

**Watch for squirting!**

An anatomical dissection of a frog's skin, showing a dense network of blood vessels. The skin is yellowish and translucent, revealing a complex web of reddish-brown vessels. A pair of surgical forceps is visible in the lower right corner, holding the skin. The background is a blue textured surface.

**LOTS OF BLOOD VESSELS**  
for gas exchange  
**CUTANEOUS RESPIRATION**

**OVARY-  
Make eggs**

**If yours looks  
like this . . .**

**trade for a  
new frog**



# FAT BODIES

Store fat for energy during:

Hibernation  
Estivation  
Breeding



# LIVER

- Make bile to break down fats
- Store glycogen
- Store vitamins
- Process toxins (including nitrogen waste for kidneys)



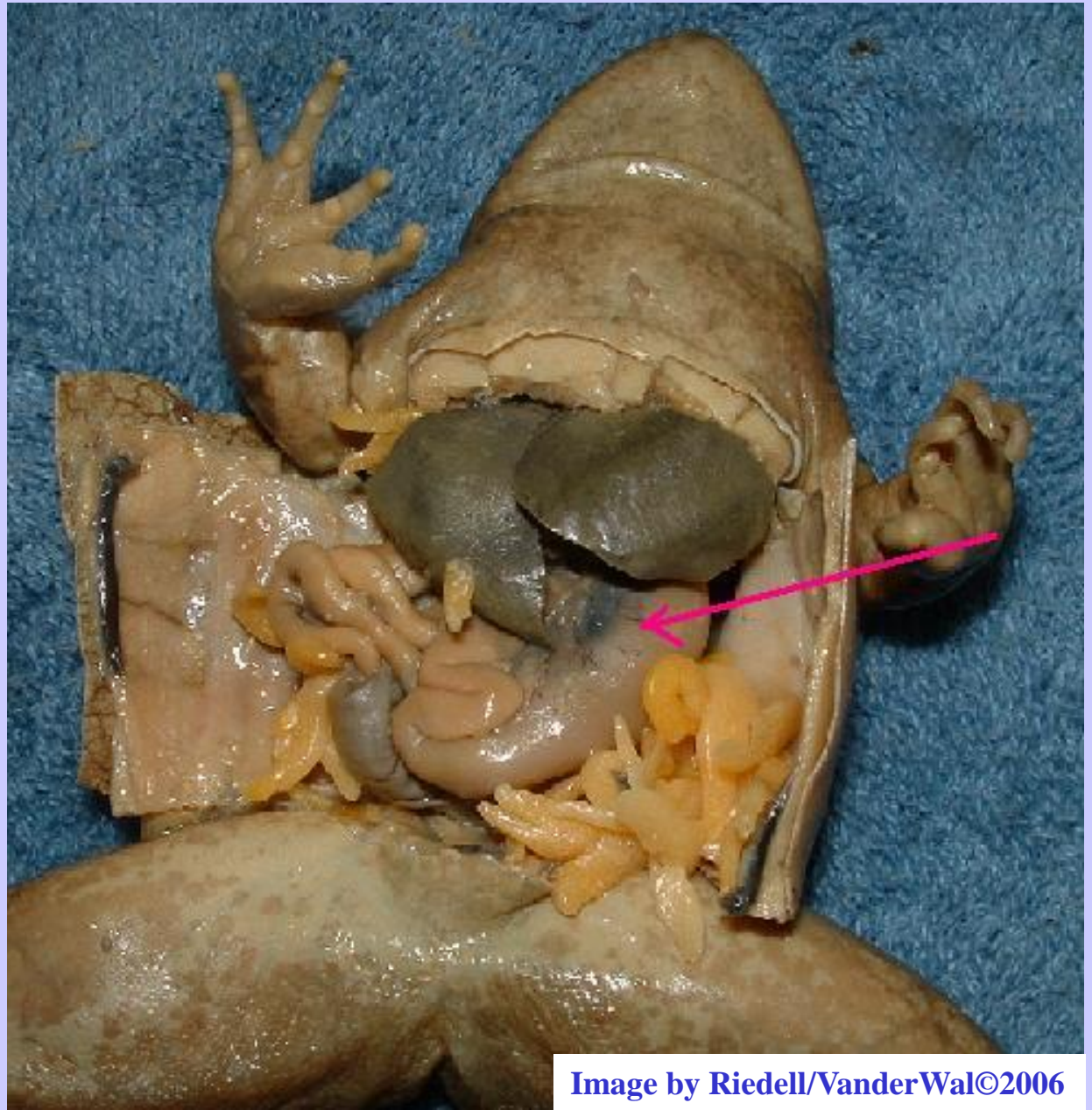


# STOMACH

Add acid

Start  
digestion

Grind/mash  
food

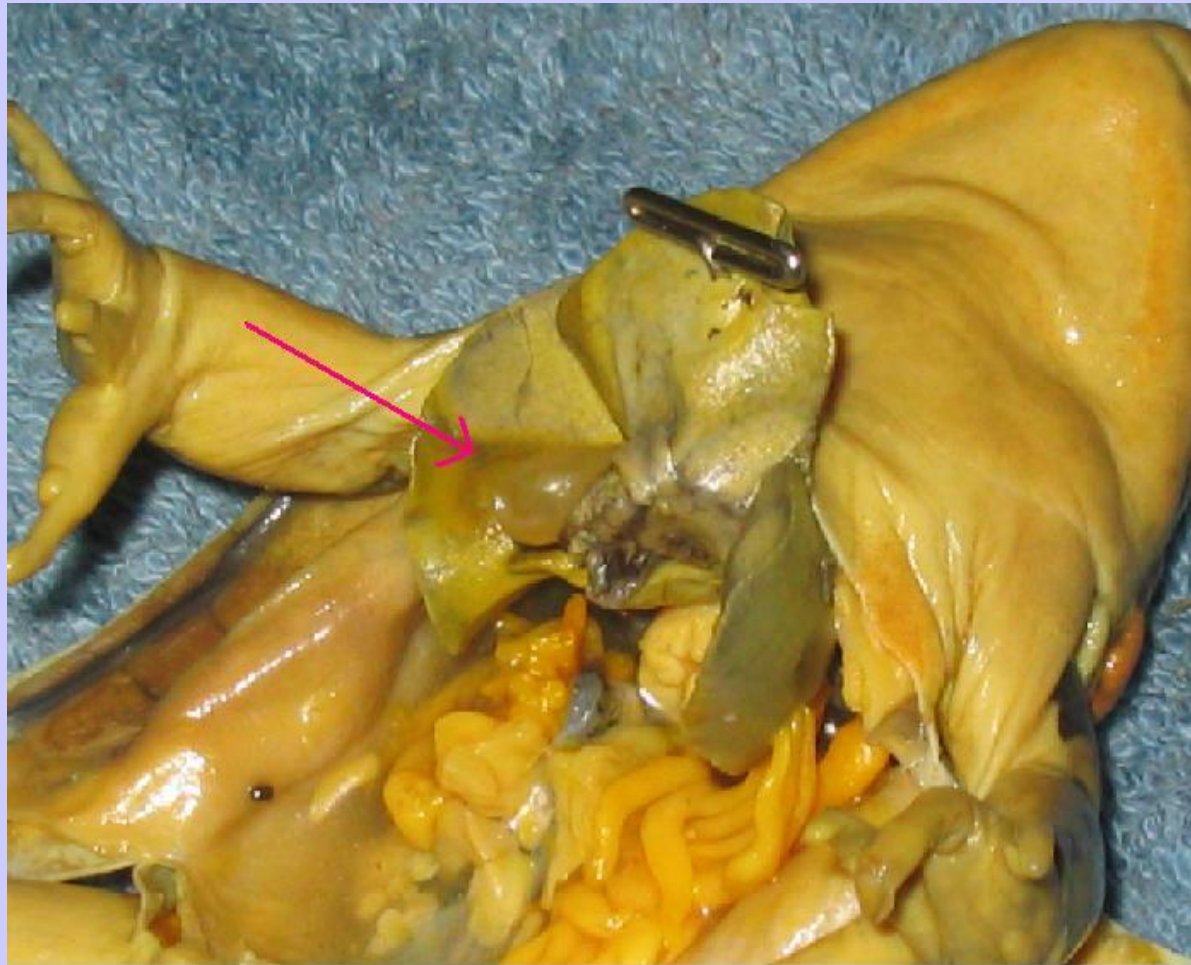


# GALL BLADDER

Storage sac  
