Fluid therapy in wildlife

Pre-workshop lecture

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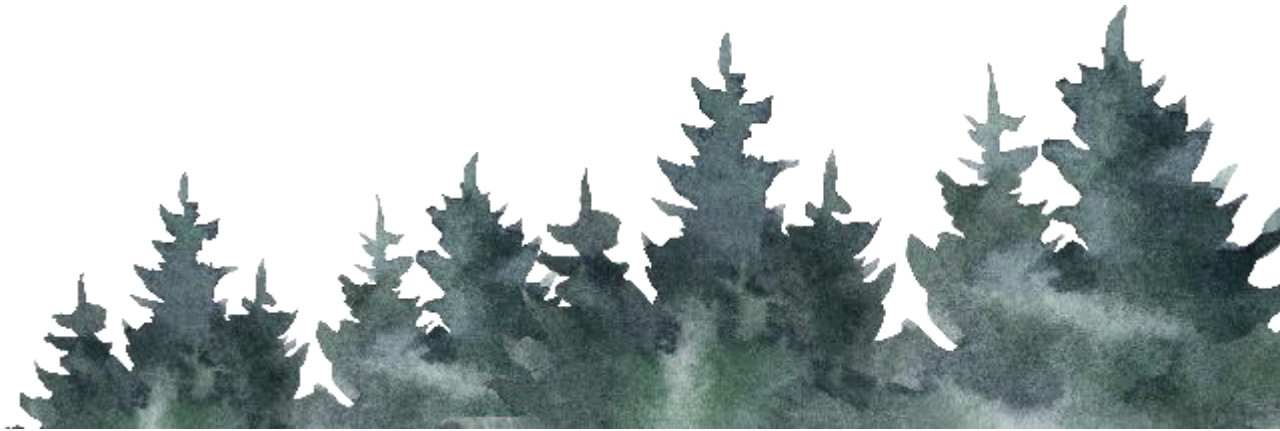

Why do we care?

- Fluids can be life saving
- Most of our patients come in with some degree of dehydration
- Simple treatment that can make a large difference
- Fluid is critical for normal function of all body systems and cells

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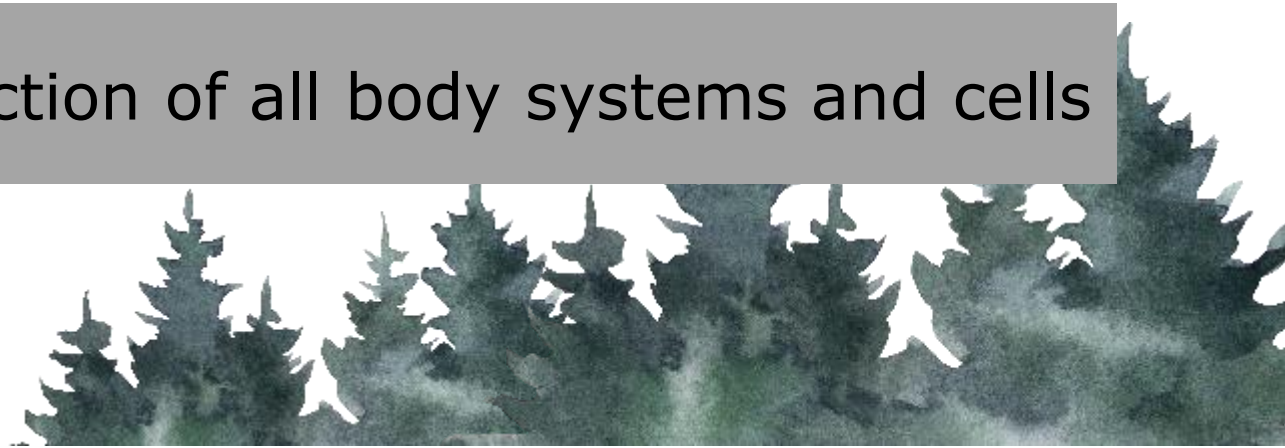
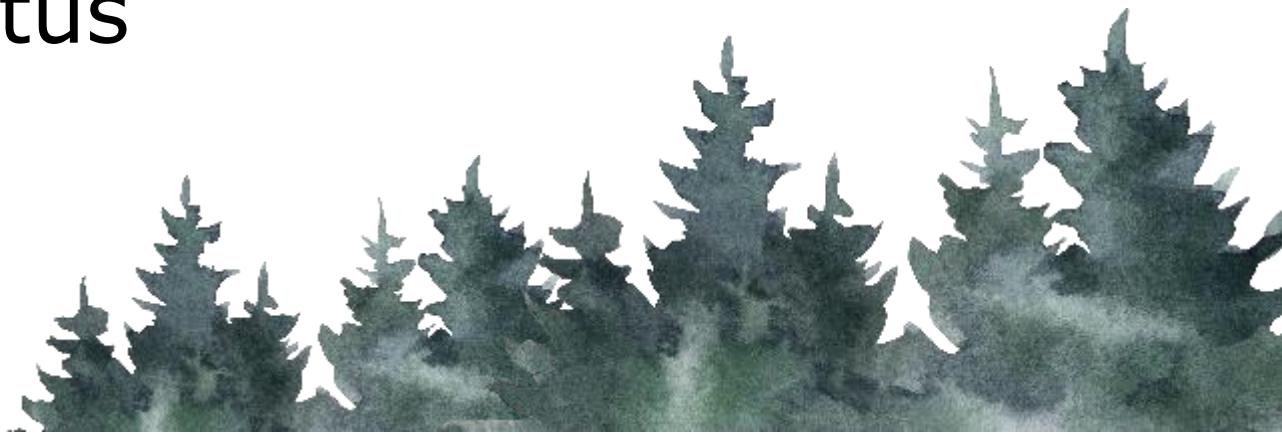


Indications for fluid therapy

- Rehydrating dehydrated patients
- Resuscitation (treatment of shock)
  - Corrects hypotension and hypovolemia
- Maintain patient's hydration status



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FLUID DYNAMICS

About 60% of body weight is water in an adult patient

Up to 80% of body weight is water in a neonatal patient

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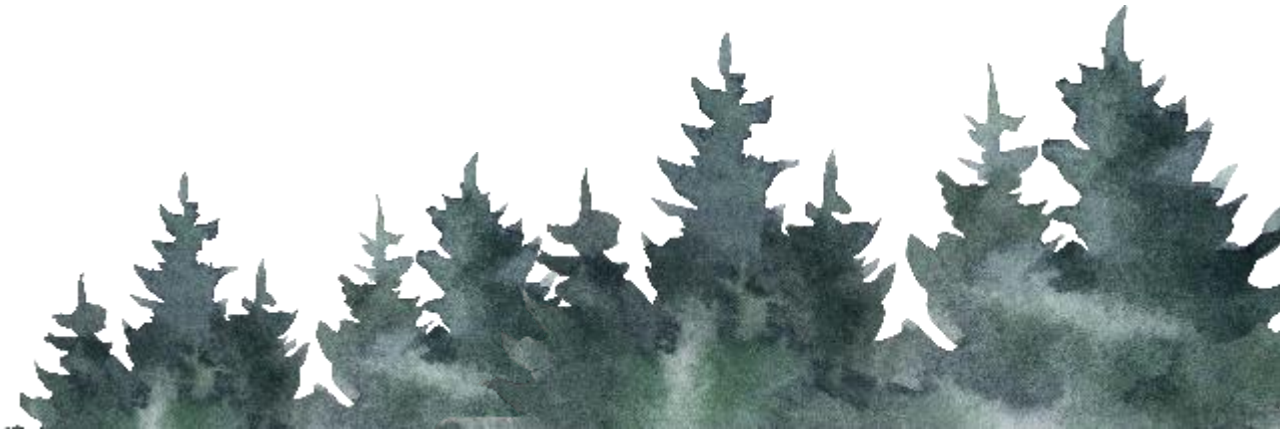


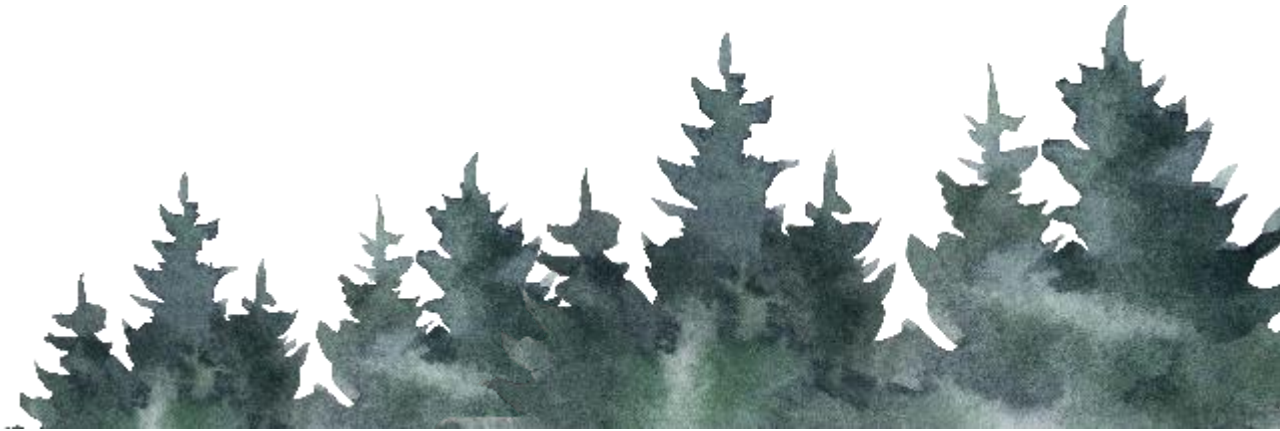
Where is the water?

