Homeostasis.

Essentially, the maintenance of stable internal conditions within the body.

We will concentrate mostly on temperature, moisture, and salt balance;

(They're the most important when choosing a habitat).

I. Temperature.

First, some definitions that everyone should already know:

endotherm - animal that maintains it's temperature internally (gets heat from metabolic processes.

ectotherm - animal that maintains it's temperature using external sources.

Some older terms that aren't used much anymore, but are still useful

homeotherm - animal whose temperature is relatively constant.

Note that an ectotherm can be a homeotherm (at least in the short term).

poikilotherm - animal whose temperature varies.

Amphibians and reptiles are all ectotherms.

In other words, they get their heat from the environment.

That does not mean that a few of them are not capable of raising their body temperature above their surroundings:

Leatherback sea turtles use a combination of size (i.e., thermal inertia) and muscle contractions to raise their body temperature above the surrounding water.

This is supplemented with insulation and counter current systems.

One of the reasons they can range so far north.

(Eat mostly jellyfish!)

Indian pythons also use muscle contractions and can raise their body temperature as much as 4 - 7 ºC above surroundings.

Temperature regulation:

Not all amphibians and reptiles thermoregulate. Many plethodontids and other salamanders don't seem to bother (except when temperatures become extreme).

Also note the obvious - just because two species of amphibian and/or reptiles are living in the same place doesn't mean the prefer the same temperatures.

In its simplest form, temperature regulation involves warming up until a desired temperature is reached, then alternatively warming and cooling as the day (night) progresses.

[Diagram from text]

Reptiles and amphibians have a preferred range of temperatures during which they are active.

At an animals preferred temperature, it is usually best able to perform.

Text mentions the green frog and jumping ability:

Is best between 10ºC and 25ºC, drops off on either side of this range.

Animals can also change their behaviors to adapt to their temperature:

E.g., running away (at preferred temperature) vs. threat displays (at suboptimal temperatures).

Extremes of temperature can be damaging or even lethal.

At extreme temperatures:

Cold: freezing kills; ice crystals forming in cells can destroy body cells (e.g., puncture cell membranes).

Some cold adapted species have glycerol and/or glucose in cells that acts as an antifreeze and can survive some freezing.

E.g., Box turtles, spring peepers, wood frogs, some others.

Heat: denatures or inactivates enzymes.

Long before temperature kills, the animal may be inactivated or slowed down enough to become easy prey.

To warm themselves, amphibians and reptiles have several choices:

- get into the sun (radiation).

- move onto something warm (conduction).

- change color (become darker)

- obviously helps absorb heat

- in general, reptiles (more so than amphibians) will warm themselves as quickly as possible when they want to be active.

- think of getting up in the morning and warming yourself up for the day's activities.

To cool off, also several choices:

- move out of the sun and off of any heat source.

- gasp/pant, foam at mouth

- carotid arteries also pass over roof of mouth

- in extreme cases, urinate, salivate, defecate (helps with evaporative heat loss).

- usually only when seriously stresses due to heat.

Interestingly, reptiles can seasonally adjust their preferred operating temperature and acclimate (somewhat) to changing temperatures.

There are also physiological changes an animal can undergo:

Different enzymes can take over as temperatures change.

Thyroid can increase/decrease metabolism

Hormones from the adrenal glands (corticosteroids) can also help adjust metabolism and heat.

Oxygen flow to tissues can be reduced at high temperatures, which lowers metabolic rate.

Nocturnal amphibians and reptiles:

Generally active at lower temperatures (though, of course, that may be what's desired (e.g., desert species).

Sometimes body temperature is more variable.

In some species, nocturnal temperatures are actually lower than the ideal temperatures.

This can impact digestions and other activities.

(As an example, geckos often spend days in warm crevices to make up for being active at lower temperatures at night).

Temperature (body temperature) is sensed by the hypothalamus.

Vertebrates (including reptiles and amphibians) also have the usual heat/cold receptors in their skin:

Organ of Ruffini - registers heat.

Krause bodies - register cold.

Advantages of ectothermy:

Lower metabolism - less food needed.

Body doesn't wear out as fast.

Lower temperatures can be tolerated (hibernate!)

No insulation needed.

Hibernate / aestivate when food is scarce.

Disadvantages:

Need to hibernate in most temperate species (aestivate in many tropical species).

Lower temperature => sluggish movements, easier prey.

Restricted geographic ranges, seasons, daily activity cycles, etc.

2. Moisture and salt balance.

Just as with temperature, amphibians and reptiles need to save/preserve water.

Of course, they generally do better under certain moisture regimes.

Much of this has already been discussed when we did anatomy, but here are some important points to remember:

Salt balance:

Amphibians are rarely found in marine environments - kidneys are not that efficient.

Cane toads and Crab eating frogs are exceptions.

Reptiles have better kidneys, and so are found more frequently in an marine environment.

Water tight skin also helps.

Several have salt glands that will excrete excess salt.

Location varies:

- near eyes in marine turtles.

- near nose in gopher tortoises (Gopherus)

- actually secretes KCl.

- near nose in marine iguanas.

- under tongue in sea snakes.

(Your text had detailed descriptions of kidney function in amphibians and reptiles).

Water retention:

Probably the most important mechanism for controlling water balance is behavior.

- adopting water conservation postures.

- drinking (!)

- changing activity cycles (active at night/aestivation/hibernation).

- adjusting food sources (don't eat excessively dry food when conditions are dry - e.g., chuckwallas)

- aggregating (groups loose less water - seen in some geckos).

- some Ranids can stop urine production while on land, and actively reabsorb water in the bladder.

- secreting uric acid (already mentioned).

- special mechanisms such as waxing skin.