under liver

Stores bile  
made by liver

Used in  
small  
intestine

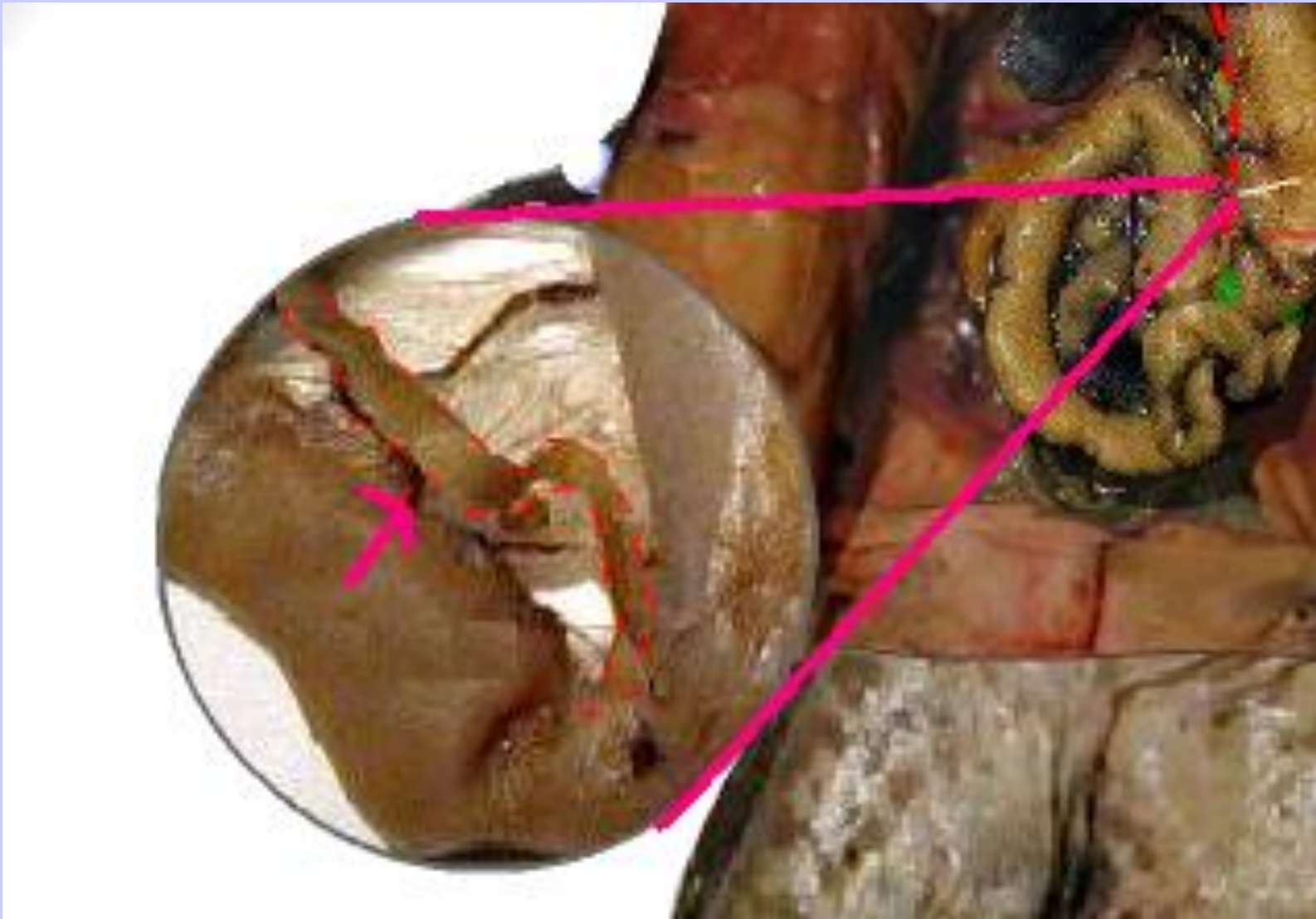


# PANCREAS



<http://curry.edschool.virginia.edu/go/frog/organs/home.html>

# Pancreas (enlarged)



# PANCREAS:

Makes TRYPSIN, INSULIN, GLUCAGON

TRYPSIN- breaks down proteins

INSULIN- tells cells to store glucose from bloodstream as glycogen

GLUCAGON- tells cells to release stored glucose to blood stream



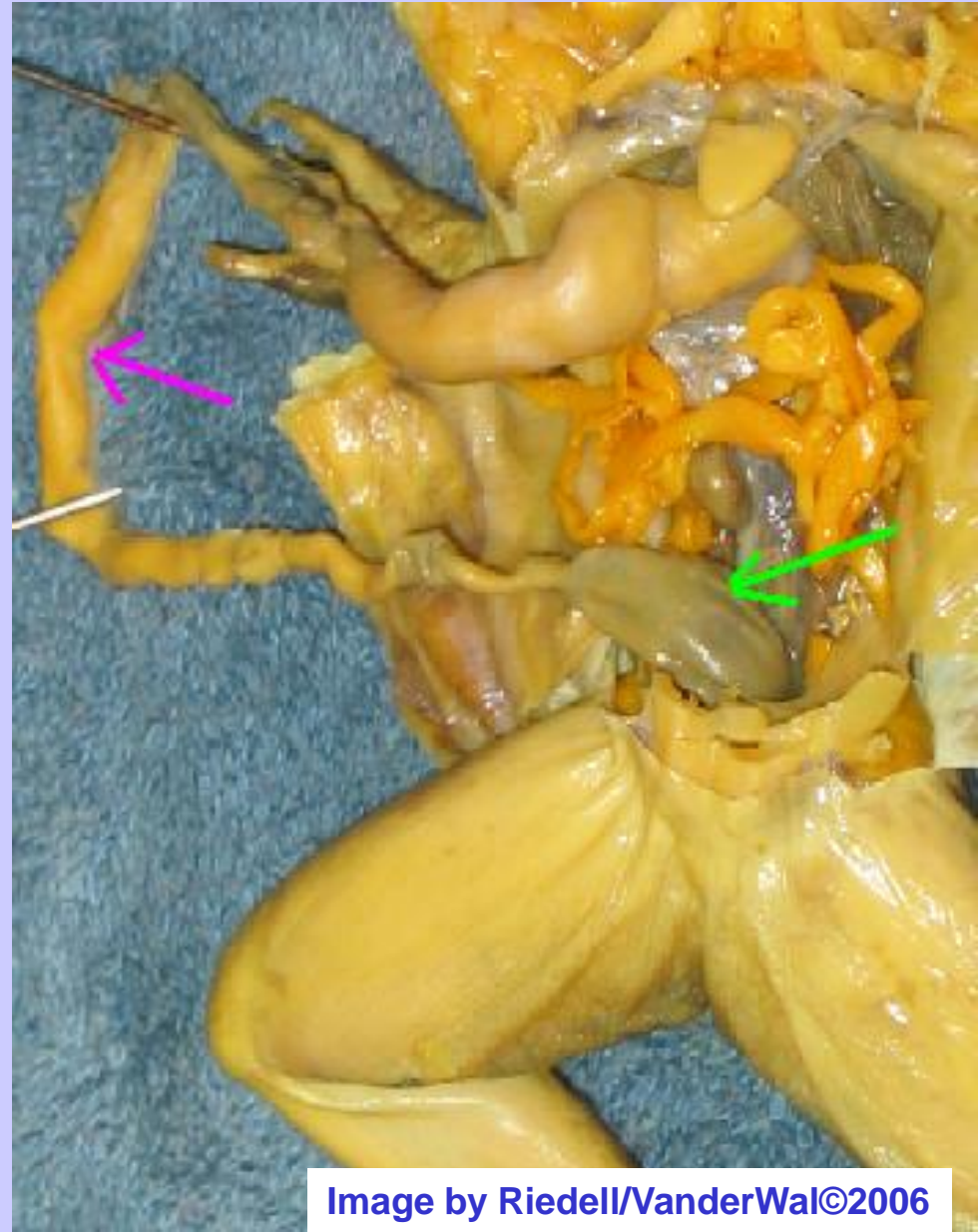
**Mesentery holds intestines together**

# INTESTINE

SMALL INTESTINE

LARGE INTESTINE

Split up intestine  
functions



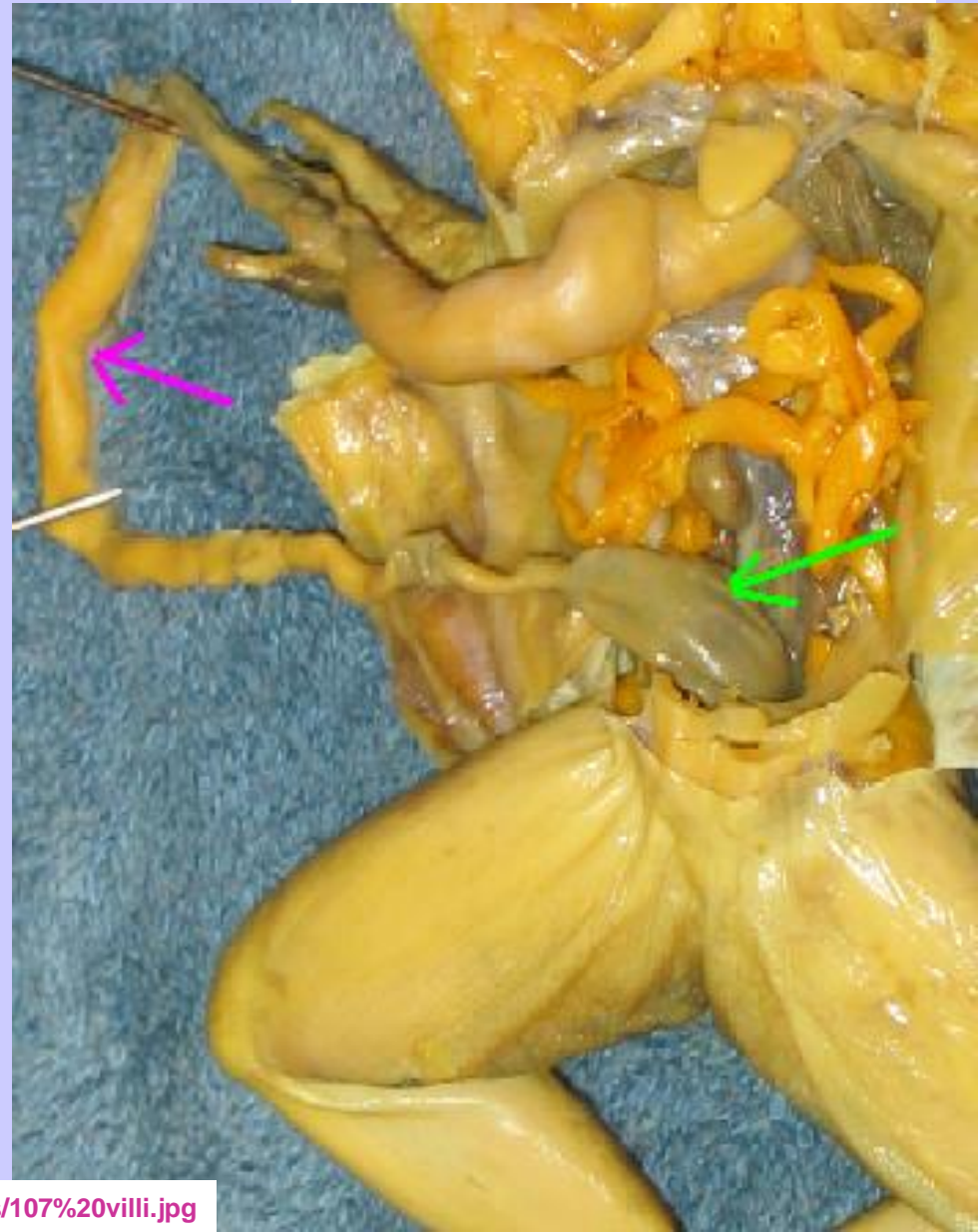
# SMALL INTESTINE



Image by Riedell/VanderWal©2006

- Bile/trypsin added
- Finish digesting
- Absorb nutrients

**VILLI**-increase surface area for more absorption

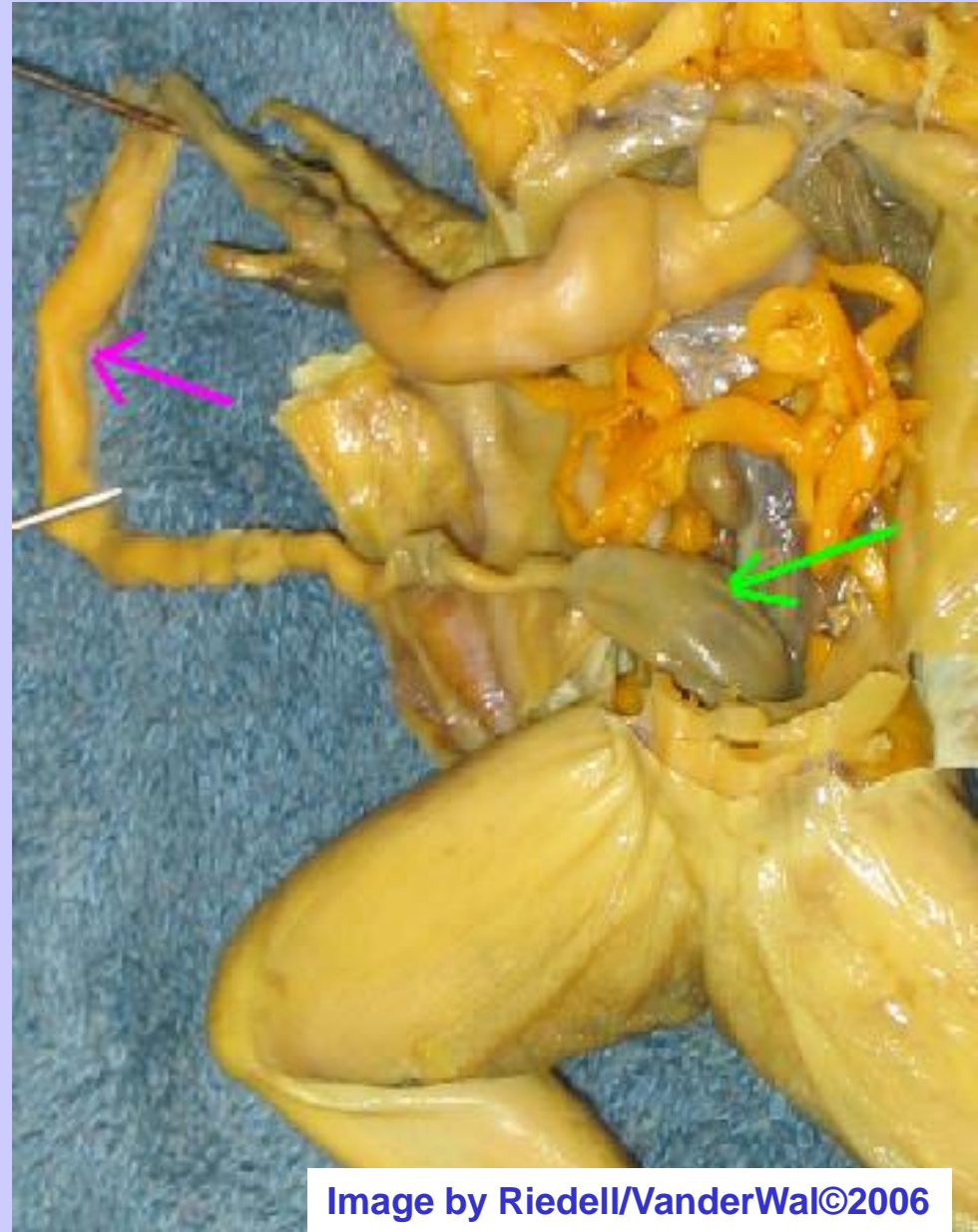




# LARGE INTESTINE



Removes water  