Total body water

- Intracellular fluid (ICF)
- Extracellular fluid (ECF)

Mammals and birds
ICF >ECF

Reptiles (generally)
ECF >ICF



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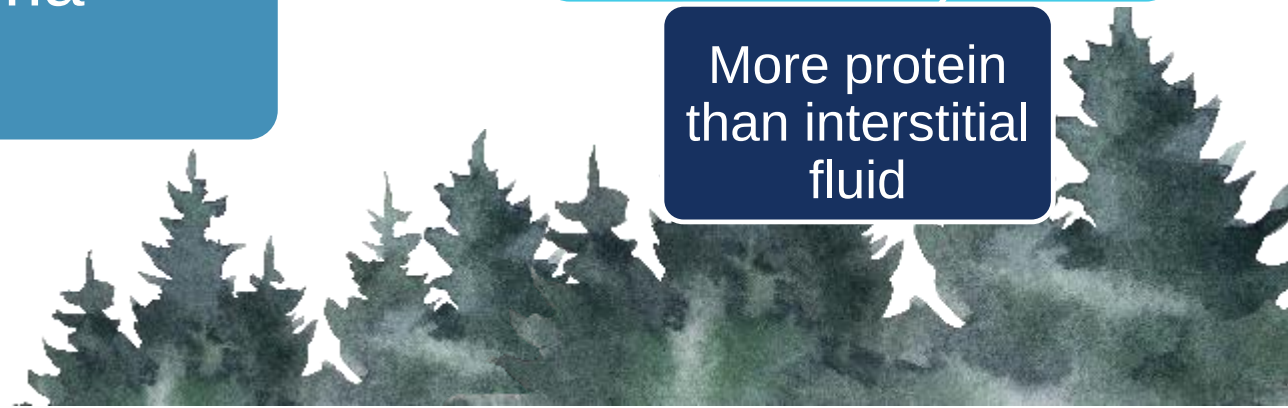
Extracellular fluid

Extracellular fluid

- Interstitial space
  - Fluid around cells and tissues
- Separated by walls of vessels
- Plasma
  - Fluid in the vascular system (the liquid part of blood)
    - More protein than interstitial fluid



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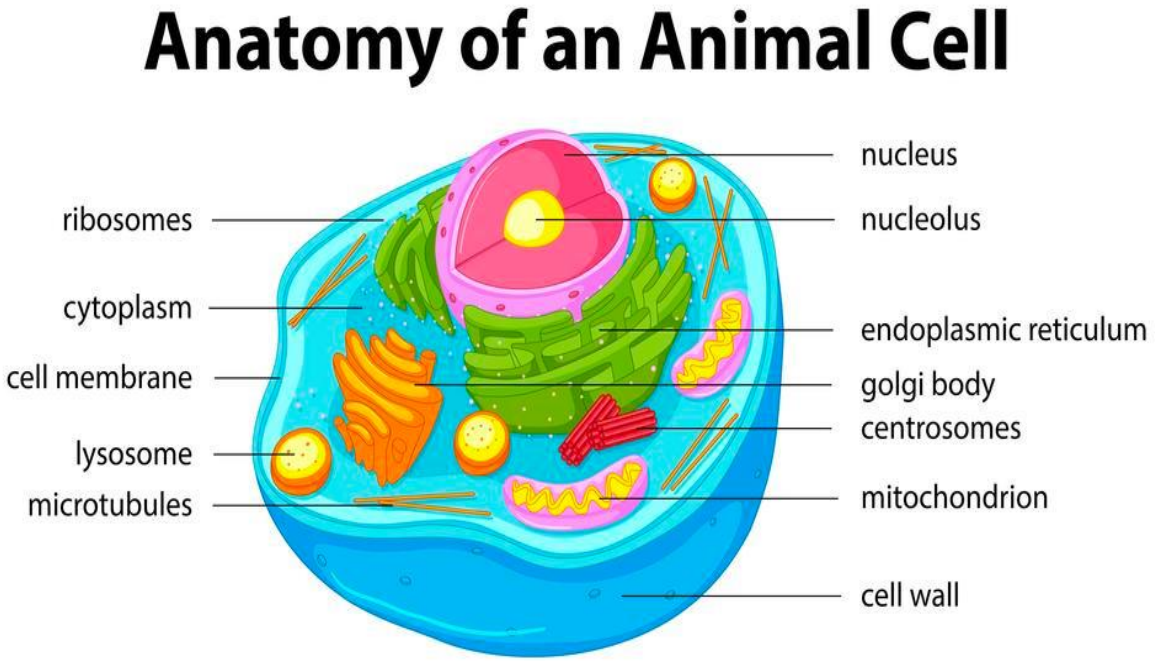
Intracellular fluid

The fluid inside the individual cells

- This is separated from the ECF by the cell membrane



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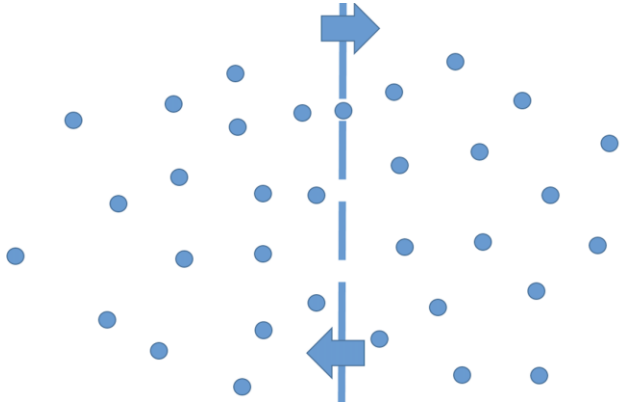
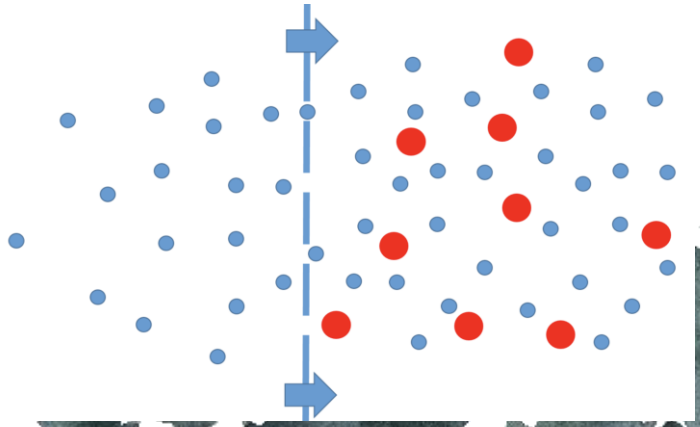
Membranes maintain compartments

- **Cell membranes** allows certain molecules or ions to pass through passively (via diffusion) or actively (via transport pumps)



- **Capillaries** are small blood vessels that have very thin walls that are bit leaky



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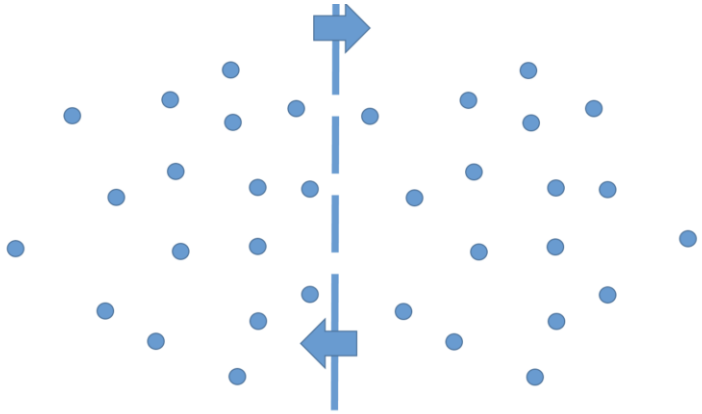
Diffusion and osmosis

- **Diffusion** is the spontaneous spread of particles from an area of higher concentration to an area of lower concentration until they are equally distributed



