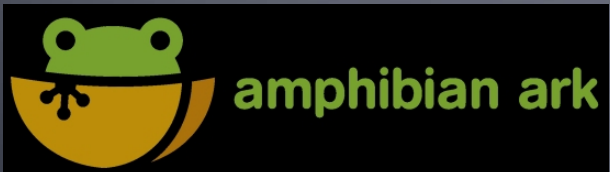


The Principle of Amphibian Husbandry



Materials produced by: **R. Andrew Odum, Curator**
Department of Herpetology
Toledo Zoological Society

What is Husbandry?

The discipline of care and breeding of animals in captivity.

Using Scientific Principles

**Taking good care of your
animals.**

Maintaining Welfare (Well Being)

How do we know? Metrics

- Absence of disease
- Normal Behaviors
- No Abnormal Behaviors
- Can reproduce
- Not Dead – The dead do not have welfare

Needs

- **Appropriate Environment**
- **Water in appropriate form**
- **Appropriate Food**
- **Appropriate Intra-specific interaction**
- **Energy**
 - Light
 - Heat
 - UVB

Know Your Animals

These are not reptiles, birds, or mammals

Amphibians are much closer to fish than they are to reptiles, birds, and mammals



Think of the amphibian as a fish with legs

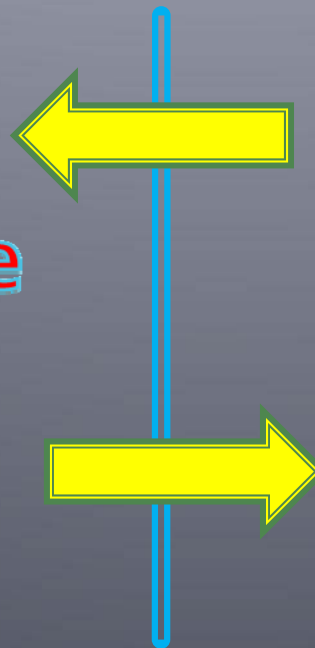
Homeostasis

The inside/outside barrier

Skin Barrier

The Outside
Environment

The Inside

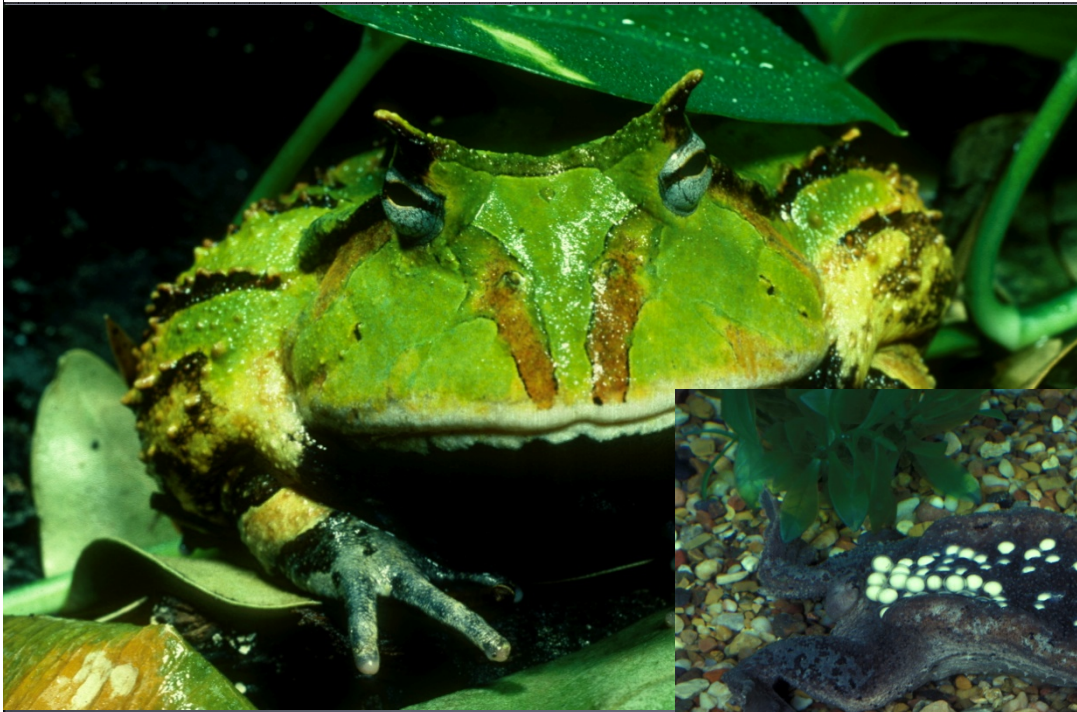


**Amphibians are cool
...and good taste**

**My
complexity is
exceeded
only by my
good looks**



Different animals have different requirements



Know your subject!

- Review Literature
- Ask others
- Observe and learn from your animals
- Share



Please do a
good job on my
home

The Amphibian Environment

The appropriate environment is
95% of good amphibian husbandry

Enclosure

One species, several life stages

Enclosures may be designed for only one life stage

Enclosure Functions

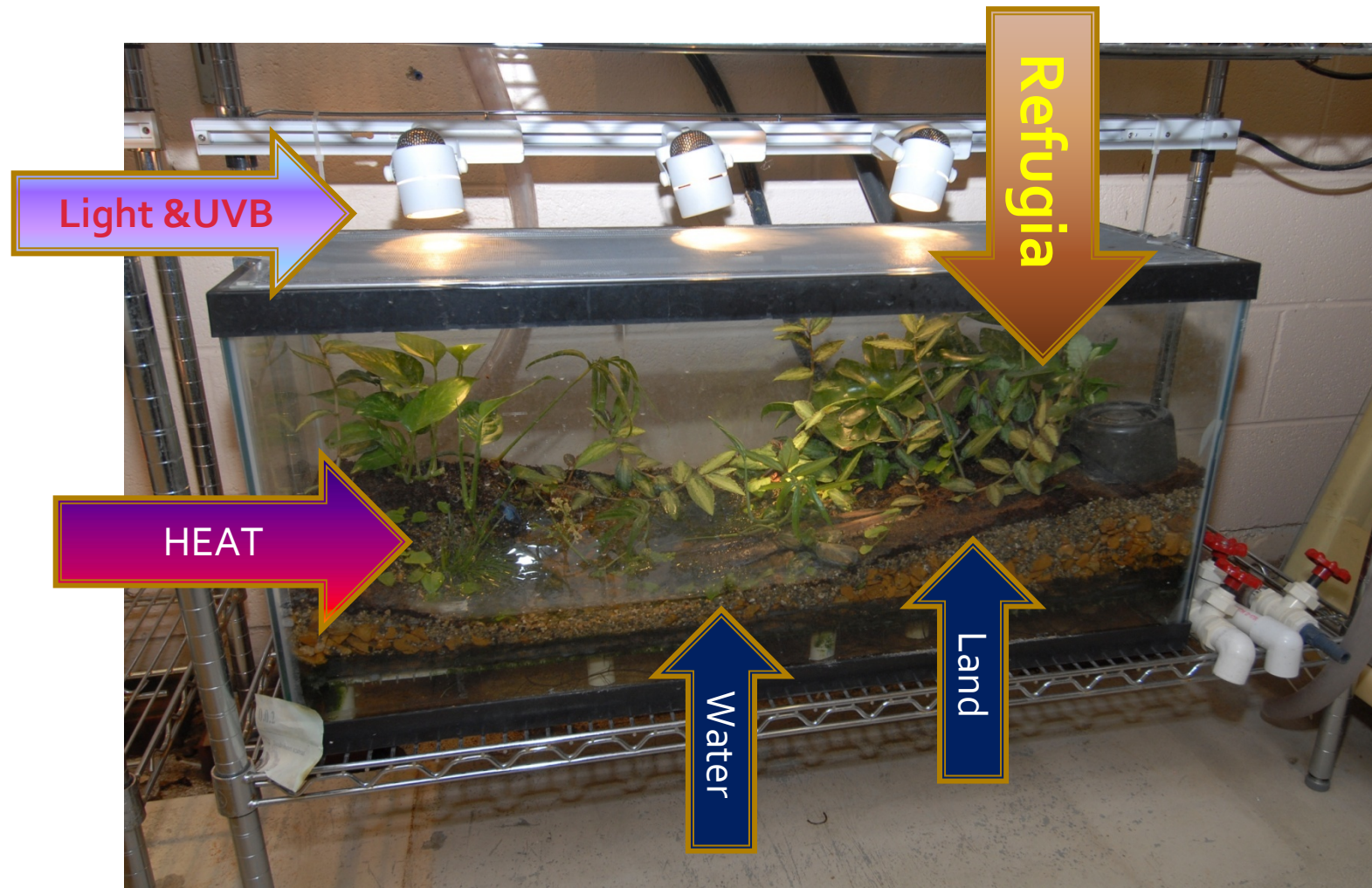
- **Maintenance**
- **Breeding**
- **Larval Rearing**
- **For Metamorphosis**
- **Growth of juveniles**