from feces  
Collects/concentrates  
digestive waste



# SMALL INTESTINE

**DUODENUM-**

Add bile/trypsin

Finish digestion

**ILEUM-**



Finish digestion

Absorb nutrients





Image by Riedell/VanderWal©2006

NEW

# CLOACA

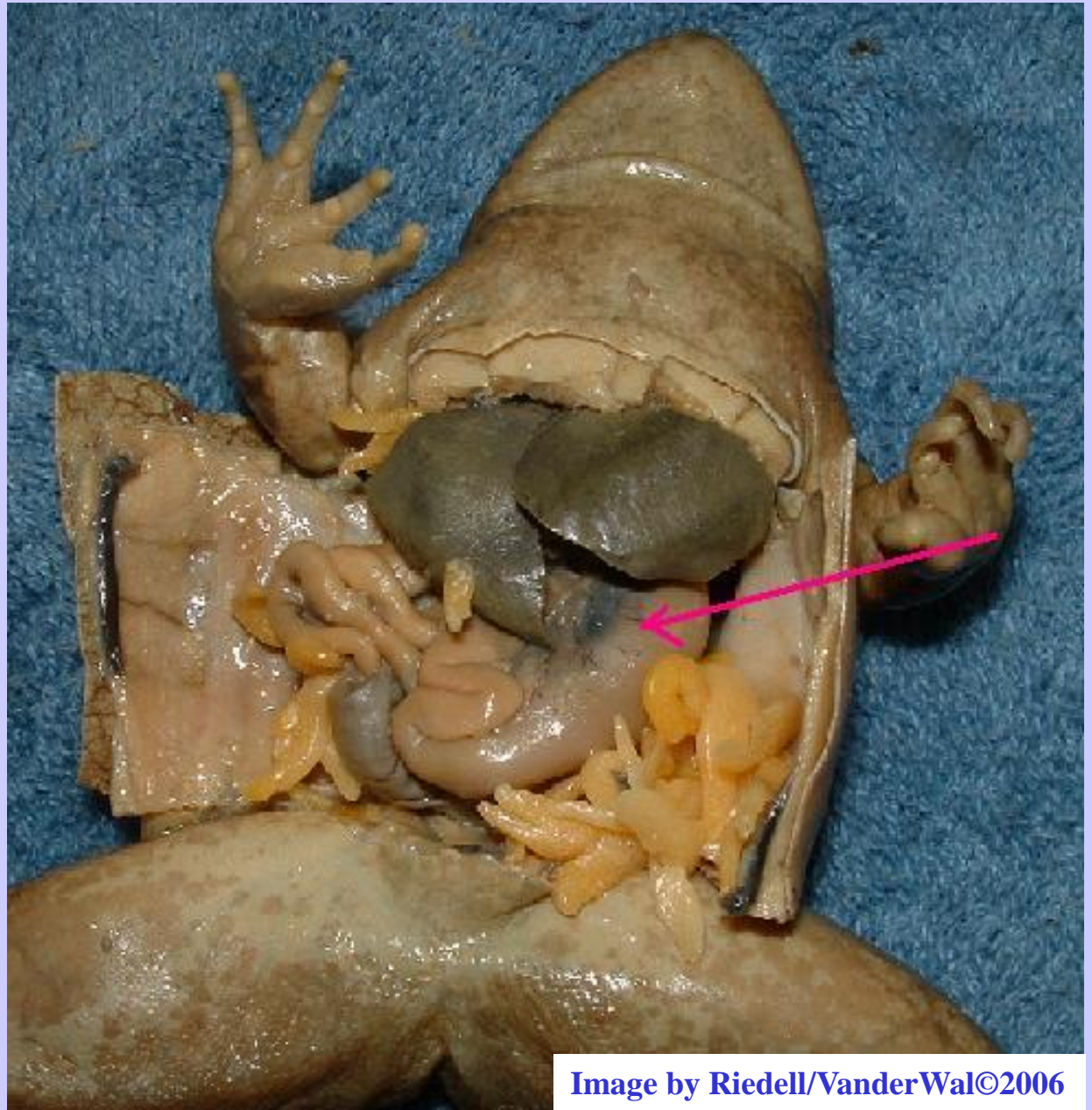
Shared  
collecting space  
for

DIGESTIVE  
EXCRETORY  
REPRODUCTIVE  
SYSTEMS

# STOMACH

What's  
for  
lunch?

Cut open  
your  
stomach



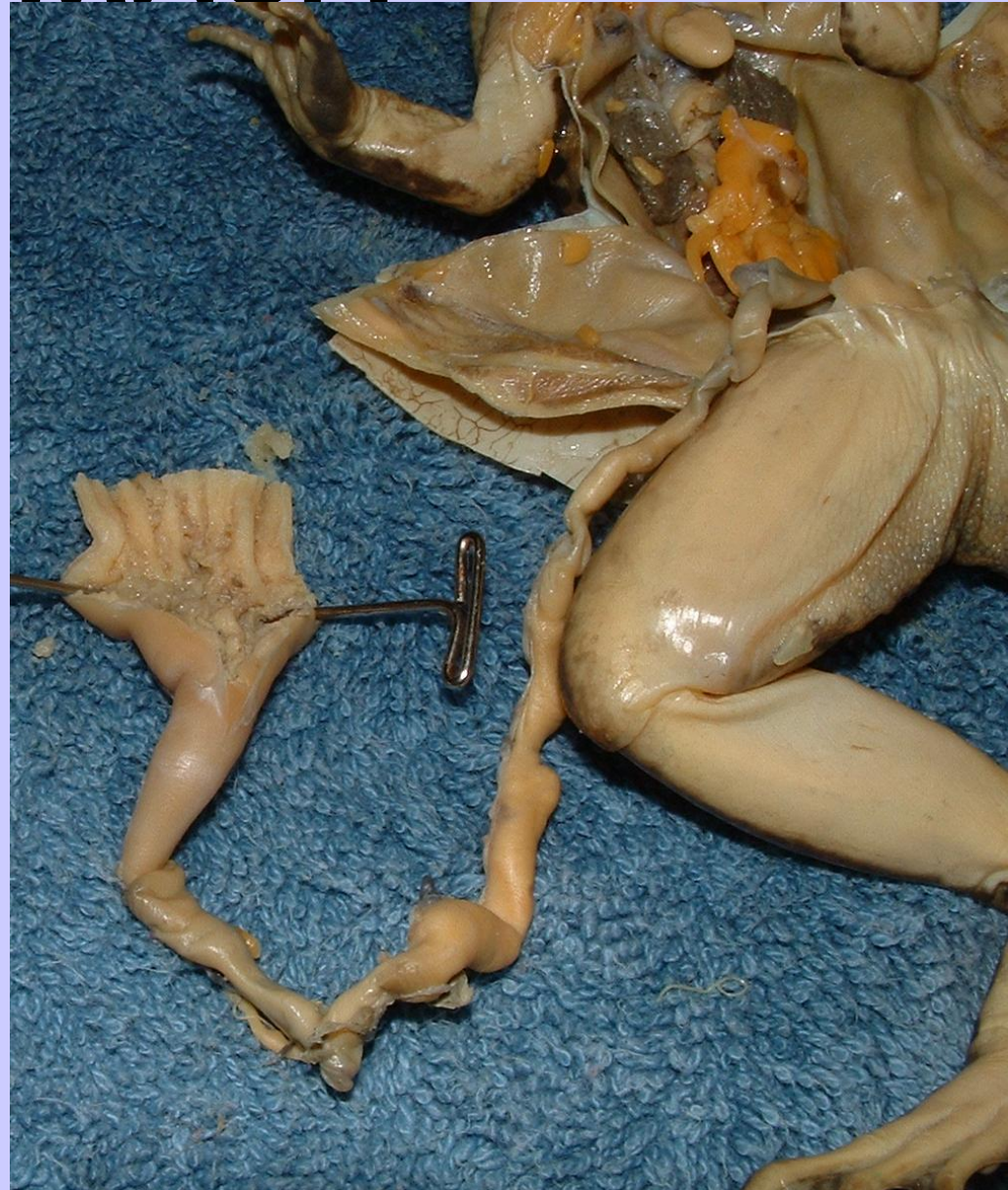
# STOMACH

**RUGAE-**

**Rough folds  
inside stomach**

**allow expansion**

**help to break  
down food**





**PYLORIC SPHINCTER**



**CONTROLS** passage of food from stomach  
into duodenum (intestine)

# SPLEEN

## BLOOD CELL FACTORY

Makes, stores,  
processes  
worn out  
red blood cells



# 10 Body Systems :

## EXCRETORY

Get rid of nitrogen waste made by cells

Nitrogen waste has different chemical forms:

### AMMONIA

**MOST TOXIC**

**FISH**

### UREA

made from  
ammonia by  
liver

**HUMANS**

**AMPHIBIANS**

### URIC ACID

**LEAST TOXIC**  
needs the least  
water to dilute

**BIRDS, REPTILES**



# **ALL WASTE is NOT THE SAME!**

## **DIGESTIVE** waste-

**left over from undigested food**

**travels through digestive system**

**leaves through digestive system as feces**

## **EXCRETORY** waste-

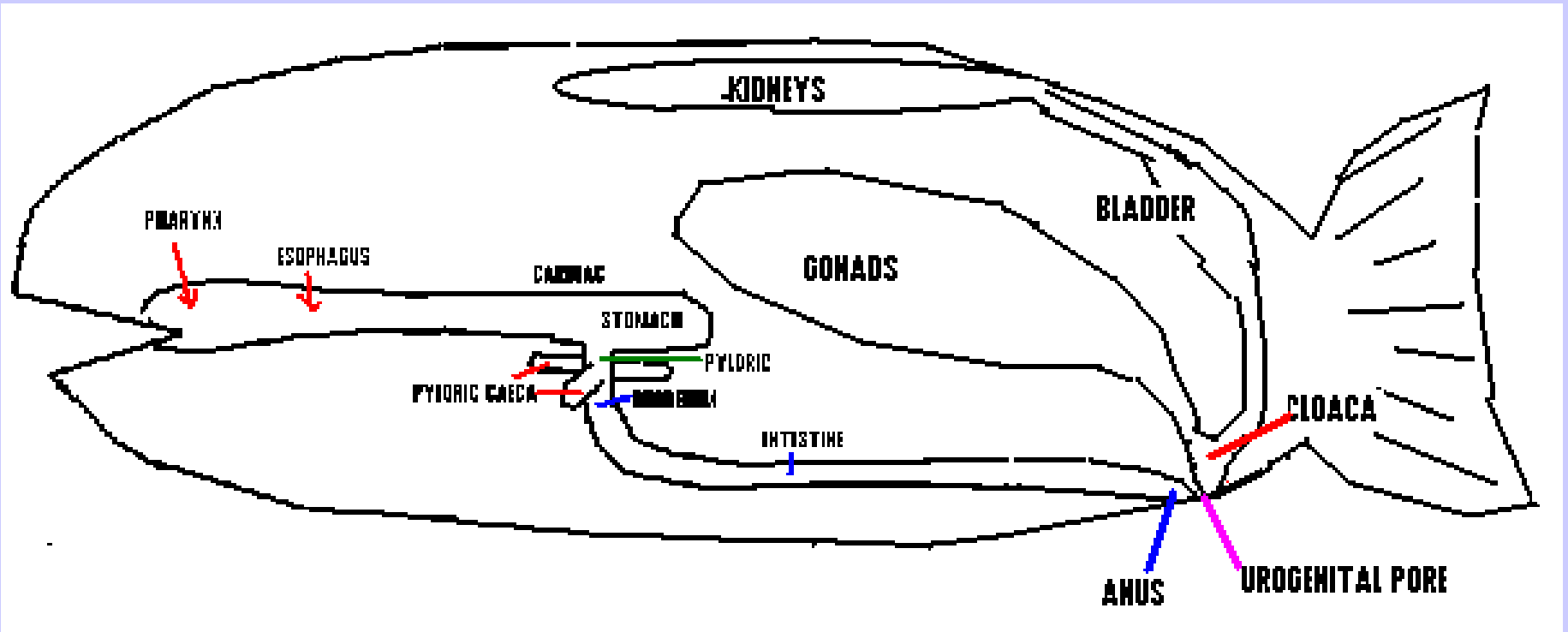
**(Also called NITROGEN WASTE)**

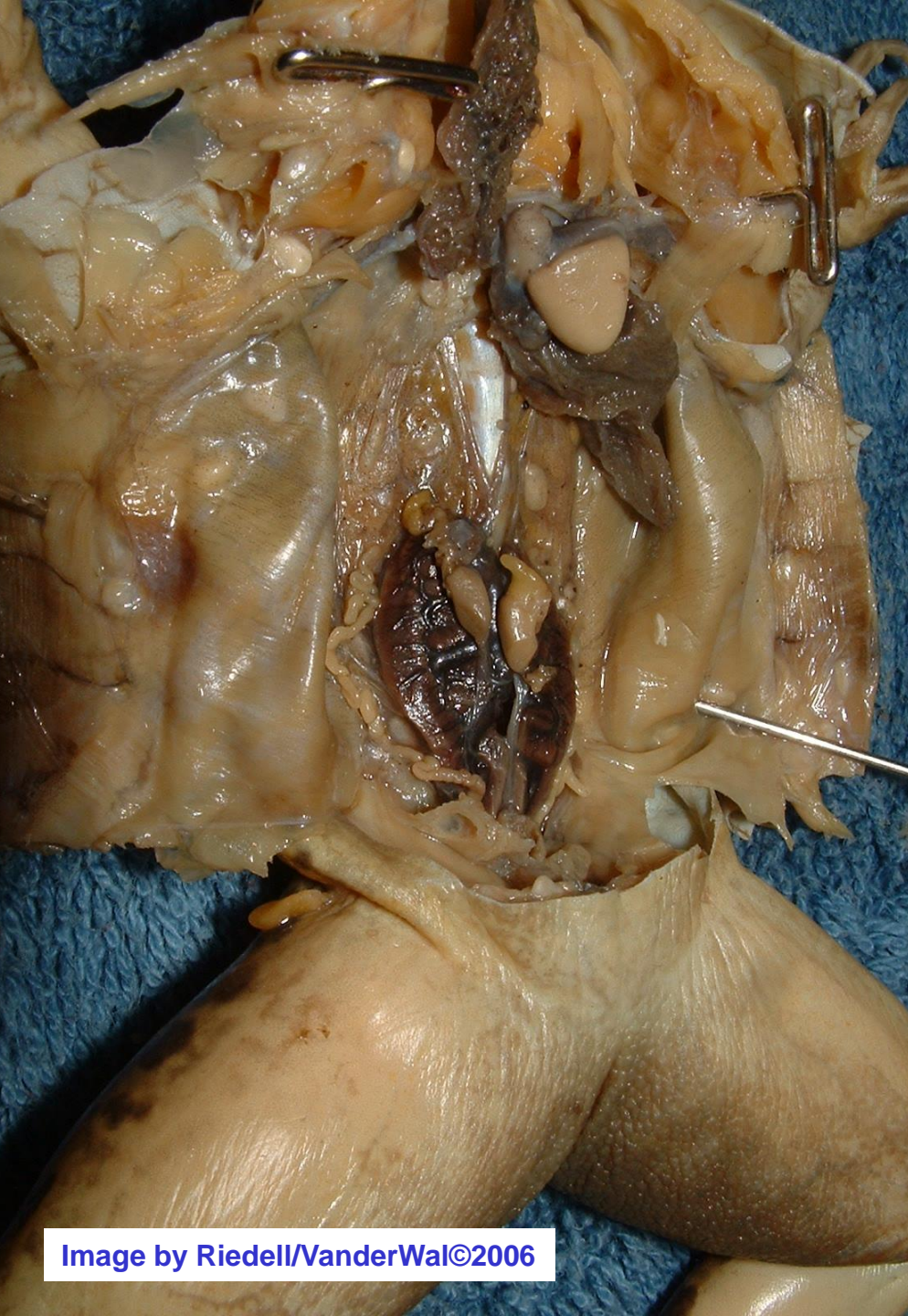
**made by cells from break down of proteins**

**travels through blood stream**

**leaves through excretory system as**

**ammonia, urea, or uric acid**





## **KIDNEYS-**

- Remove nitrogen waste from blood and dilute it with water to make urine;
- Osmoregulation
- Adult frogs excrete as **UREA TO CONSERVE WATER**