- **Osmosis** is the diffusion of water across a membrane

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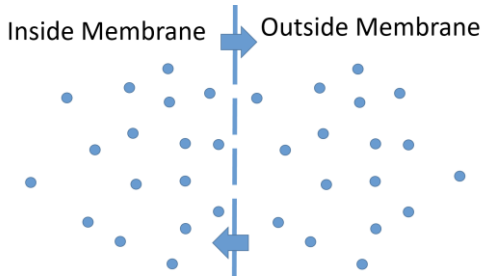
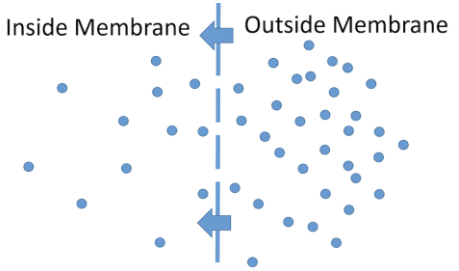
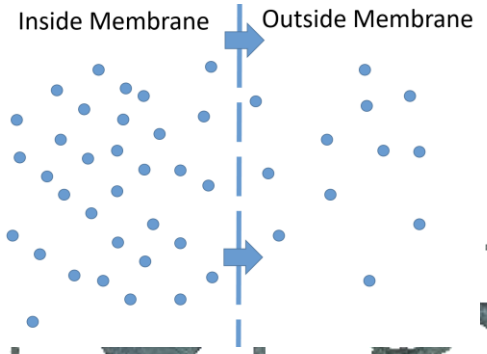
Tonicity

- **An isotonic solution** has the same concentration of molecules on the inside and the outside of the membrane
- **A hypotonic solution** has a lower concentration of molecules than on the inside of the membrane
  - Water will move into the cell via osmosis
- **A hypertonic solution** has a higher concentration of molecules that on the inside of the membrane
  - Water will move out of the cell via osmosis







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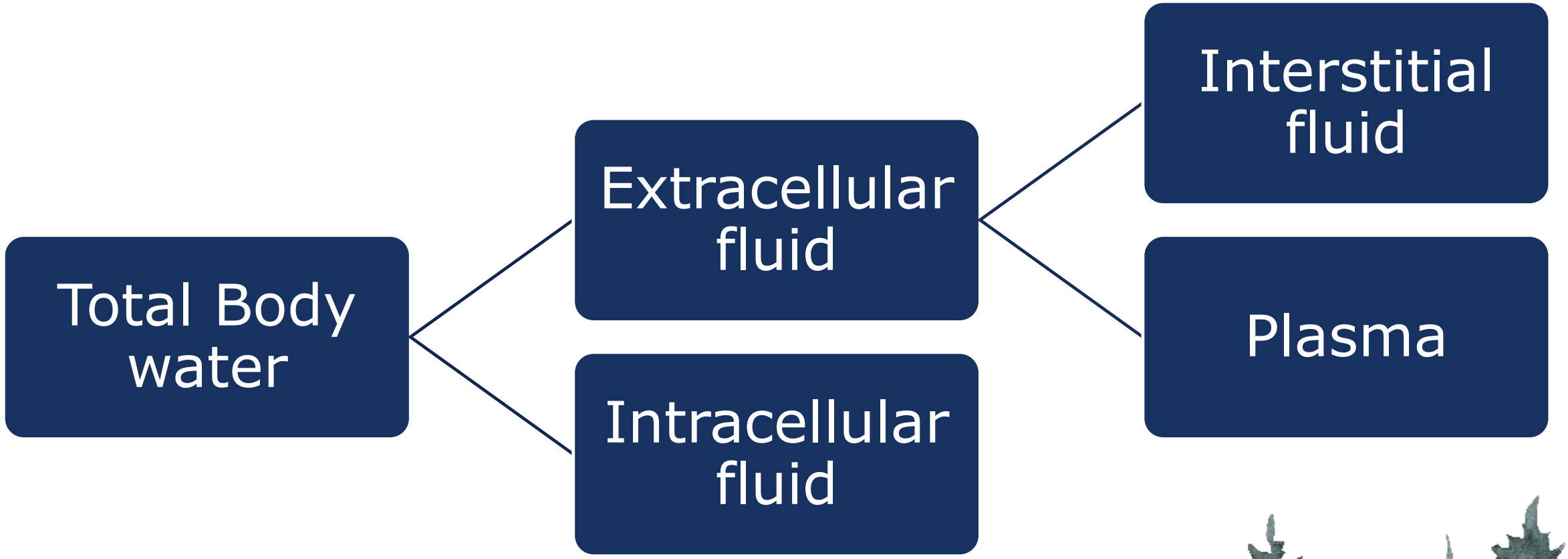
Fluid shift

Water moves freely between ICF and ECF (and compartments of the ECF) depending on osmotic pressure

Hydrostatic pressure

Gradients of electrolytes and other solutes pull fluid across semipermeable membranes

Putting it all together



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Water loss

Kidneys regulate water balance

- Primary way fluid leaves the body

Water is also lost via

- Breathing
- Feces
- Vomiting
- Skin

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While we usually think of dehydration as “water loss”, keep in mind when water is lost, the concentration of electrolytes, protein, and cells in the body are affected, which can alter their physiologic function

Water balance

water intake < water loss = dehydration

Water intake > water loss = over hydration

Kidneys change how much they are eliminating/conserving based on this in an effort to maintain optimal hydration

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Assessing and treating patients

Assess every patient to determine...

- Type of fluid
- Volume of fluid
- Rate of administration
- Route of administration

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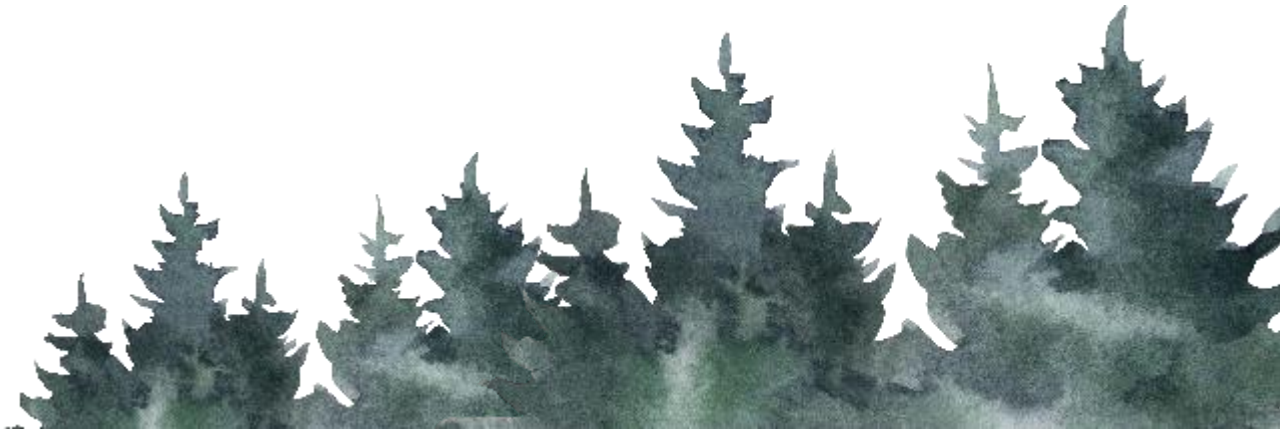

Common types of fluids use in wildlife

Crystalloid vs colloid

Crystalloids

Contain electrolytes and non-electrolytes that can enter all body fluid compartments so their effects are on interstitial and intracellular compartments

Examples: LRS, plasma-lyte, Normosol-R

Colloids

Molecules are too large to cross membranes, so stay in plasma and therefore have an intravascular effect

Only to be given IV or IO

Examples: hetastarch, plasma, dextran

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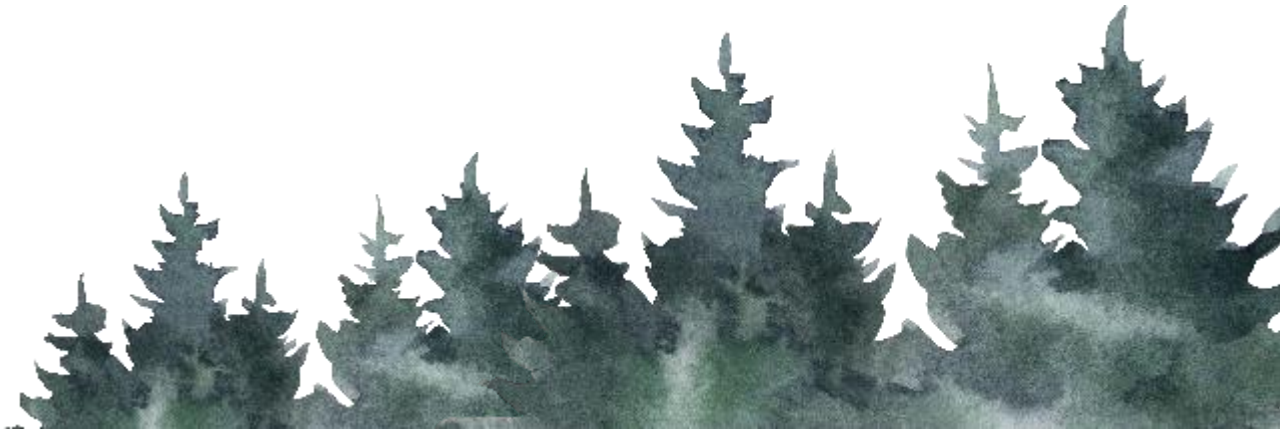