The Environment

Heterogeneity



Creating a micro-environments



Environment

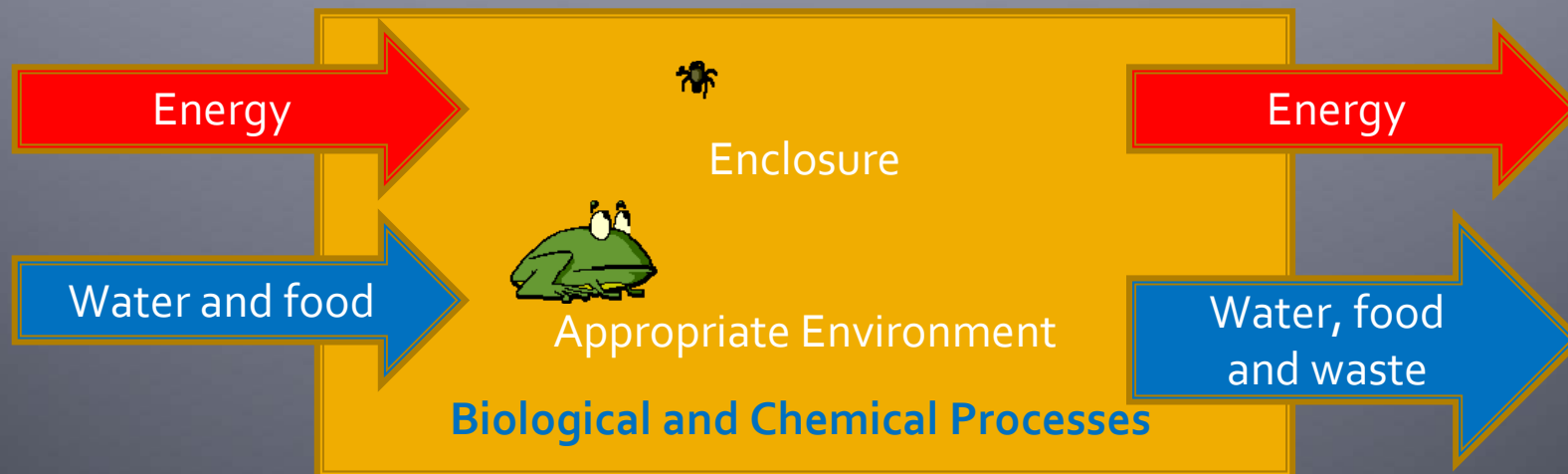
Think on the view point of the amphibian

Different micro environments are necessary for difference physiological process.