# URINARY BLADDER



**STORES URINE  
MADE BY KIDNEYS**

**LARVAE (Tadpoles)  
Excrete AMMONIA like fish**

**Adult frogs excrete  
UREA to conserve water**

Image by Riedell/VanderWal©2006



Image by Riedell/VanderWal©2006

NEW

# CLOACA

Shared  
collecting space  
for

DIGESTIVE  
EXCRETORY  
REPRODUCTIVE  
SYSTEMS

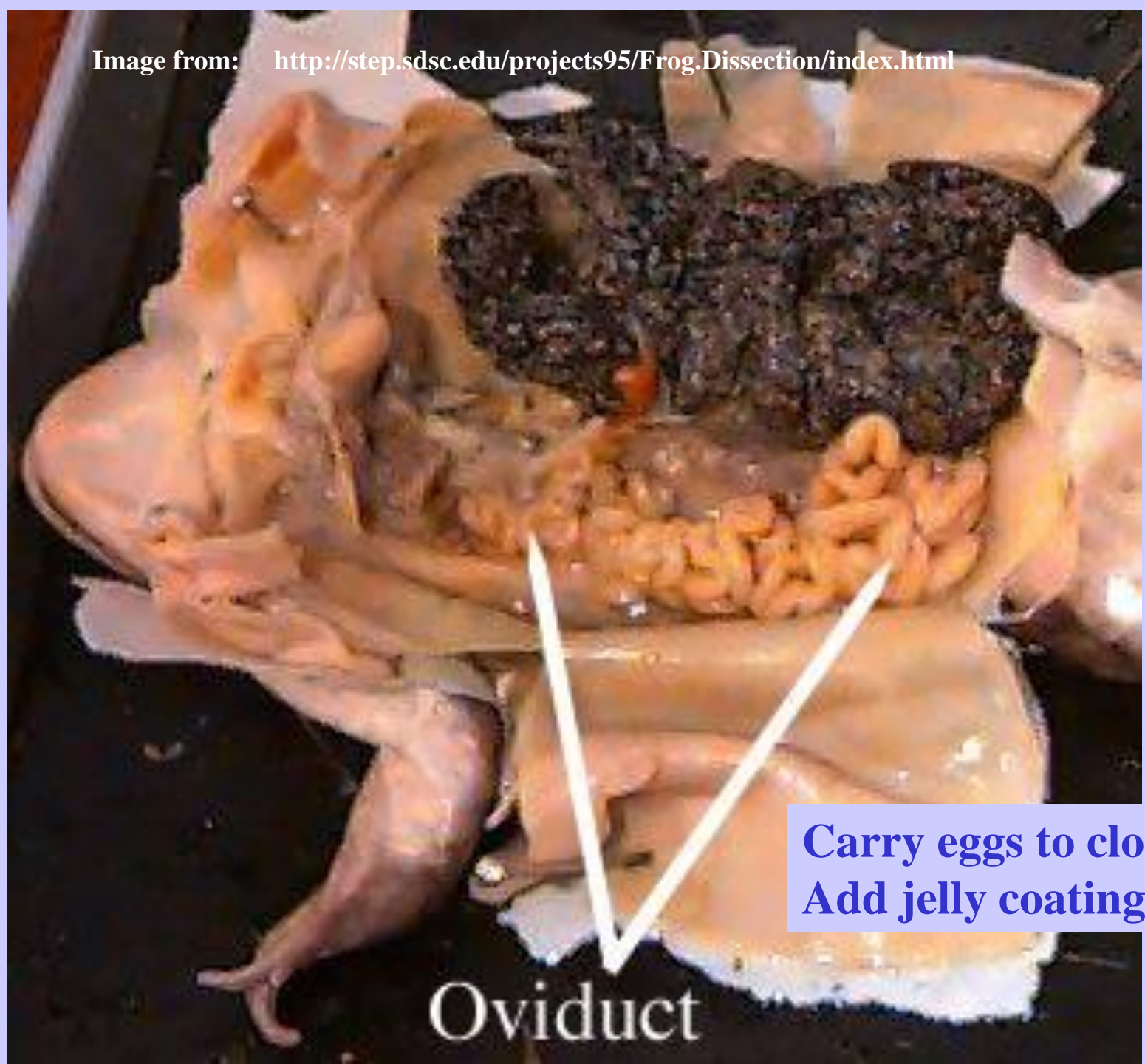
# OVARIES

Make eggs



Image by Riedell/VanderWal©2006

Image from: <http://step.sdsc.edu/projects95/Frog.Dissection/index.html>



**Carry eggs to cloaca  
Add jelly coating**

**Oviduct**

# OVARY without eggs

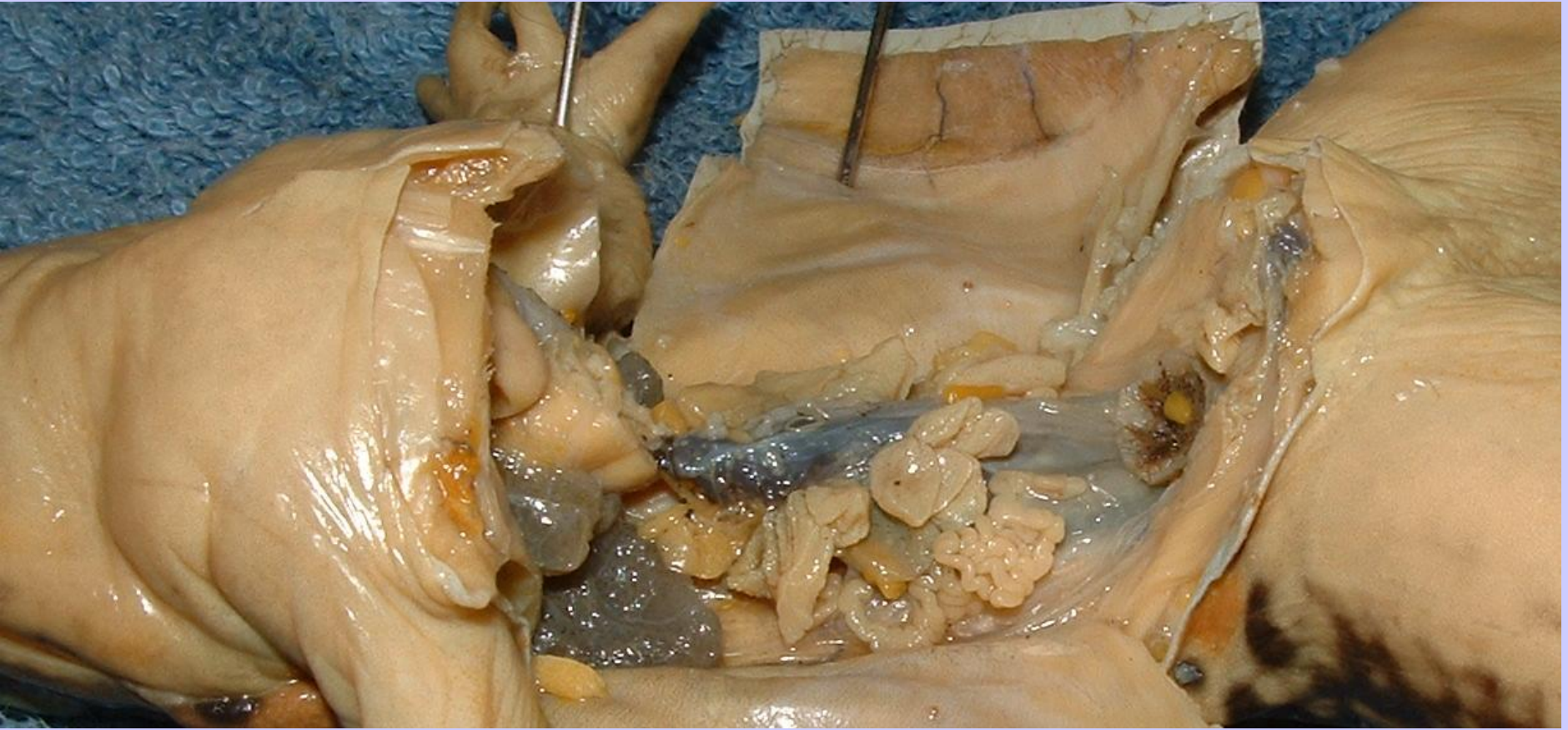


Image by Riedell/VanderWal©2006



**TESTES**-makes sperm  
**VAS DEFERENS**-tubules  
that carry sperm to cloaca



# AMPLEXUS

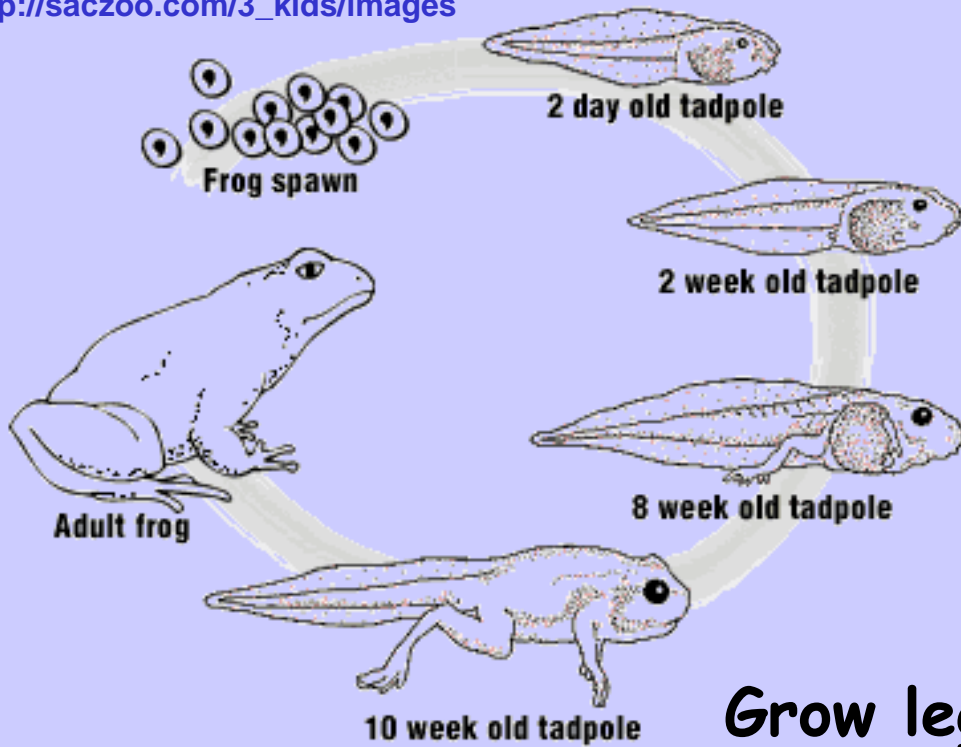
## "firm embrace"



Sperm and egg released @ same time and place  
Increases chances of external fertilization

# INDIRECT DEVELOPMENT

[http://saczoo.com/3\\_kids/images](http://saczoo.com/3_kids/images)



Grow legs; Lose tail

2 chambers → 3 chambers

1 loop → 2 loops

Breathe w/ gills → lungs & skin

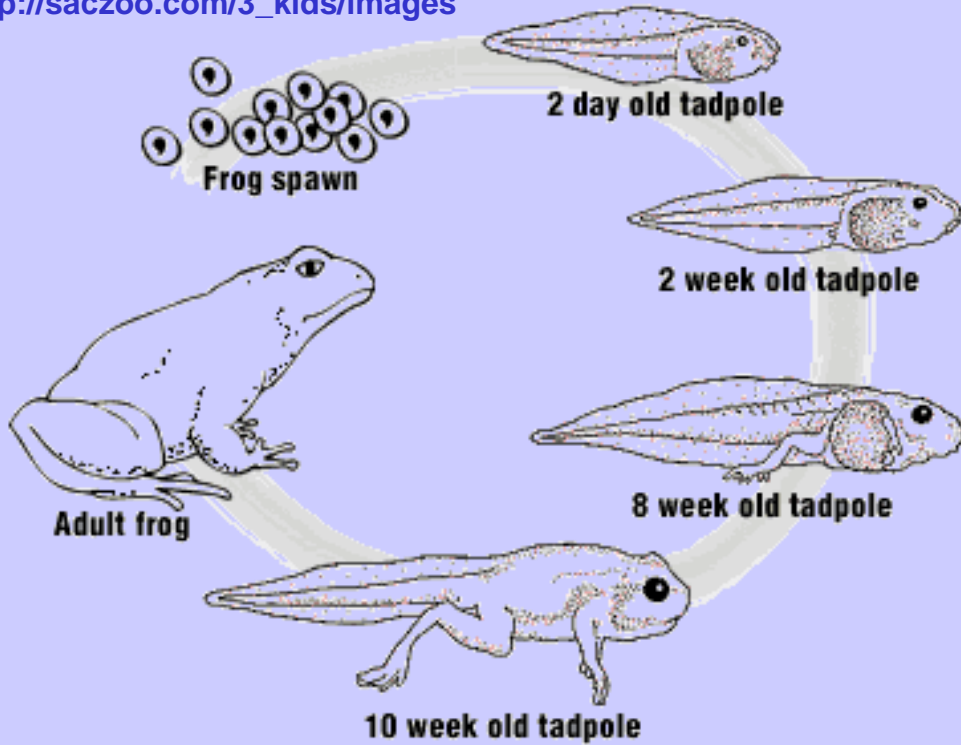
Excrete ammonia → excrete urea

(gills & kidneys)

(kidneys)

# ENDOCRINE SYSTEM

[http://saczoo.com/3\\_kids/images](http://saczoo.com/3_kids/images)