Fluid class	Subclass	Routes	Use	Examples
Crystalloid	Balanced or isotonic	IV, PO, SQ, IP/Ice, IO	• Restore fluid deficits • correct electrolyte imbalances, • provide maintenance fluids	• 0.9% NaCl • LRS • Normosol-R • Plasmalyte
	Hypertonic	IV, IO	• Treat hypovolemia • Treat cerebral edema	• 3% saline • 7% saline
Colloids	Natural	IV, IO	• Replenish red blood cells • Replenish plasma clotting factors	• Whole blood • Plasma products
	Synthetic	IV, IO	• Restore intravascular volume	• Dextran 40 or 70 • Hetastarch • Oxyglobin

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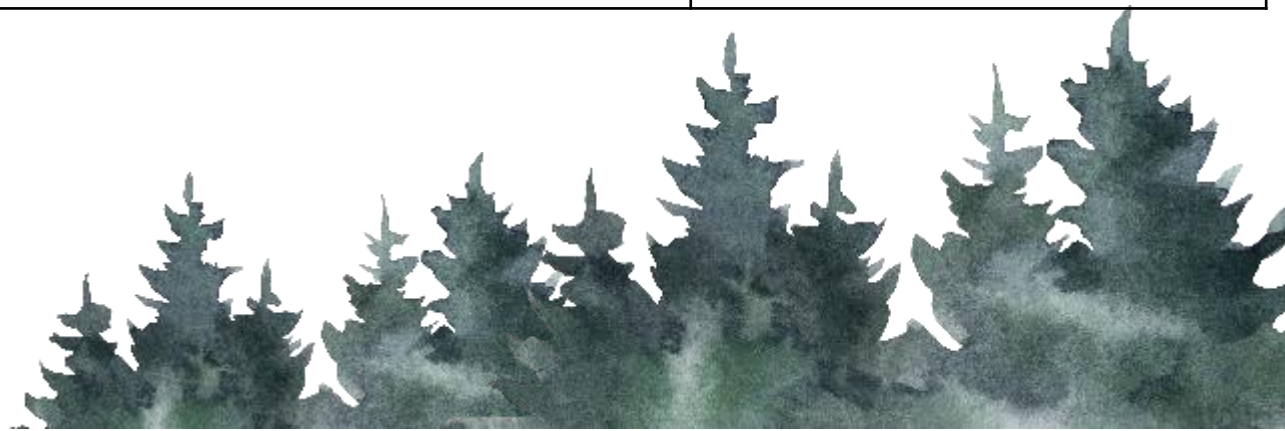

Assessing hydration status

- Use a **combination** of **physical** and **lab parameters** where possible to assess dehydration

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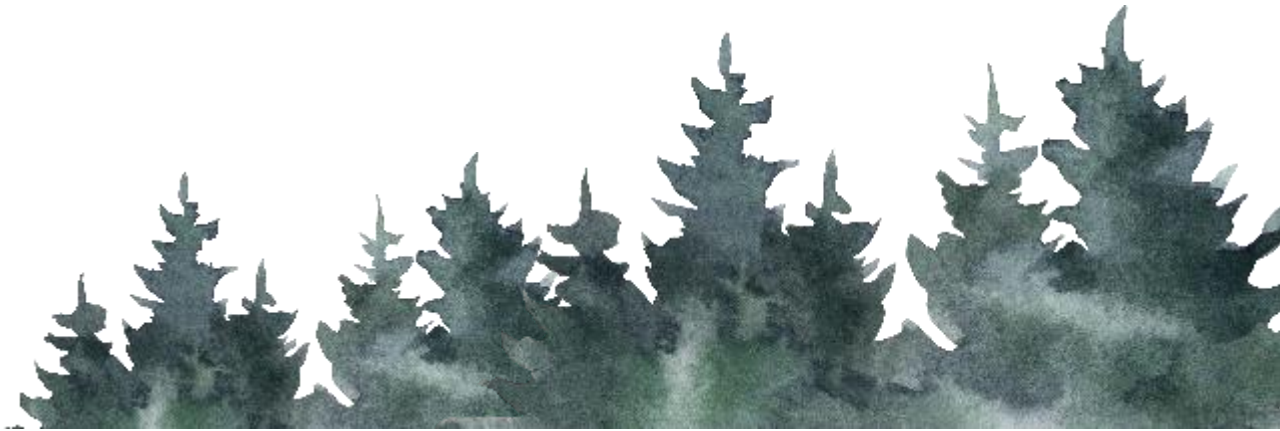

Dehydration – physical parameters

- Prolonged skin tent
- Decreased CRT
- Pale mucous membranes
- Sunken eyes

- Skin tent may be prolonged in old and young patients
- Mucous membranes may be dry due to panting
- Eyes may appear sunken due to trauma or emaciation

Caution!

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Prolonged skin tent

- Pinch and lift skin
- Should snap back into place quickly is patient is well hydrated

Capillary refill time

- The time it takes for capillaries to refill after pushing firmly
- In mammals, can test mucous membranes, in birds can measure ulnar or basilic (wing) vein
- CRT of > 2 seconds is abnormal

Mucous membranes

- Evaluate the color and texture of the mucous membranes
- Should be pale pink to pink
- Should be shiny and slippery to touch
- Thick mucous strands or a tacky texture are indicative of dehydration

Dehydration – lab parameters

- Elevated packed cell volume
- Elevated total protein
- Elevated urinary specific gravity

- ** evaluate prior to administration of fluids!

- Packed cell volume can also increase due to splenic contraction
- Total protein can also increase with inflammatory proteins
- Some animals have naturally very concentrated urine

Caution!

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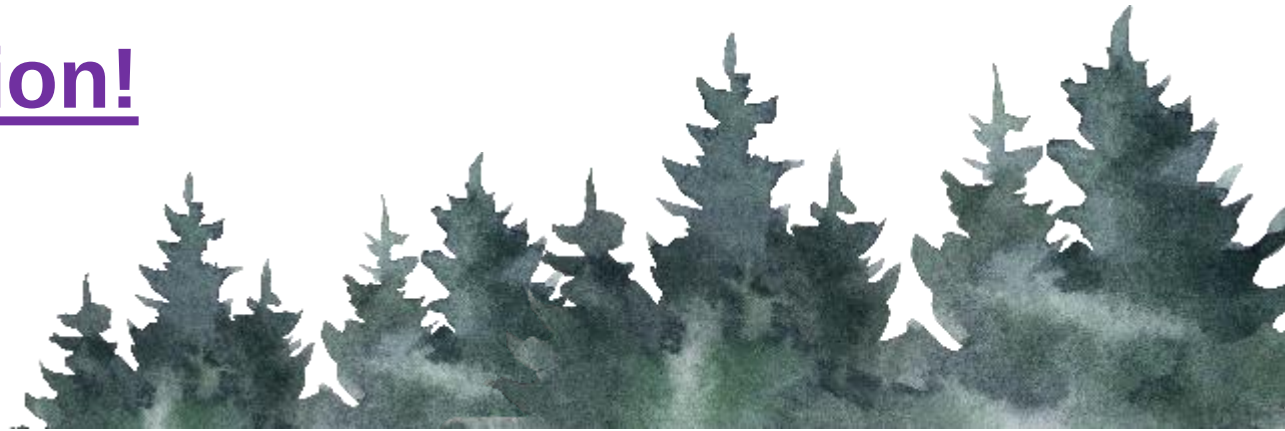

Assessing hydration – avian

<5%	5-10%	10-15%
• No changes on physical exam, but assume all injured birds experience this to a degree	• Skin appears tight over keel • Skin tents temporarily • Eyes are dull • Eye lids tent • Inside of mouth is dry	• Mouth is very dry • Mucous strands in mouth • Distal feet and wings may be cold • Skin stays tented • Rapid heart rate • Depressed

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Assessing hydration – mammals

<4%	5-7%	8-12%
• No changes on PE	• Skin tents • Mouth and mucous membranes dry	• Weak pulse • Cold • Sunken eyes • Skin remains tented • Pale mucous membranes