The Enclosure

It's a system

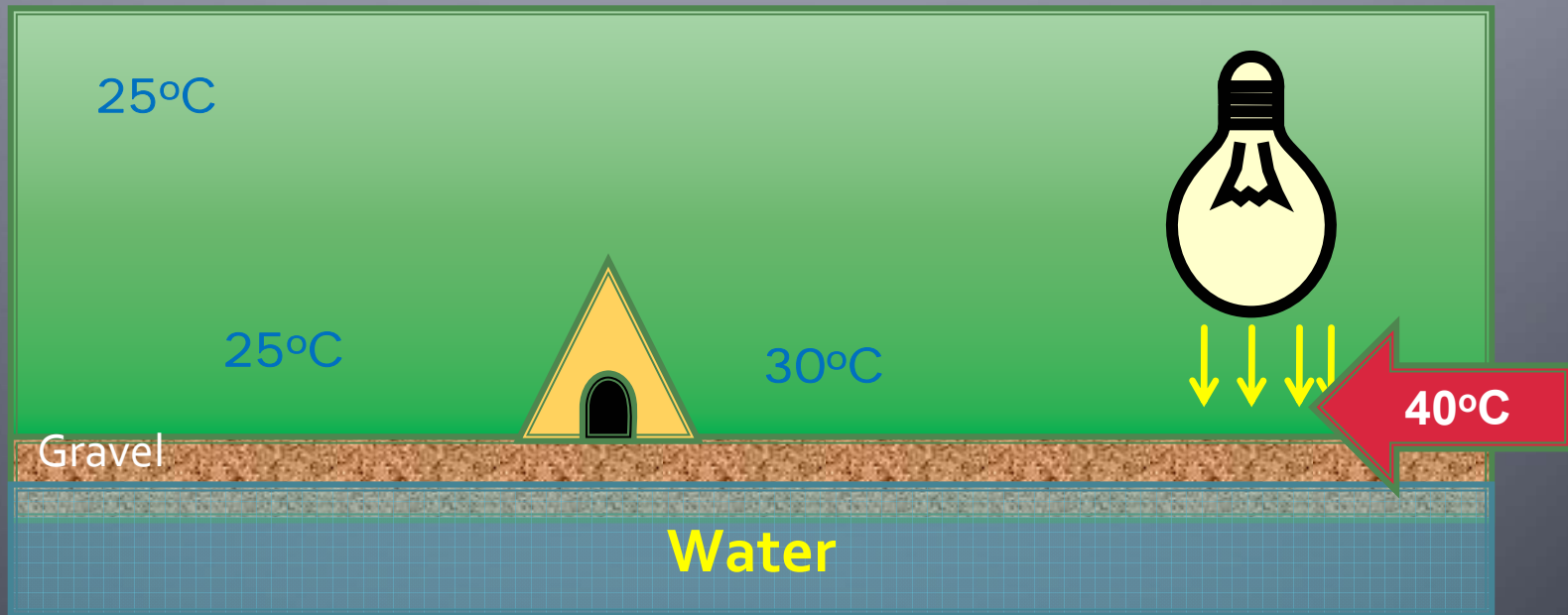
An Open System



Environment Parameters

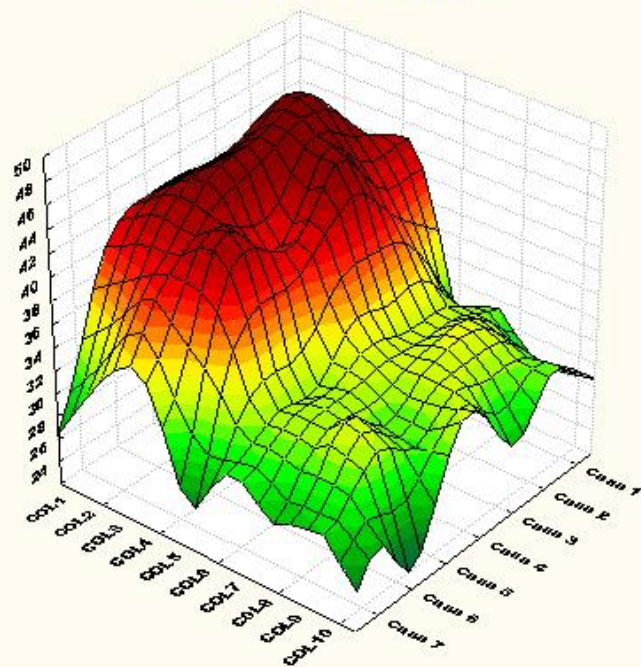
- Temperature
- Water in the air (Water Vapor)
- Water as a liquid
- Substrate
- Cage furnishings (for function, and physical and psychological needs)
- Light
 - Photo Period
 - Quality
 - UVB

Temperature Gradient

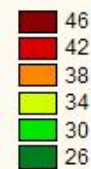
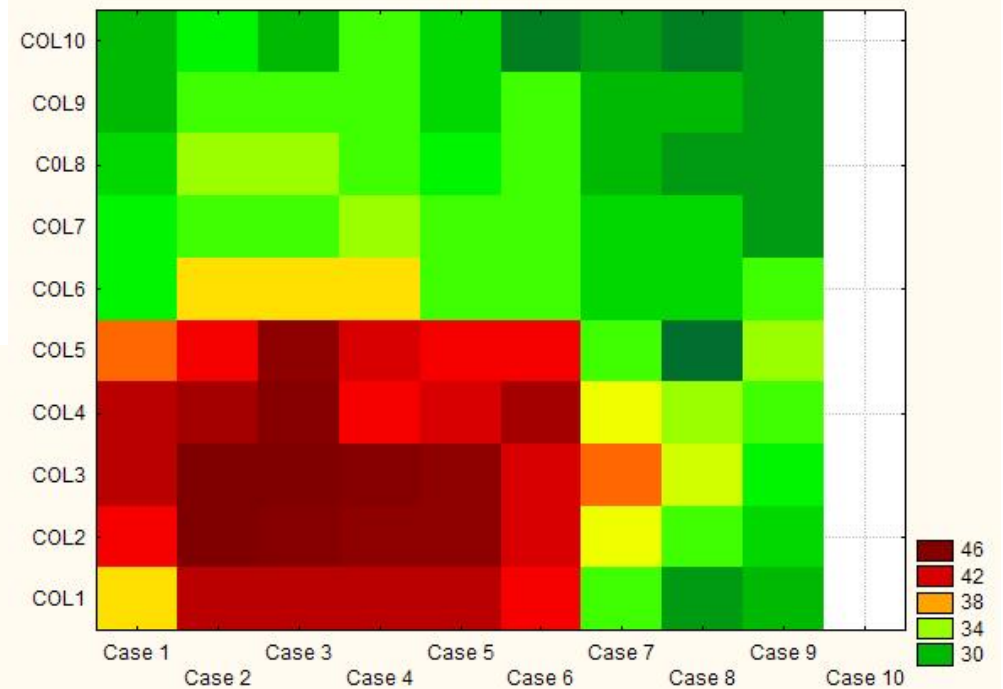