**THYROID GLAND**  
makes **THYROXIN** to  
control heart rate,  
metabolism, and  
**METAMORPHOSIS**



# Ways tadpoles are like fish

Have a LATERAL LINE

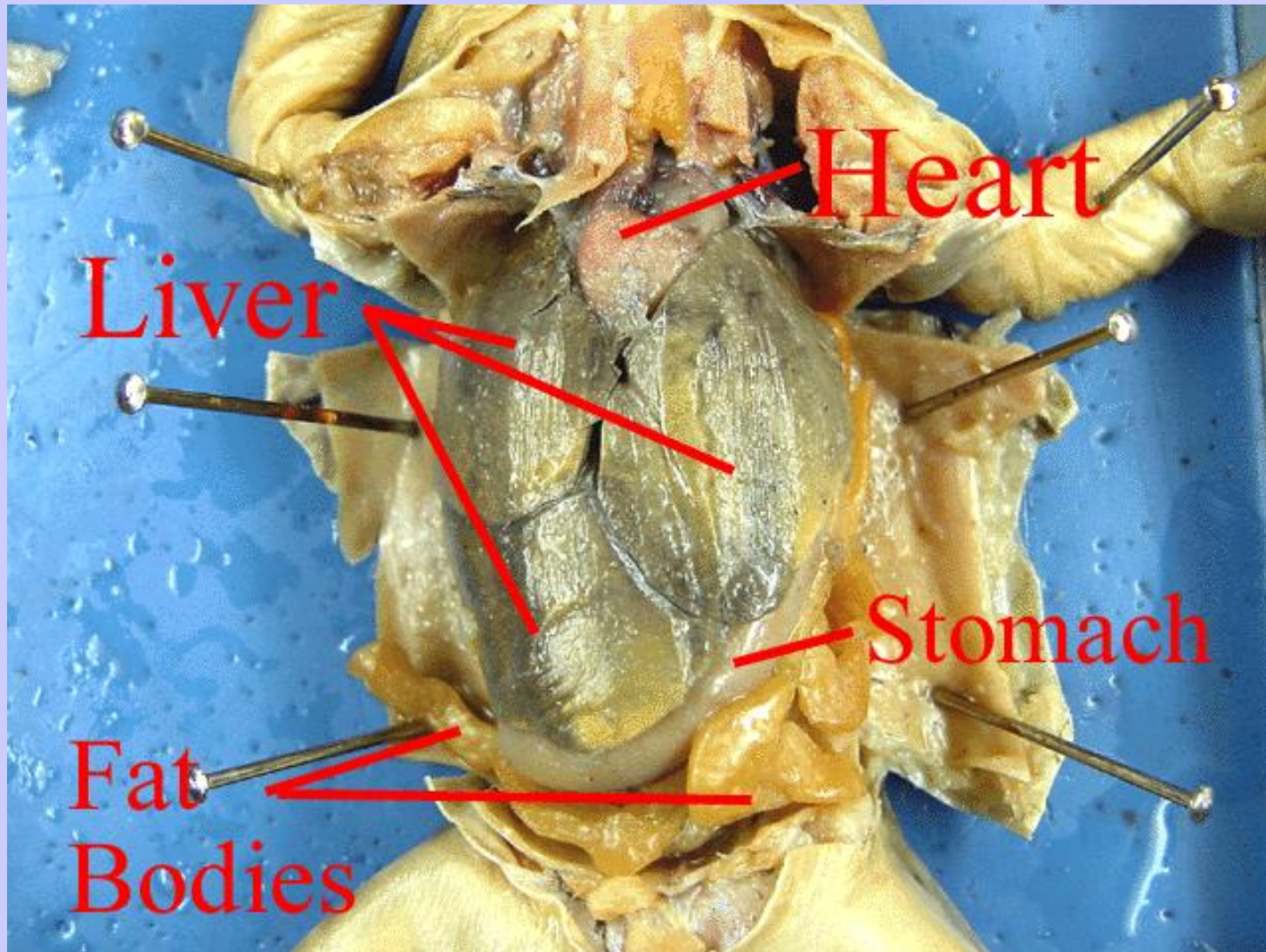
Breathe with gills

Excrete nitrogen waste as AMMONIA  
(with gills & kidneys)

Have a 2 chamber heart

Have a 1 loop  
circulatory system



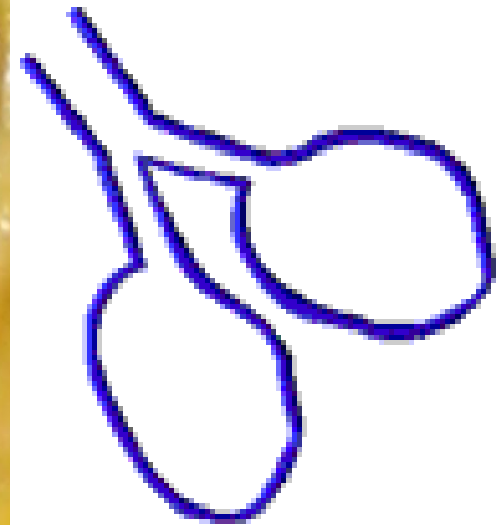


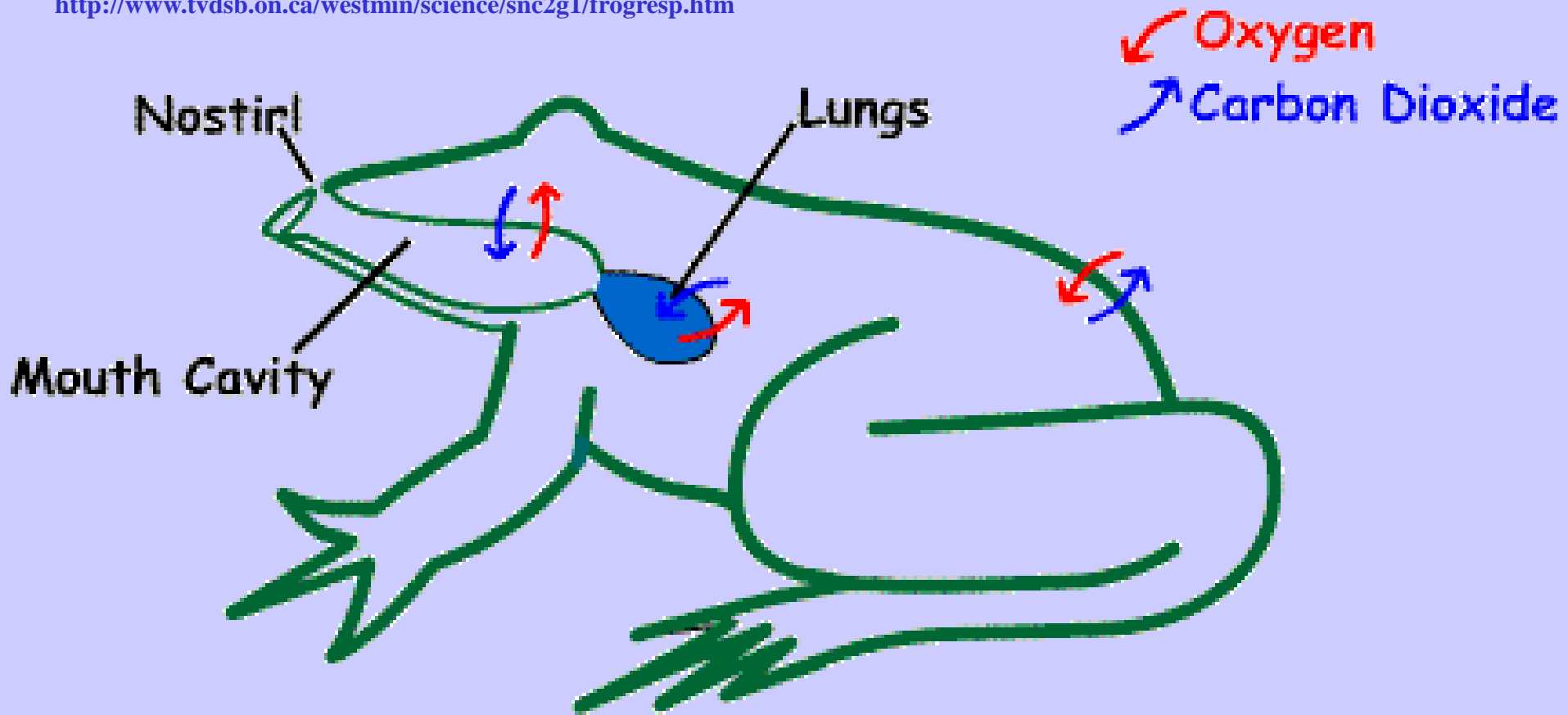
**Pericardial membrane around heart**  
**Mesentery holds intestines together**