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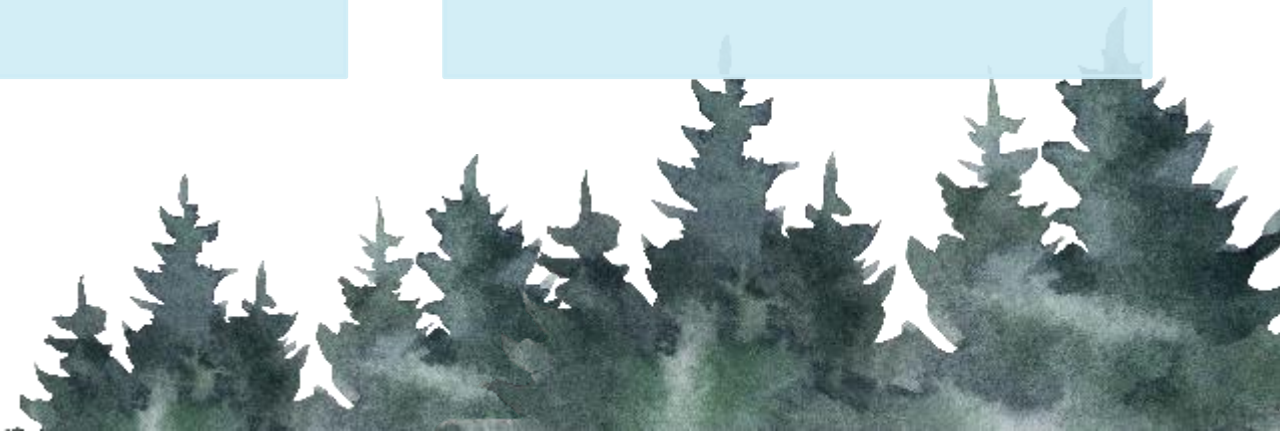

Assessing hydration – reptiles

3%	7%	10%
• Increased thirst • Slight lethargy • Deceased urates	• Anorexia • Dullness • Loose wrinkled skin when tented slowly returns to normal • Dull corneas • Dry/sticky mucous membranes	• Dull to comatose • Skin remains tented • Sunken eyes

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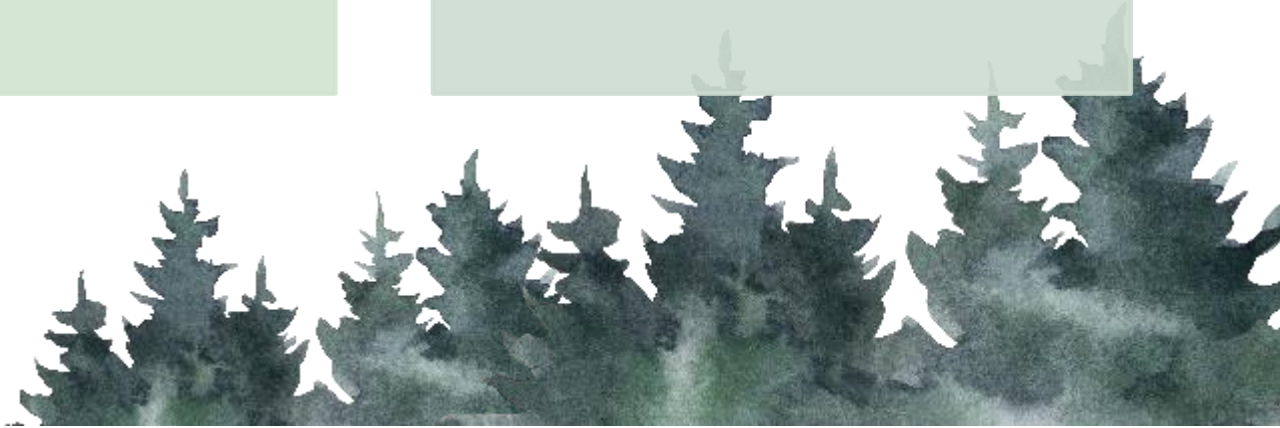

Overhydration

- Pulmonary edema / pulmonary crackles
- Dyspnea
- Chemosis (swelling of the eye lids)
- Serous nasal discharge
- Edema (especially in dependent areas)
- Ascites (fluid in the abdomen)

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Calculate fluid requirements

- Need to know:
  - Body weight (kg)
  - Maintenance fluid rate for the species
    - Generally, smaller animals will have a higher maintenance rate
  - % dehydration
    - based on Physical exam

Species	Maintenance Fluid Rate
Birds	60-90ml/kg/day
Mammals	50-60 ml/kg/day
Reptiles	10-30 ml/kg/day

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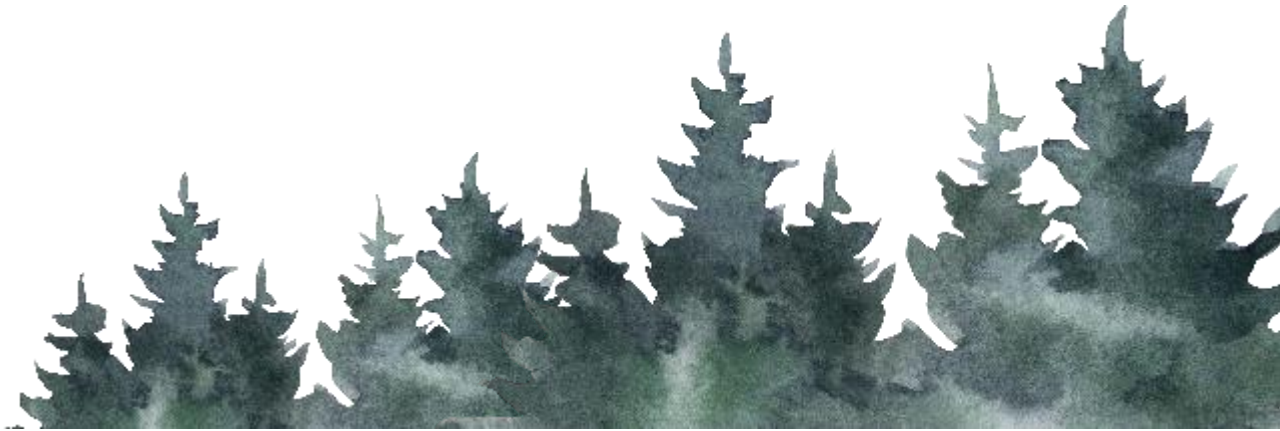

Fluid calculation

A. Maintenance Fluid Requirement

- Weight (kg) x Maintenance Rate for the species (ml/kg)
- = Volume in ml or cc

A. Fluid Deficit (Rehydration)

- % Dehydration x Body Weight (gms)
- = Volume in ml or cc

Species	Maintenance Fluid Rate
Birds	60-100ml/kg/day
Mammals	60-100ml/kg/day
Reptiles	10-30 ml/kg/day

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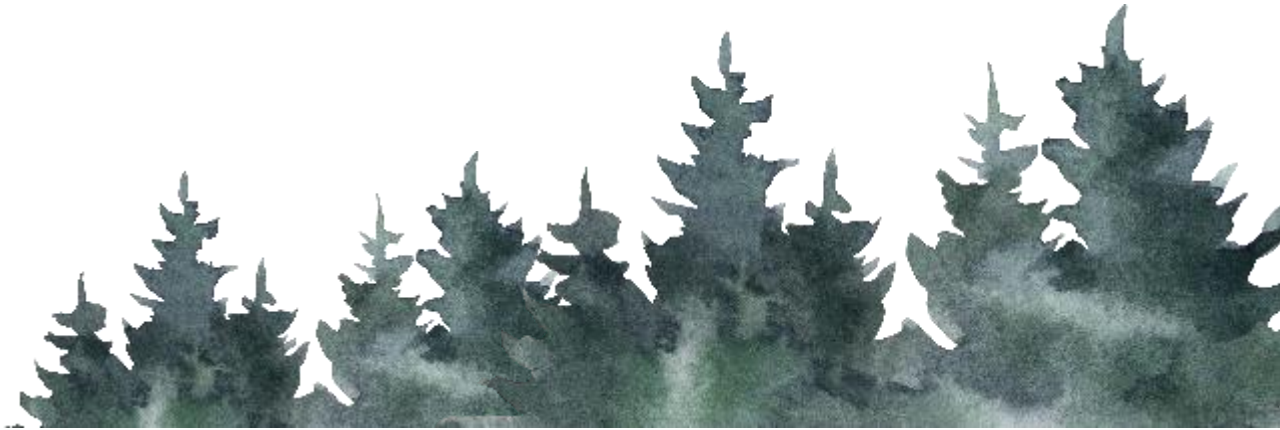
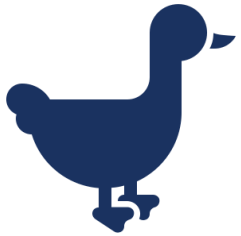