Cage Temperature

Cage Temperature Environment



Cage Temperature



The importance of thermal options in many species

General Rules: Start with lower temperature and add heat in specific areas



Cooler Temperature species

Chiller



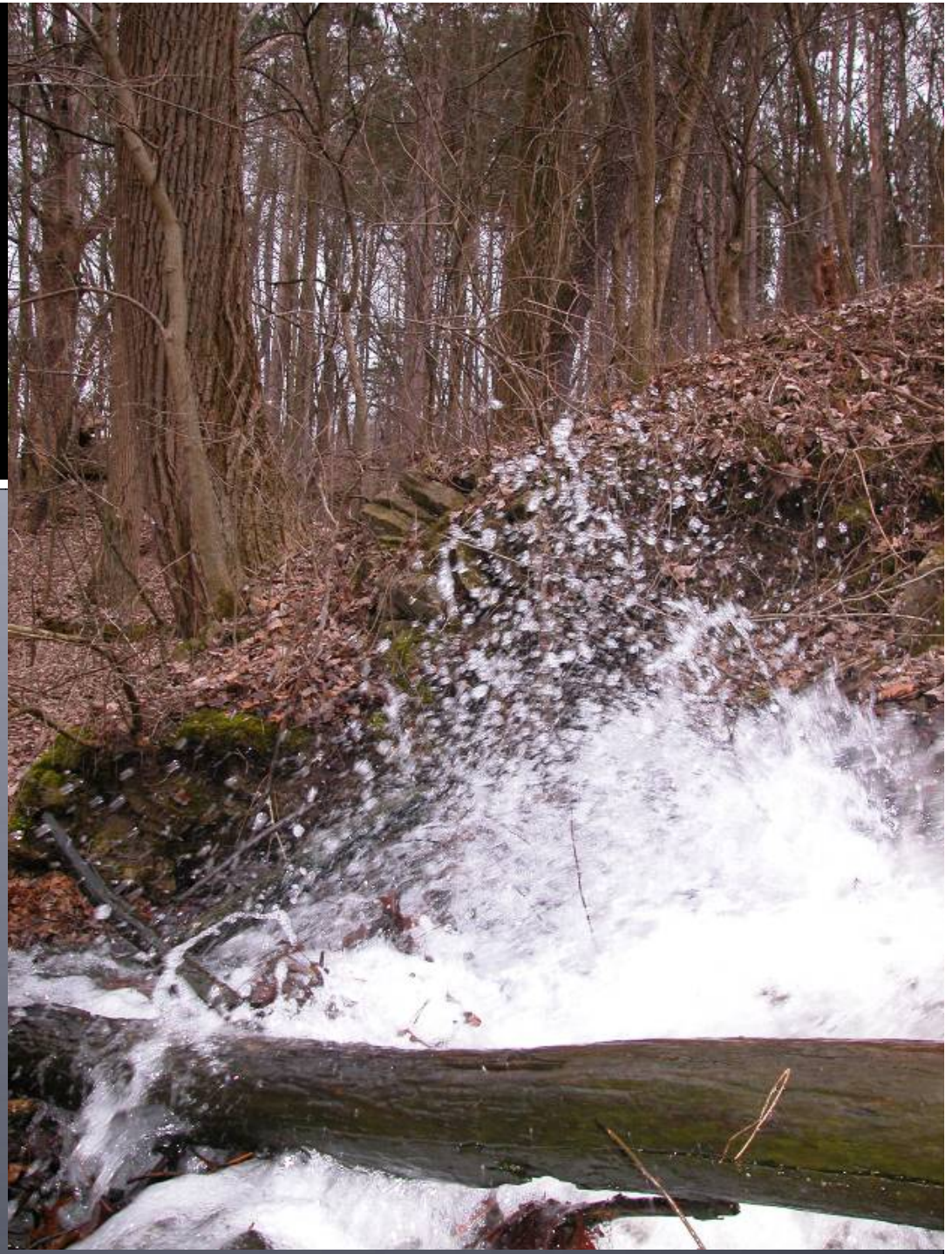
Hibernation

The period of low
temperature dormancy



Water

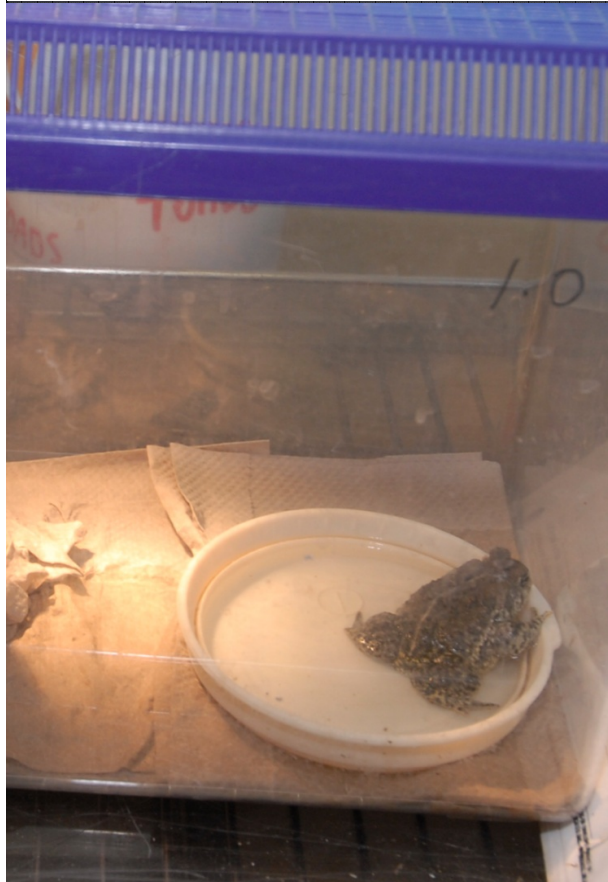
H₂O Quality will be presented later in the workshop.



Water as a Liquid

- Accessible
- Appropriate quality
- Appropriate form
 - Standing water
 - Running water
 - Surface moisture
 - Mist and Rain

Standing Water



Flowing water

American Stream

Many amphibians have an aquatic larval stage such as a tadpole. They then change (metamorphose) into the adult form.



Mist and Rain Systems



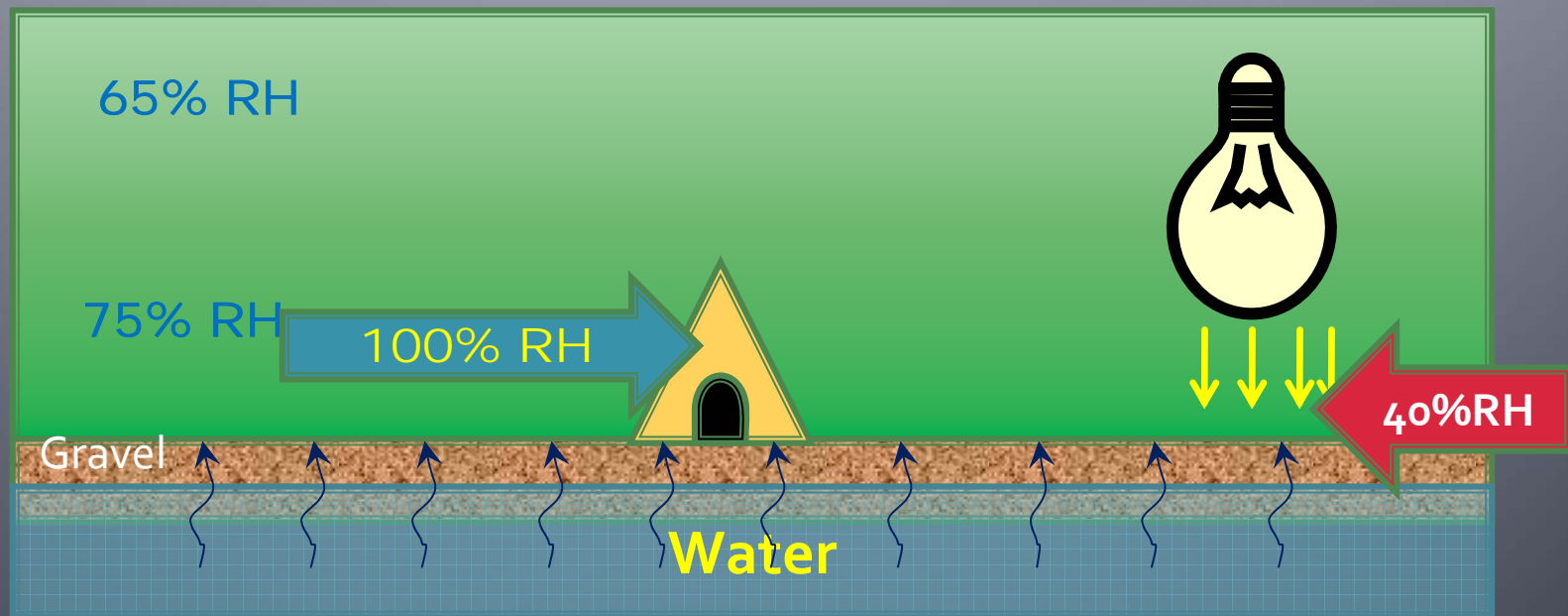
Water Vapor (Its all relative)

- Relative Humidity (RH)
- Microenvironments
 - May be very different in different parts of cage.