Image by Riedell/VanderWal©2006

# LUNGS:

## GAS EXCHANGE





**BREATHING WITH LUNGS is called  
PULMONARY RESPIRATION**

**Frogs PUSH AIR INTO LUNGS  
= POSITIVE PRESSURE**



# Larvae breathe with GILLS



Image by Riedell/VanderWal©2006



# HEART

3 chambers

2 loops

# HEART

3 chambered heart

Right atrium

Left atrium

Ventricle

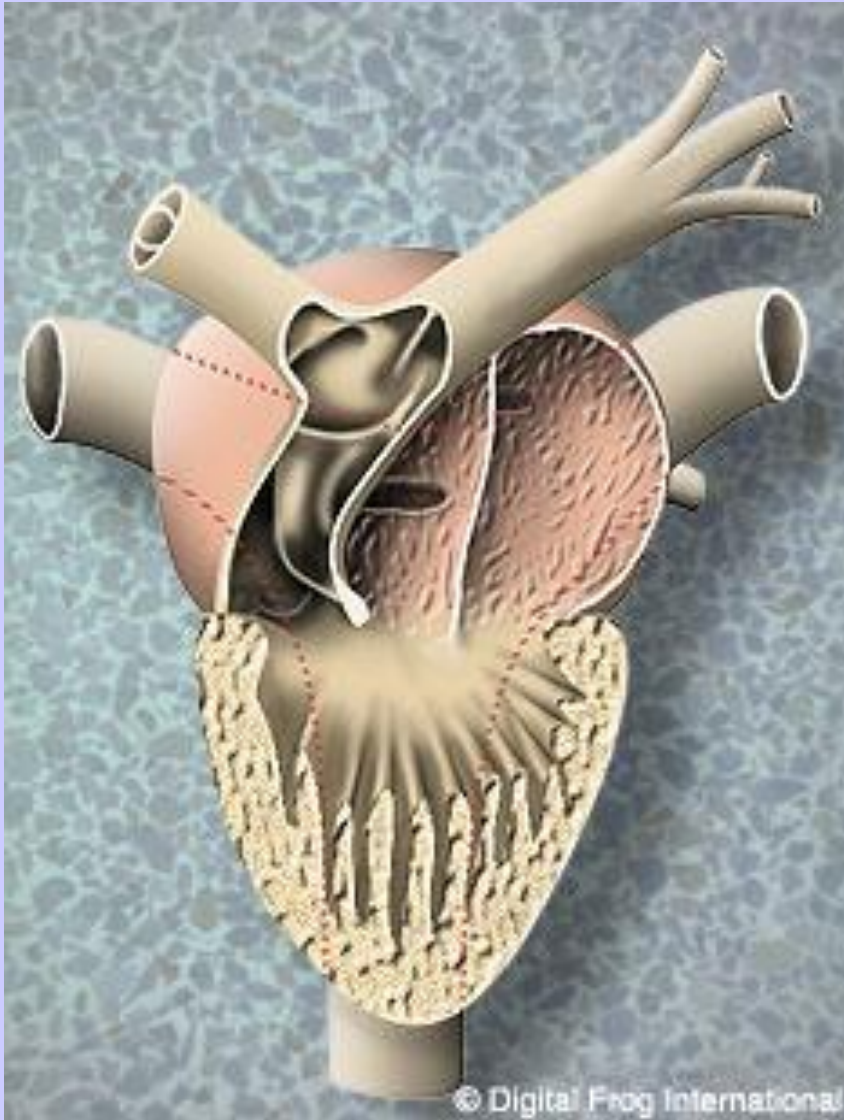
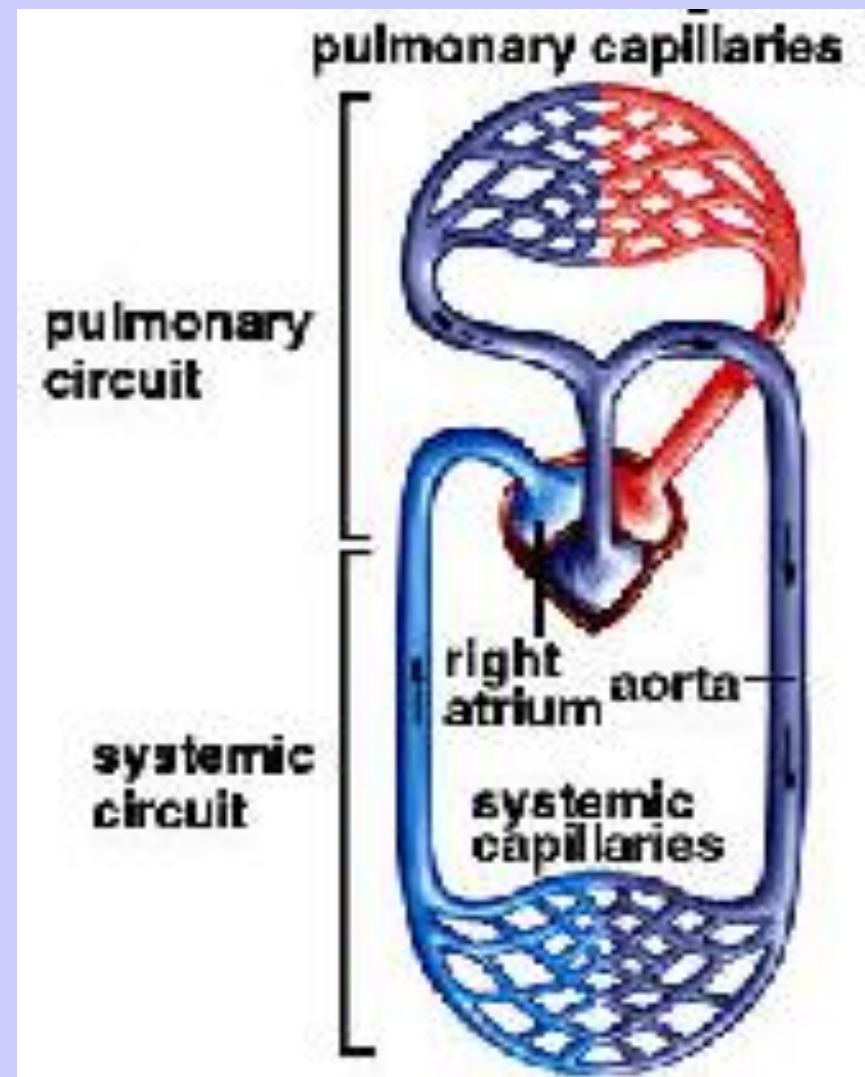
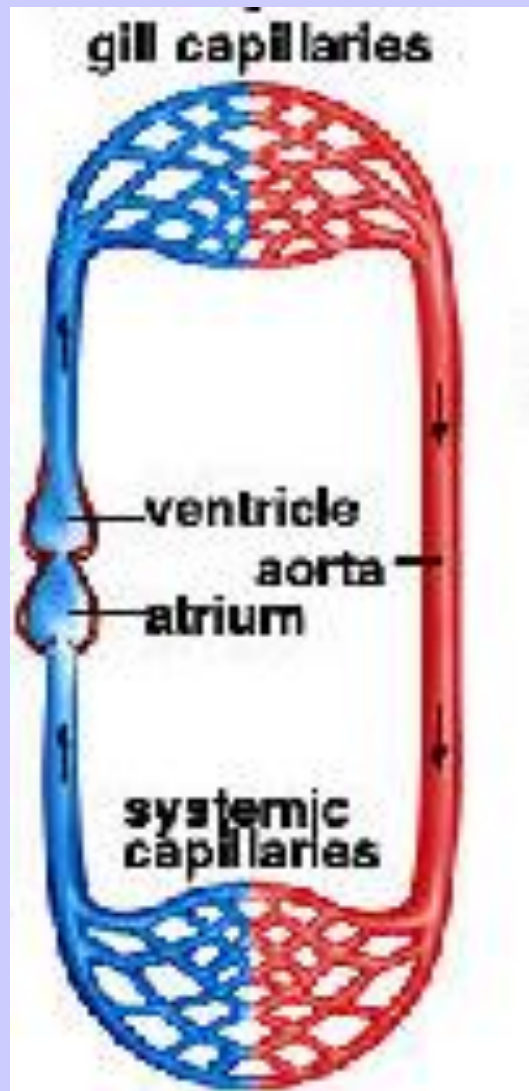


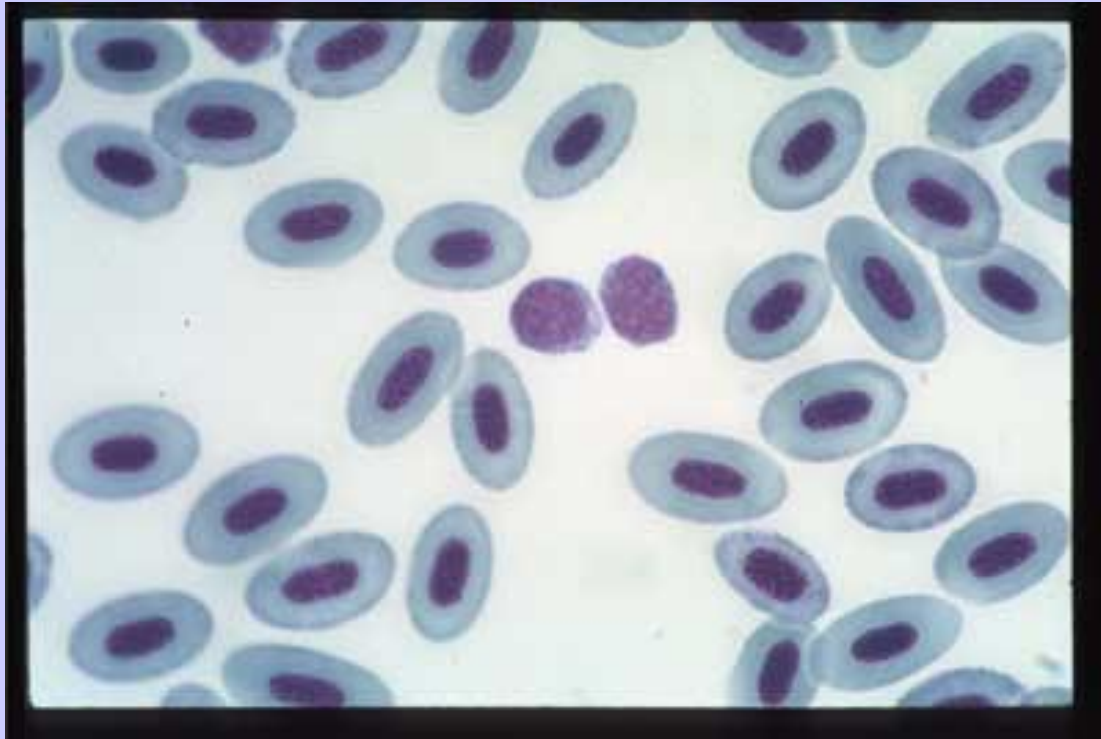
Image from: <http://www.digitalfrog.com/resources/froggallery.html>



**TADPOLES & FISH:**  
2 chambered heart  
1 loop system

**ADULT FROG:**  
3 chamber heart  
2 loop system

# **MOST vertebrates have nuclei in their RBC's**

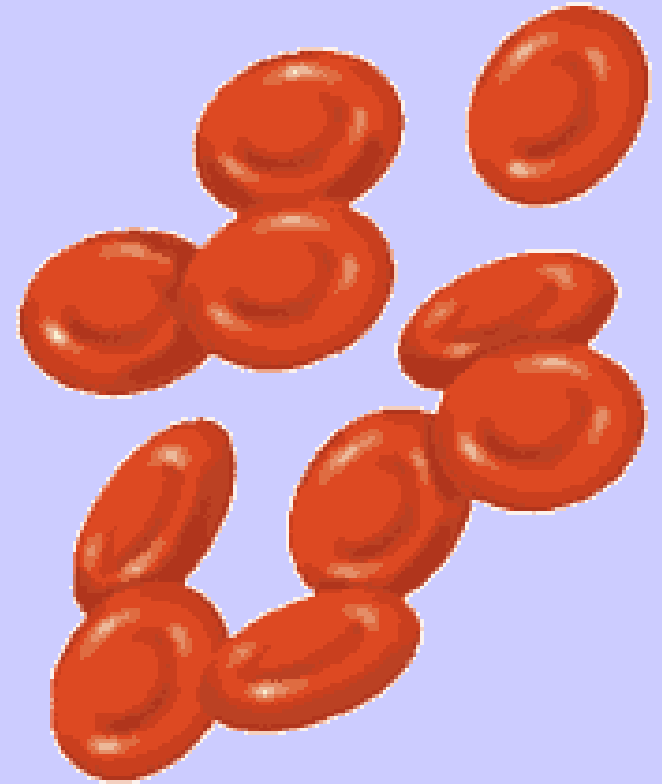


RBCs' image from:

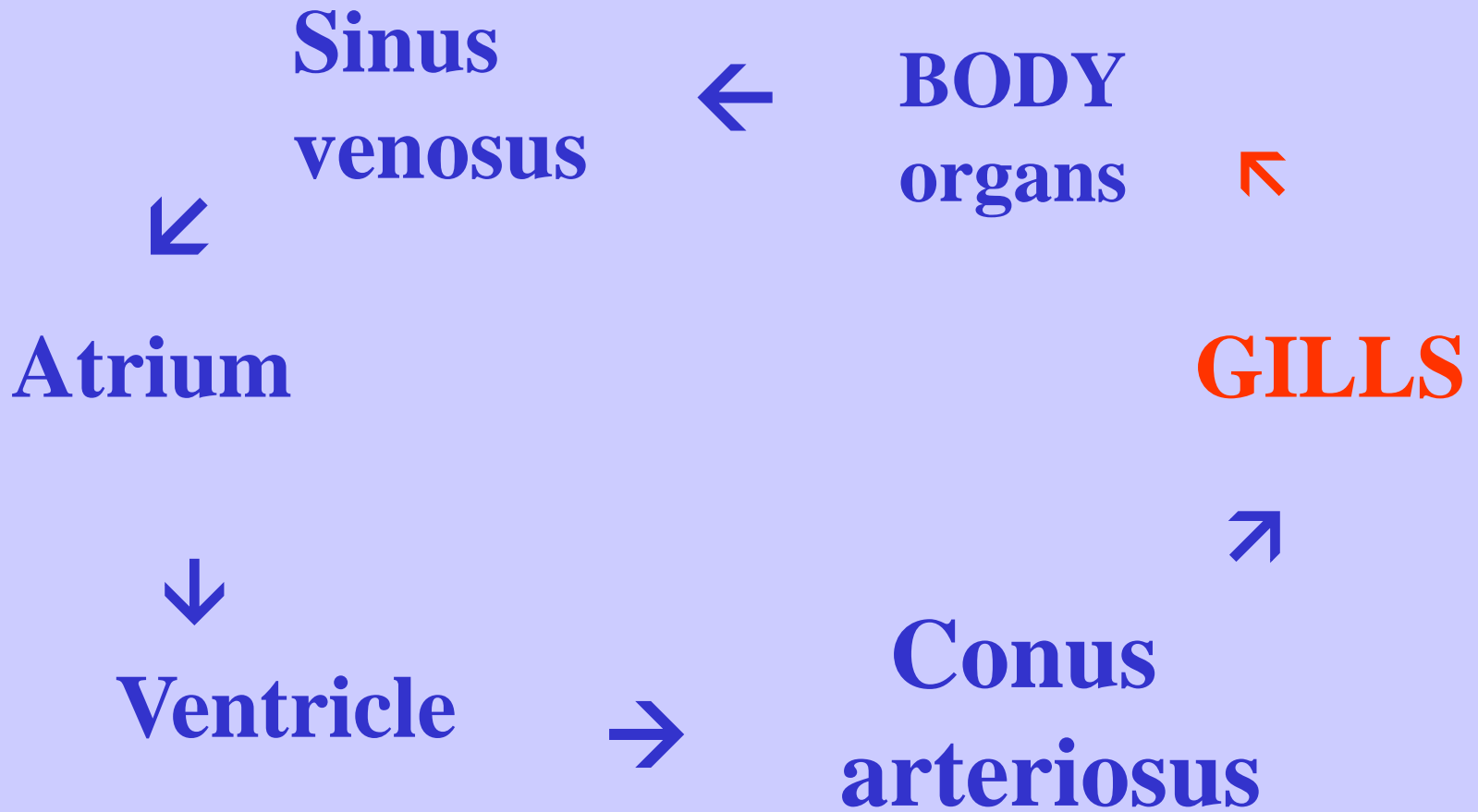
<http://www.fish-news.com/RG4001.jpg>

Human RBC image from:

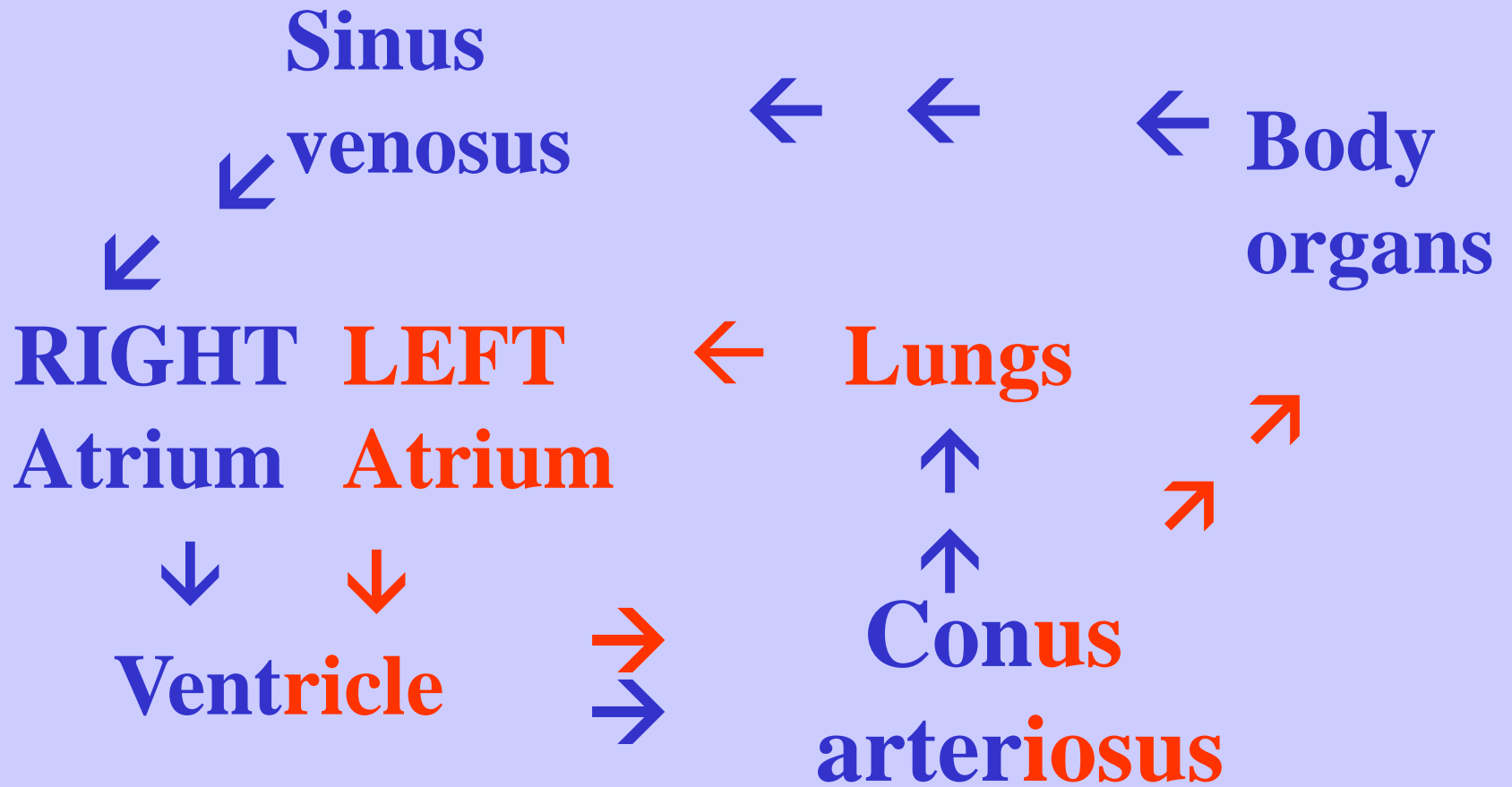
<http://www.nigms.nih.gov/moleculestomedes/images/bloodcells.gif>



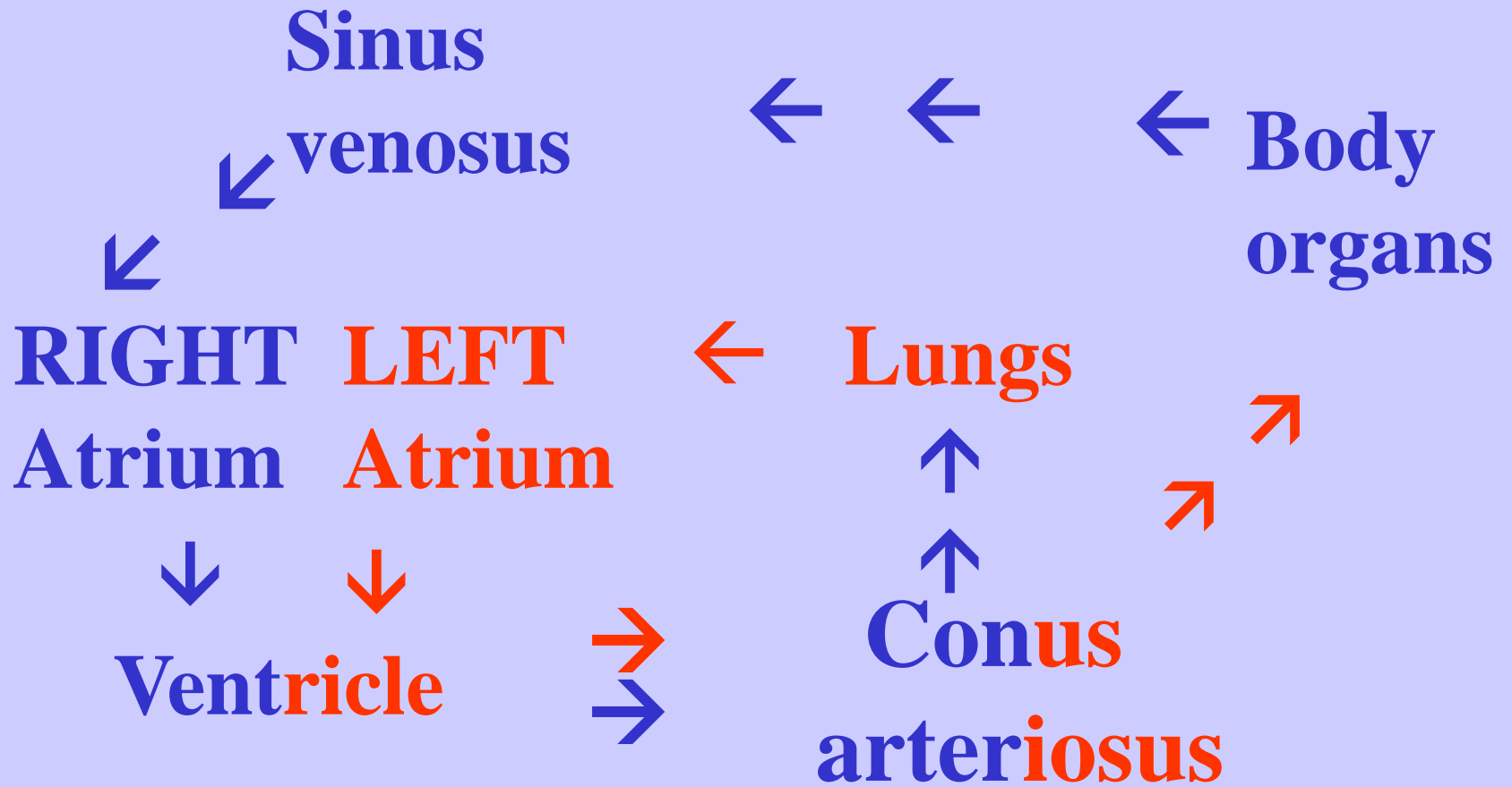
**MAMMALS DON'T**



# FISH CIRCULATION



# FROG CIRCULATION



# FROG CIRCULATION



# **SYSTEMIC CIRCULATION**

**→ LUNGS = Pulmonary**

**→ Kidneys = renal**

**→ Heart = coronary**

**→ Liver = hepatic**

# BRAIN