Spread out the deficit

Mammals – replace over 24-48 hours



Birds – over 48 hours

Reptiles – over 72 hours

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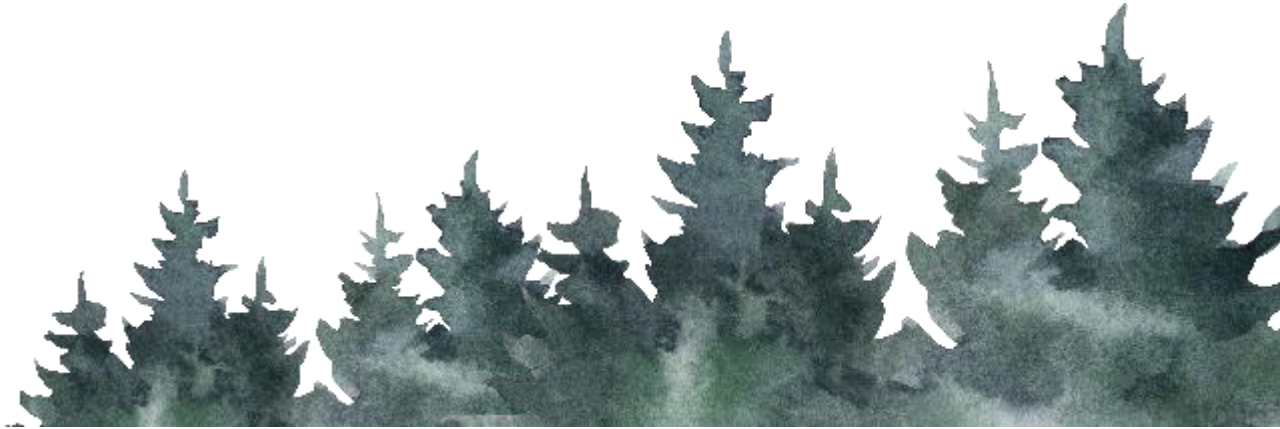

Spread the deficit out

- The maintenance fluids and ongoing losses are given daily
- Correct the Fluid Deficit over several days.
  - Half of the Fluid Deficit should be corrected within the first 24 hours.
    - **Day 1 = A + 1/2B**
  - The remaining half of the Fluid Deficit is divided over the following 24 – 48 hours.
    - **Mammal or Bird--Day 2 = A + 1/2B**
    - **Reptile-Day 2 &3 = A + 1/4B**

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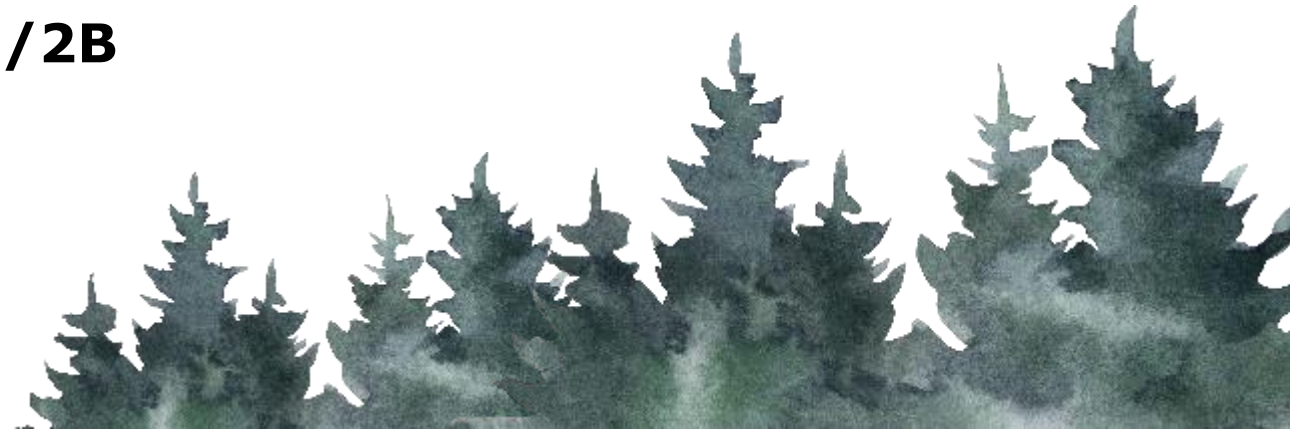

Rate of administration

Not as straight forward in wildlife as it is for dogs and cats

An “ideal” fluid therapy plan may cause extreme stress in our wildlife patients, which can cause death just as fast as dehydration

Strike a balance between spreading out the deficit replacement and keeping disruptions and handling of that patient to a minimum

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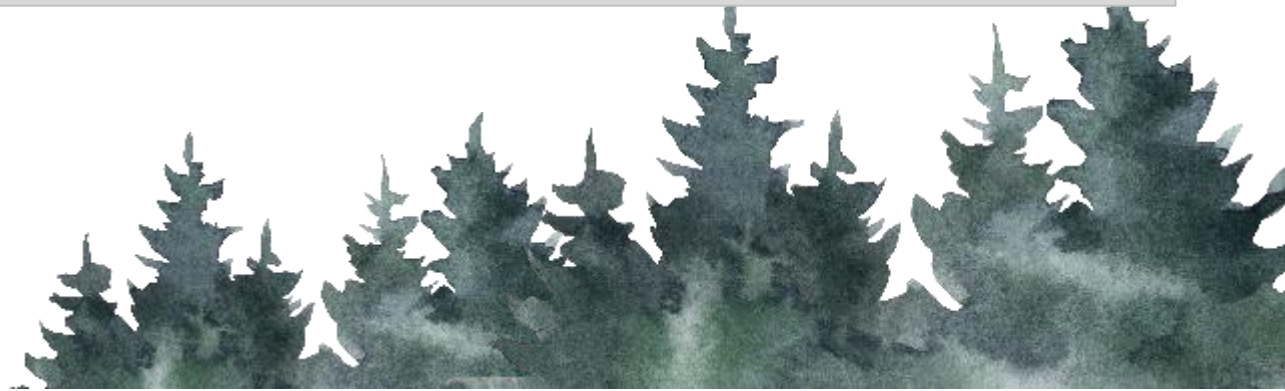

Fluid calculation example 1

Eastern Screech Owl, 150 grams BW, 7% dehydrated

A. Maintenance
   - = 0.15 kg x 60 mL/kg
   - = 9 mL

B. Fluid Deficit
   - 0.07 x 150 grams
   - = 10.5 mL

- Day 1: A (9 mL) + ½ B (5.25 mL) = 14.25 mL daily
- Days 2 : A (9 mL) + 1/2 B (5.25 mL) = give 14.25 mL daily

Fluid calculation example 2

Eastern Box Turtle, 350 grams BW, 9% dehydrated

A. Maintenance
   - = 0.350 kg x 20 mL/kg
   - = 7 mL

B. Fluid Deficit
   - 0.09 x 350 grams
   - = 31.5 mL

- Day 1: A (7 mL) + ½ B (15.75 mL) = 22.75 mL daily
- Days 2 + 3 : A (7 mL) + 1/4 B (7.87 mL) = give 14.9 mL daily

Shock

- A life-threatening decrease in blood flow that results in an inability to meet basic requirements for oxygen and nutrient delivery and waste removal
- In our patients, most often **hypovolemic shock**

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Causes of shock

- **Hypovolemia** (extreme dehydration or fluid loss) leading to **hypotension** (low blood pressure)
- Inability to pump blood (heart disease)
- Sepsis
- Central nervous system disease (inability to control vessels)
- Anaphylaxis

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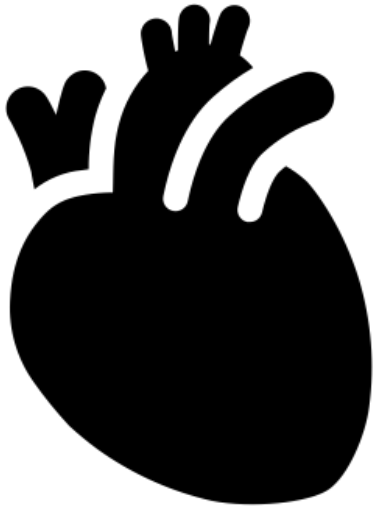
Physiologic response to hypovolemic shock



- Small vessels constrict to push blood volume into the larger vessels
- Heart beats faster and contracts with more force
- Hypotension (decrease in blood pressure) results in decreased blood flow to the kidneys which decreases urine production but can also cause injury to the kidneys