RH - Relative Humidity

- **The amount of water in the air compared to the amount of water the air can hold**
- **Increase in temperature increases the amount of water the air can hold**
- **Lower pressures increase the amount of water the air can hold**

RH Microenvironment



Moisture in substrate

Frogs and other amphibians absorb
water through their skins

Drinking patch

Drinking Patch

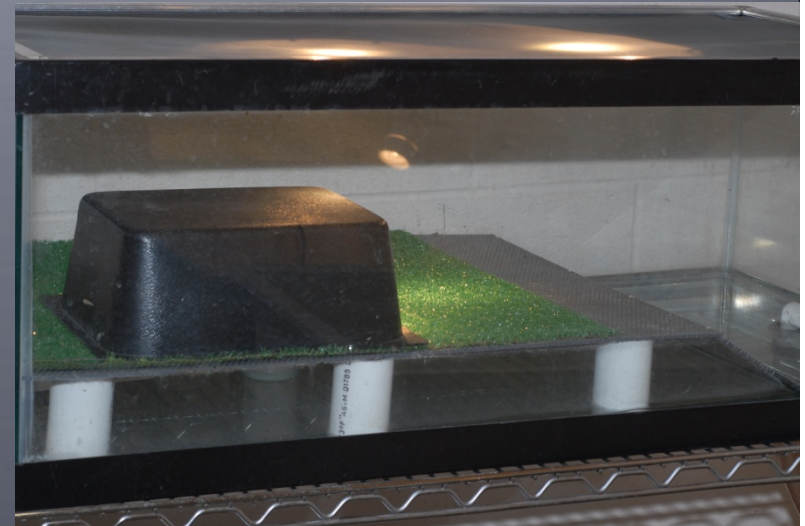


Substrate

Its more than just the stuff
on the bottom of the cage

Substrates (Artificial)

- Paper towels
- Astroturf
- Rubber mats
- Screening
- Cage bottom (none)



Substrates (Natural)

- Gravel
- Coconut husks
- Potting soil
- Moss
 - Living
 - Dead
- Sand
- Rocks
- Mulch

Gravel

Foundation of the environment





Moss growing on palm husk on gravel



Potting Soil



Bucket of soil

Leaf litter



Mulch

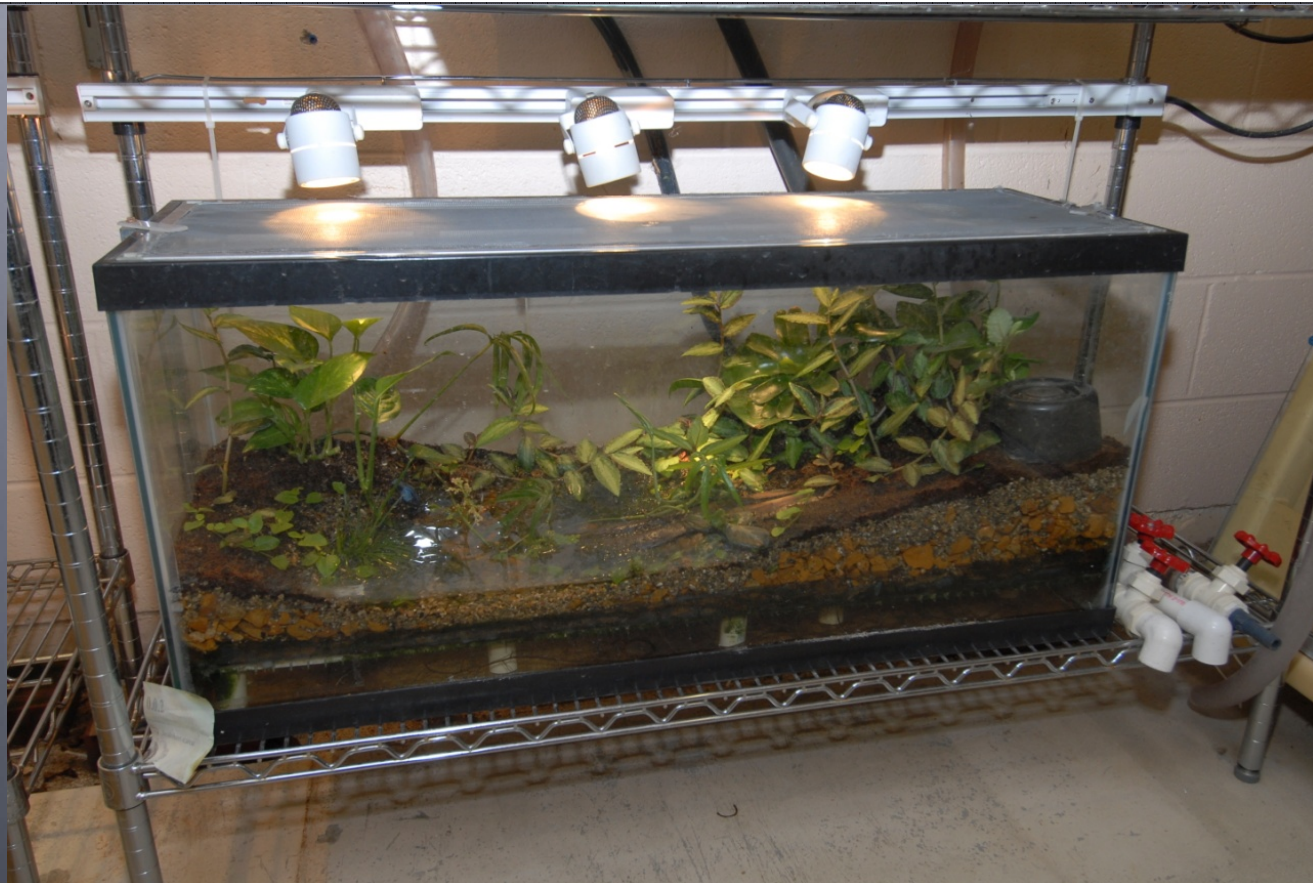


Rocks

Substrates (Additives)

- Activated carbon
- Dolomite (CaCO_3)

Maintaining and cleaning the environment



Water in – Water out

- Drainage
 - Water flow
 - Cleaning



Adding drains to a glass tank

It is easier than
you think

Caution: Make sure the tank
glass is not tempered



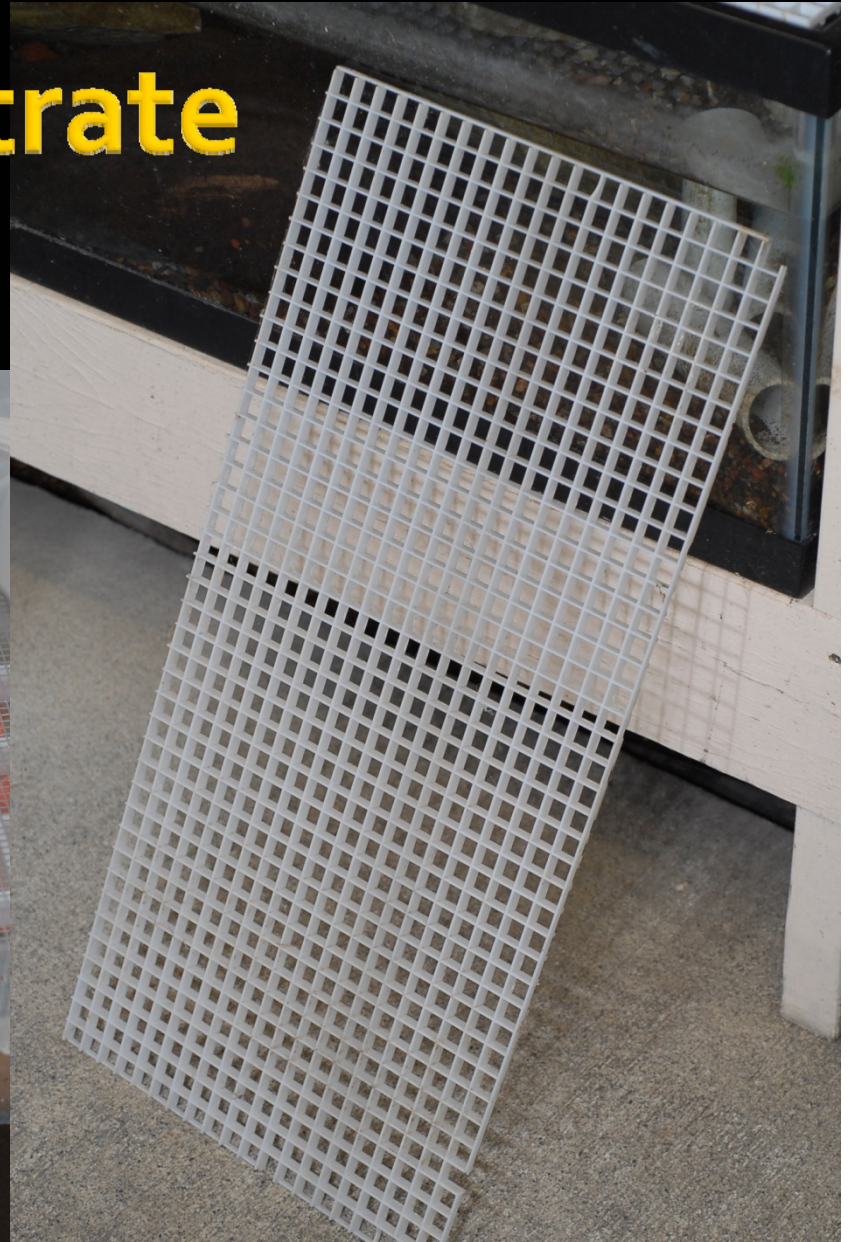
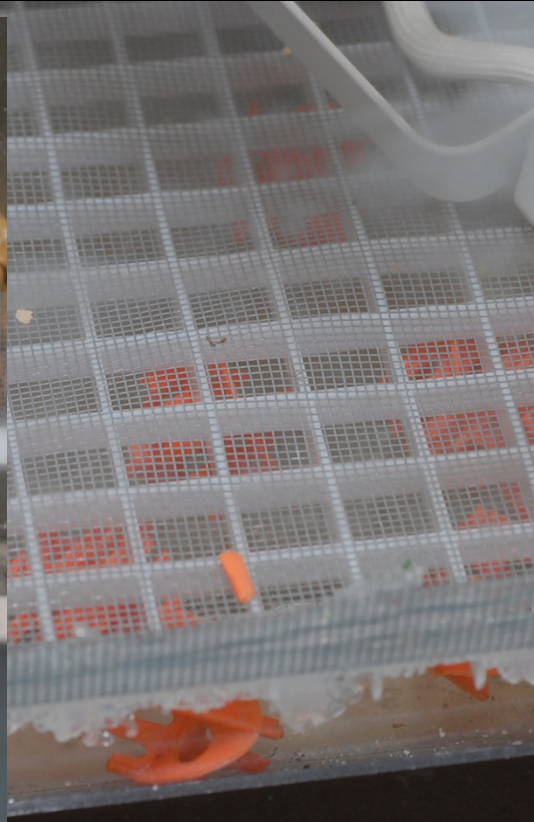
Bulkhead Fitting

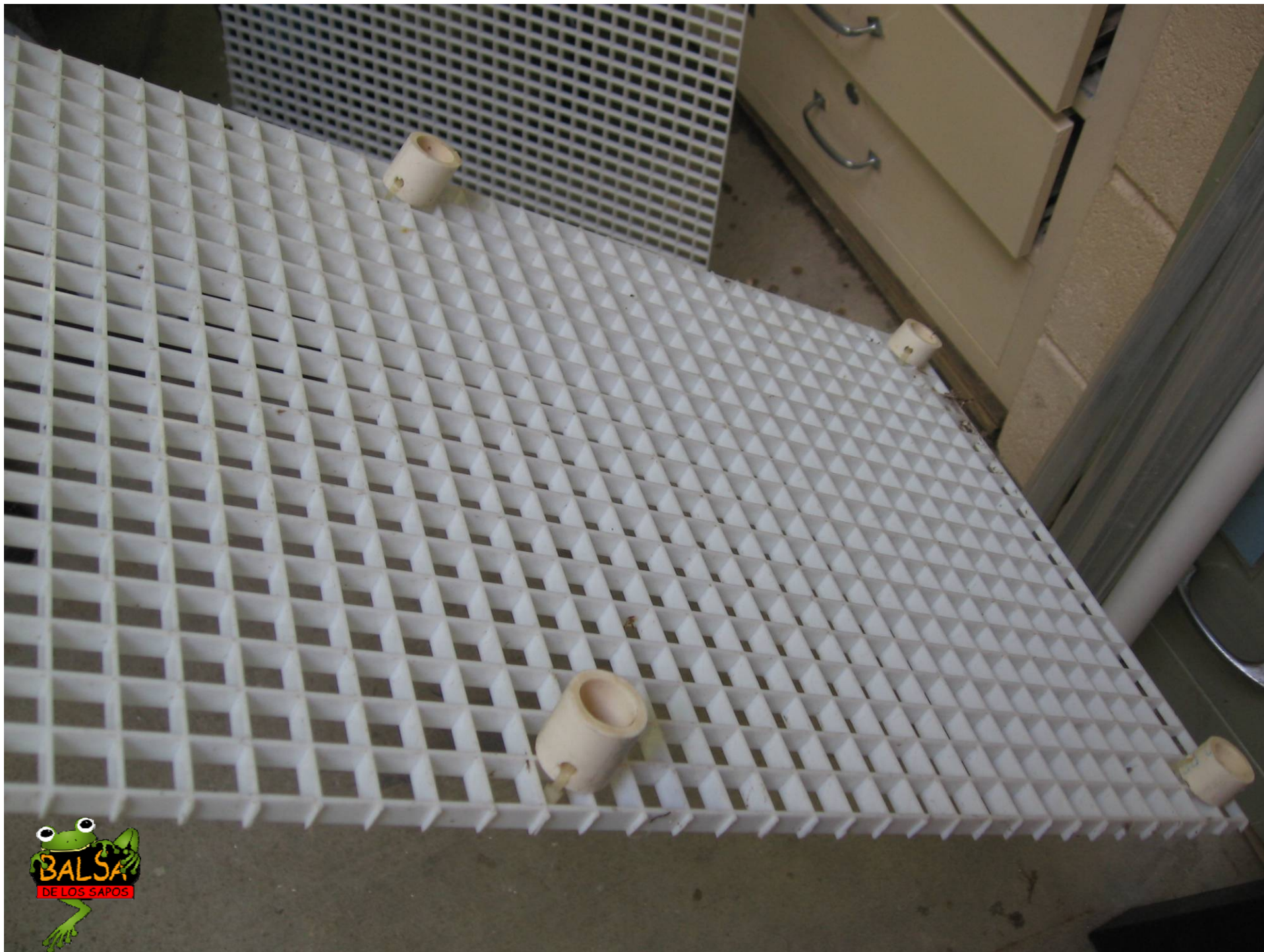


The False Bottom



Drainage of Substrate





A drainage system



Cage structures

- **Environmental Complexity**
- **Refugia**
- **Visual barriers**
- **Breeding sites**