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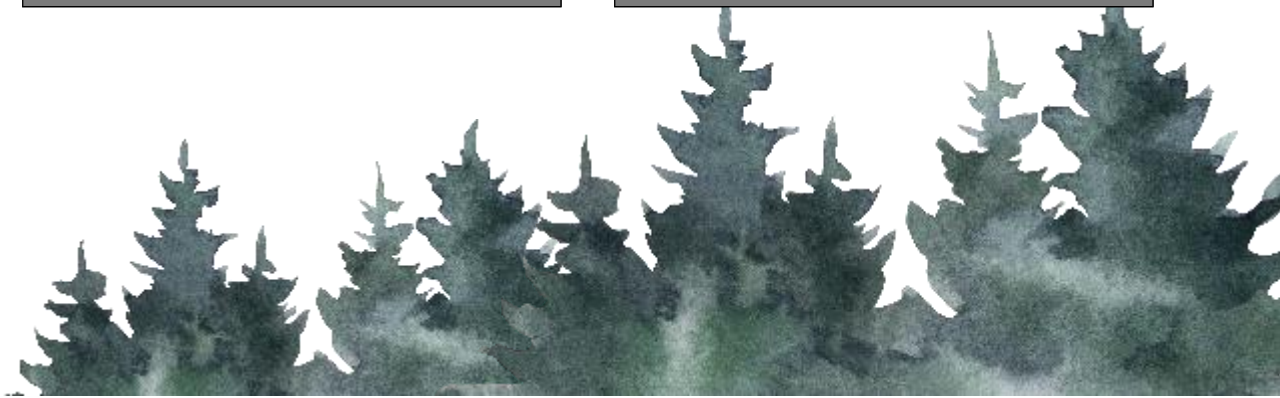
How to recognize shock

Depressed or obtunded mentation	Cool/cold extremities	Pale, tacky mucous membranes	Weak, rapid pulses
Lethargy	Collapse of peripheral veins	Decreased or no urine production	Hypotension (low blood pressure)



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Goals of treating hypovolemic shock

- Increase fluid volume in the intravascular space to increase fluid flow
- This will result in increased oxygen delivery to tissue

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Treatment of shock

- Requires immediate intervention
- Often large volumes of fluids given quickly
  - Give IV or IO
- Start with ¼ of "shock" dose, reassess, and repeat as needed
- Reassess frequently until patient is stable
- Monitor for signs of overhydration

Species	Shock Fluid Rate	
	Crystalloid	Colloid
Birds	90 mL/kg/hr	10-20 mL/kg Slow
Mammals	90 mL/kg/hr	Variable
Reptiles	40 mL/kg/hr	3-5 mL/kg slow

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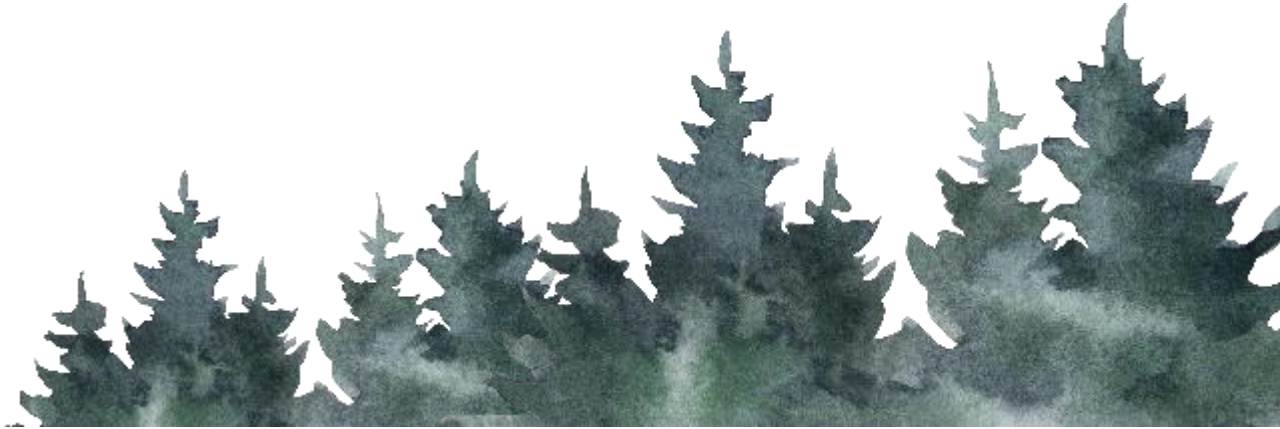

Routes of administration

- PO – orally or by mouth
- SQ/SC – subcutaneous or under the skin
- IP – intraperitoneal or into the abdomen
- ICe – intracelomic or into the ceolomic cavity
- IV – Intravenous or into the vein
- IO – Intraosseous or into the bone

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Mammal	Avian	Reptile
• PO • IV • SQ • IO • IP	• PO • IV • SQ • IO	• PO • IV • SQ • IO • ICe

How can fluids be given?

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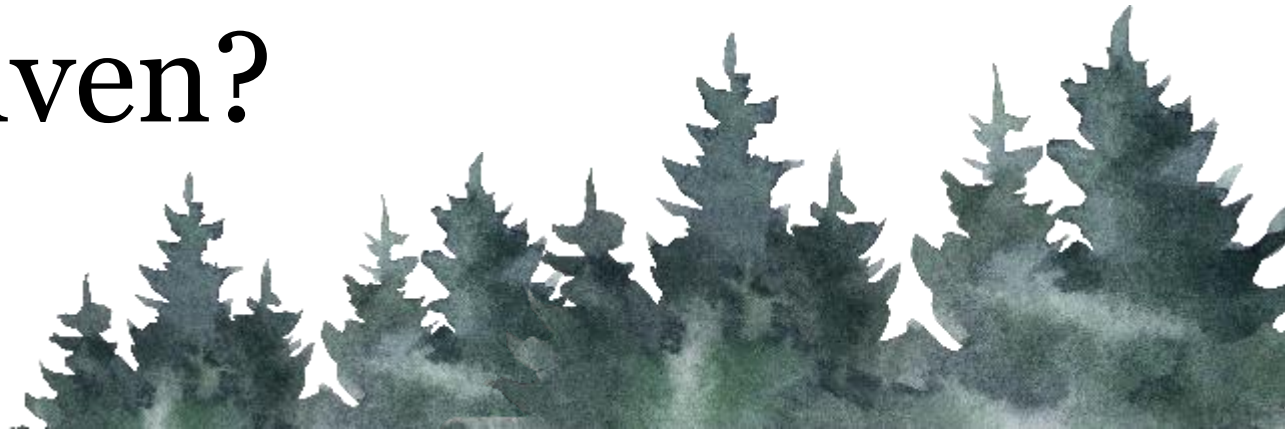

When to choose which route?

Less than 5%

- PO fluids
- ** unless GI issues

Moderate dehydration

- SQ fluids

Severe dehydration

- IV or IO (so large fluid deficits can be replaced)

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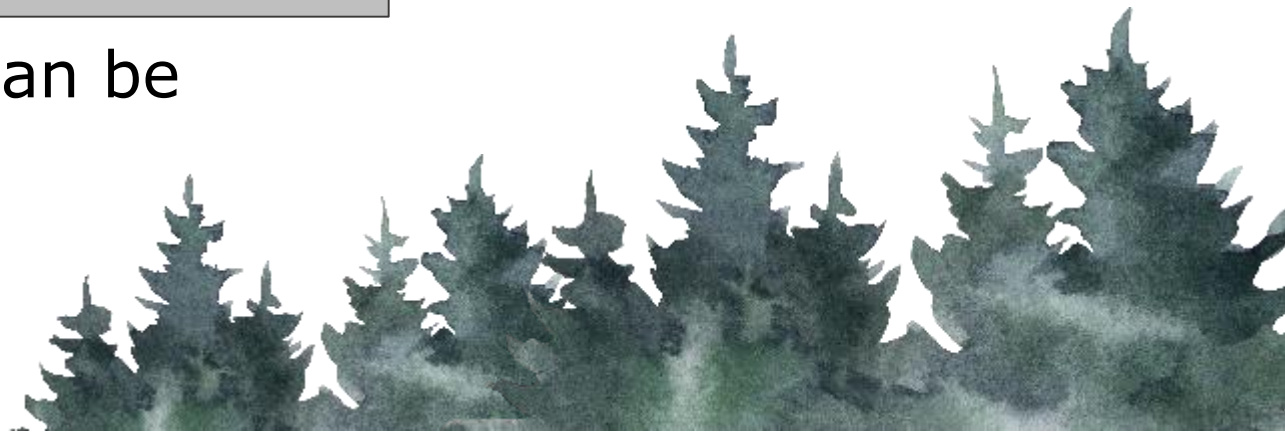

Oral fluids

- If the GI tract is working – use it and support it!
- Never use in unconscious animals or those that are unable to swallow
- Be mindful of patient's stomach volume
  - General rule no more than 5% body weight
- Use a balanced electrolyte solution, but Pedialyte or even water can work in a pinch
- Ideal for birds and young mammals

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Where to put the needle…

	REPTILES	BIRDS	MAMMALS
SQ	- Skin fold in inguinal fossa - Skin fold between the neck and forelimb	- Inguinal skin fold - Intrascapular (between shoulder blades)	- Intrascapular (between shoulder blades)
IV	- Jugular vein - Tail vein	- Basilic vein (wing) - Jugular vein (neck) - Medial metatarsal (leg)	- Cephalic vein (forelimb) - Jugular vein (neck) - Saphenous vein (hindlimb)
IO	- Femur - Tibia	-Ulna - Tibia	- Femur - Tibia