Refugia



Perching



Oviposition Sites



Oviposition Sites



Creating an Environment

North American Cave Salamander



Other living components in the Enclosure

- **Plants**
- **Bacteria**
- **Invertebrates**

Light and UVB

Light and UVB is important
component of the amphibian
environment

Halogen bulbs

Produce light, excellent UVB, and a heat spot

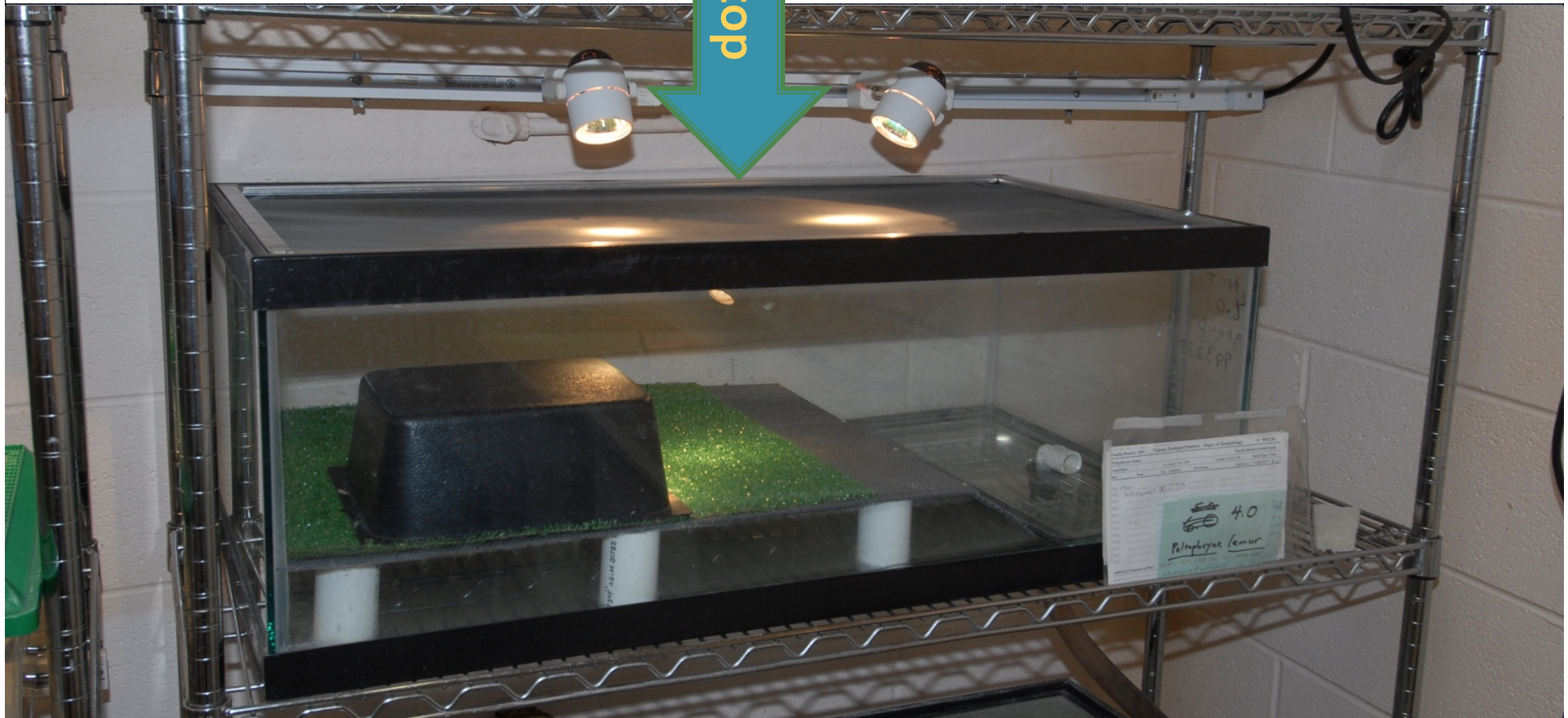


This is one of many products available

Air Exchange

Air flow is particularly important for some species.

Screen top



Remember containment!