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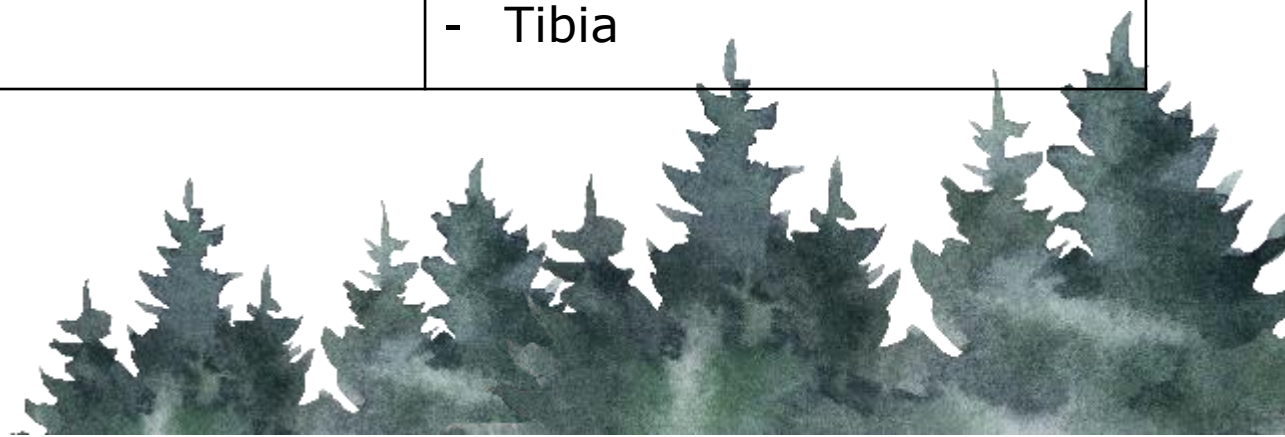
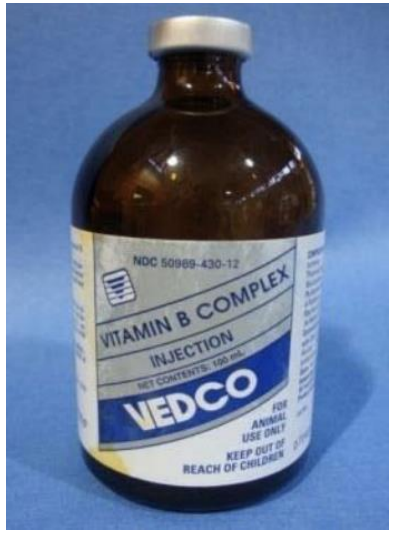
More on this in the lab!



Fluid additives

- Vitamin B
  - Patients are also deficient in vitamin B when they are anorexic and dehydrated
  - Water soluble vitamin, so little risk in supplementation
  - “hint of color”



WILDLIFE CENTER OF VIRGINIA

Soaking reptiles

- Soaking reptiles can be an effective way to maintain their hydration when in care
- Reptile will take up water while soaking, but also stimulates excretion and can help shed skin normally

WILDLIFE CENTER OF VIRGINIA

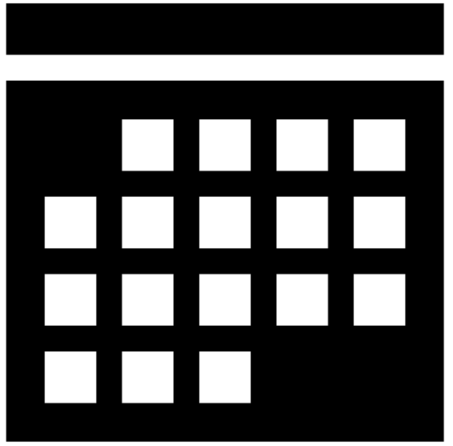
Fluid temperature

- Fluid should ideally be administered at body temperature
  - Giving cold fluids can lead to significant loss of body heat, especially in small patients and reptiles
- Can keep fluids in a fluid an incubator or fluid warmer
- Can warm in water bath or using a heating pad
- **Always ensure fluids are not too hot before administration as you can burn your patient with hot fluids!**

WILDLIFE CENTER OF VIRGINIA

Fluid expiration

- Once a bag is opened keep for a maximum of 30 days
- Label with date opened and expiration so there is no confusion!
- Use a new clean needle each time you draw up from that bag!



WILDLIFE CENTER OF VIRGINIA

Reassess

- Hydration status is extremely dynamic
- Fluid plan needs to be just as dynamic
- Re-assess patient looking for signs of dehydration and overhydration and modify plan accordingly

WILDLIFE CENTER OF VIRGINIA

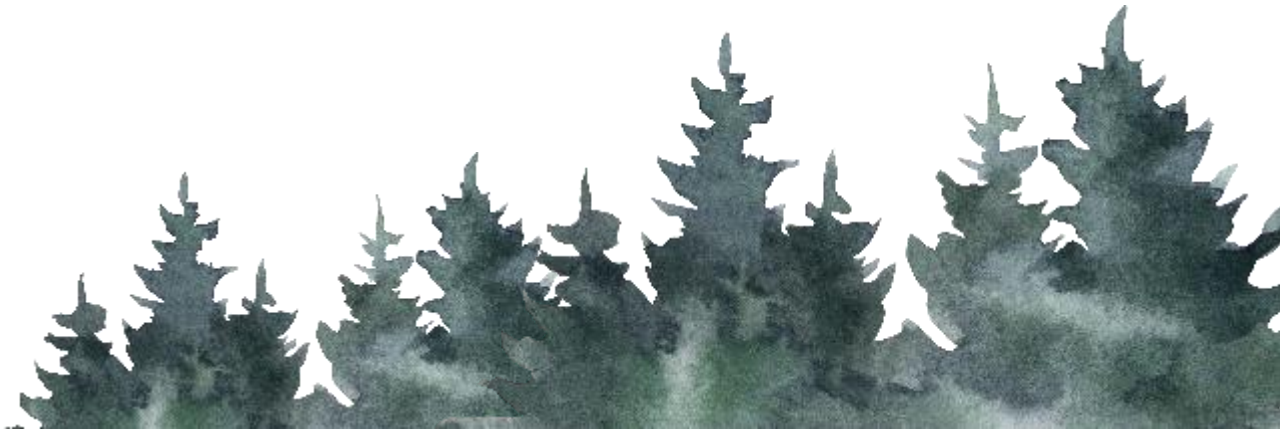
Common mistakes to avoid

- not giving fluids
- not giving enough fluids
- not continuing fluid therapy plan
- not reassessing routinely
- not addressing the underlying cause of dehydration

WILDLIFE CENTER OF VIRGINIA

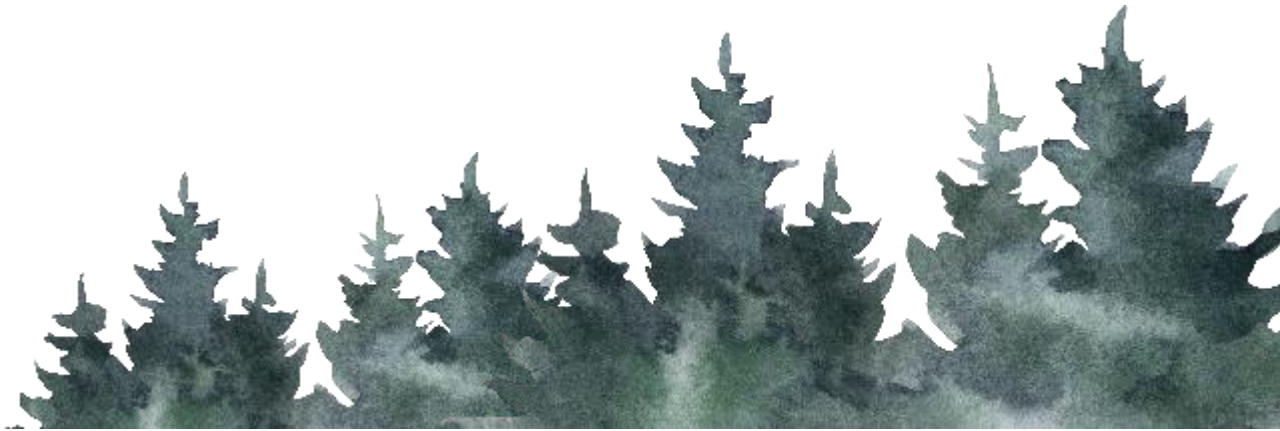
Questions?

WILDLIFE CENTER OF VIRGINIA



Let’s practice!

WILDLIFE CENTER OF VIRGINIA



Lab curriculum

- Using a needle and syringe
- Gavaging oral fluids
- Giving SQ fluids
  - Birds
    - Inguinal
    - Intrascapular
  - mammals
    - Intrascapular
  - reptiles
- IO catheter placement demo

WILDLIFE CENTER OF VIRGINIA