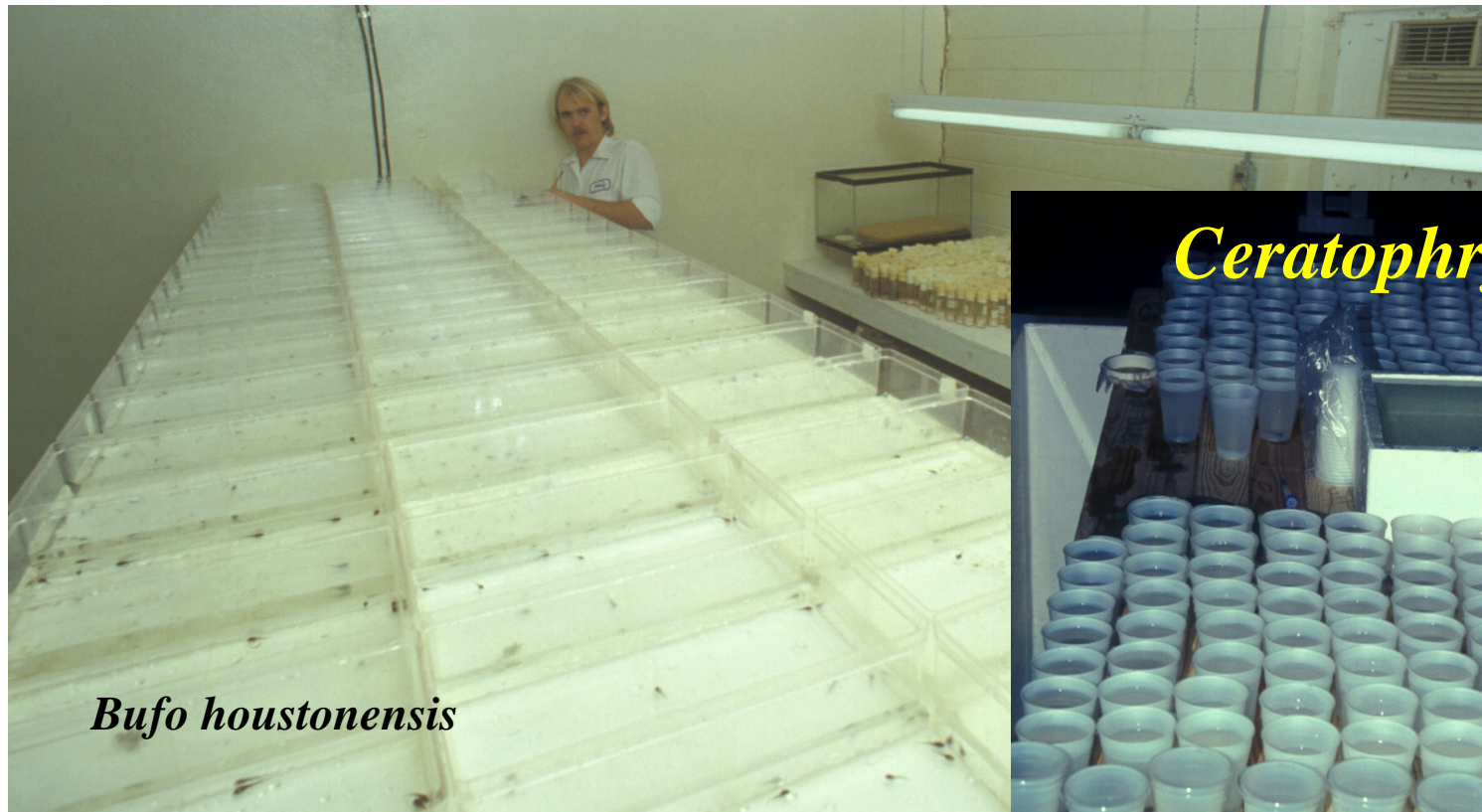


Other considerations

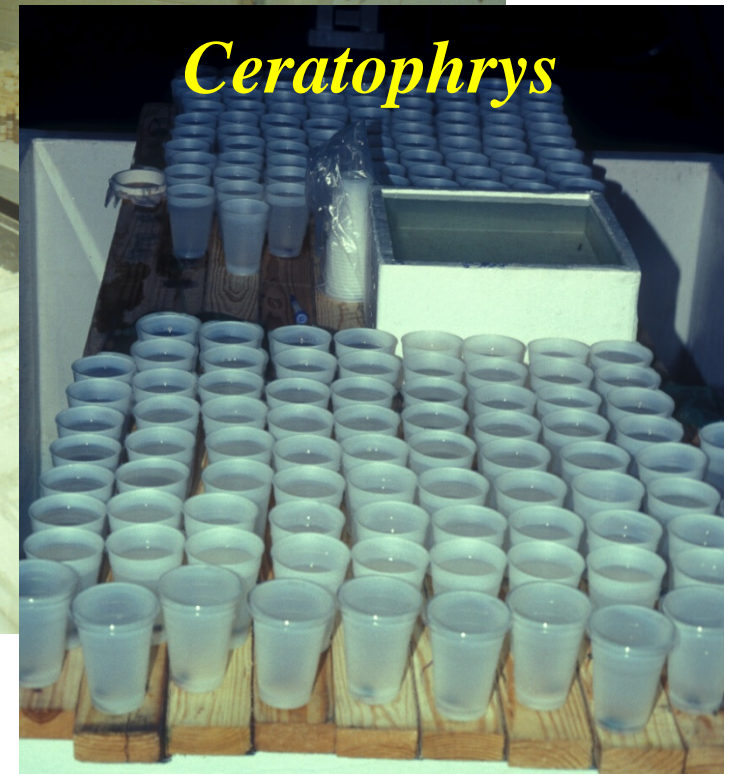
- **Social groups**
- **Medical Treatment**
- **Disease control**

What about larvae?

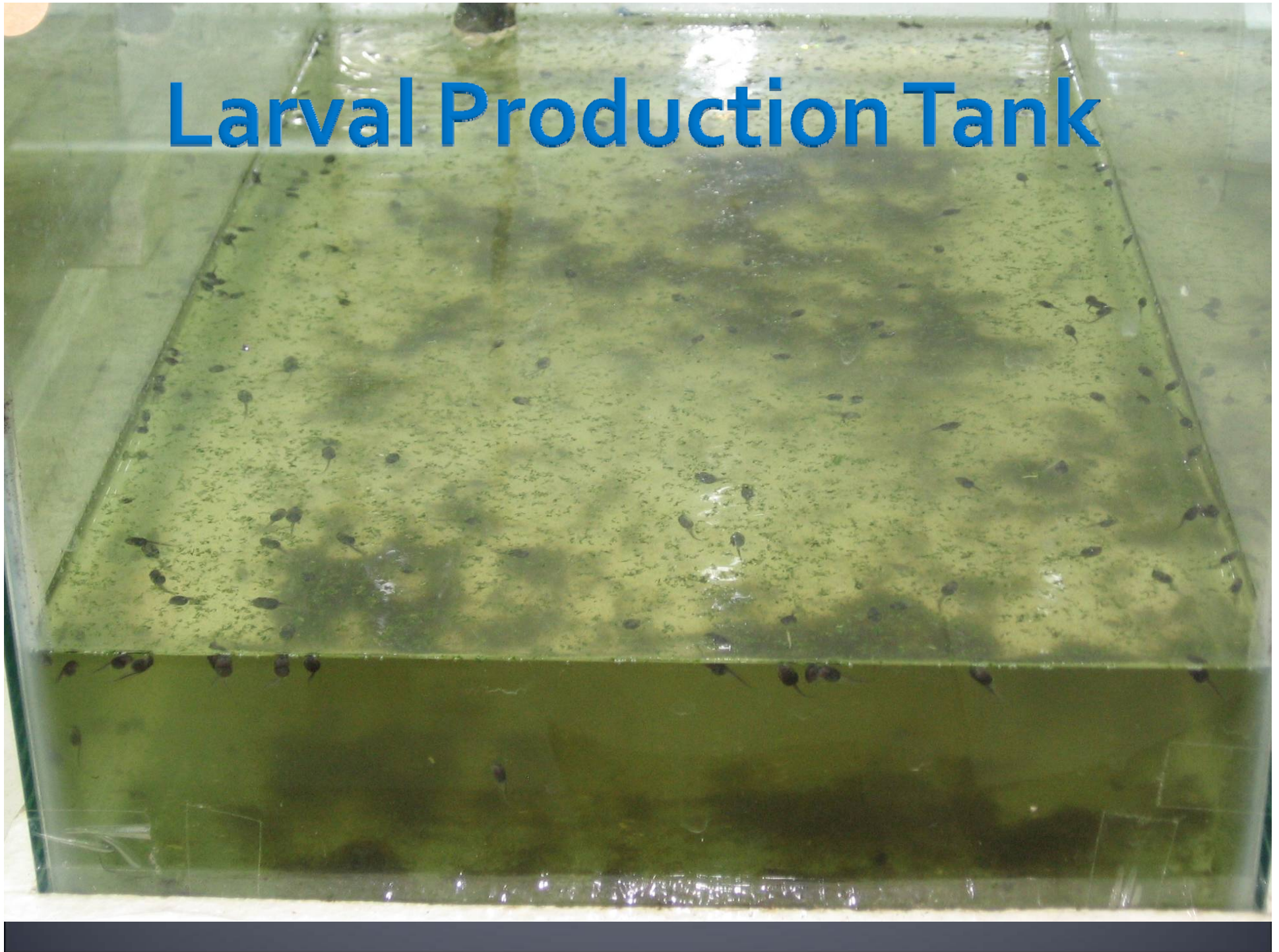
A day's work



Bufo houstonensis

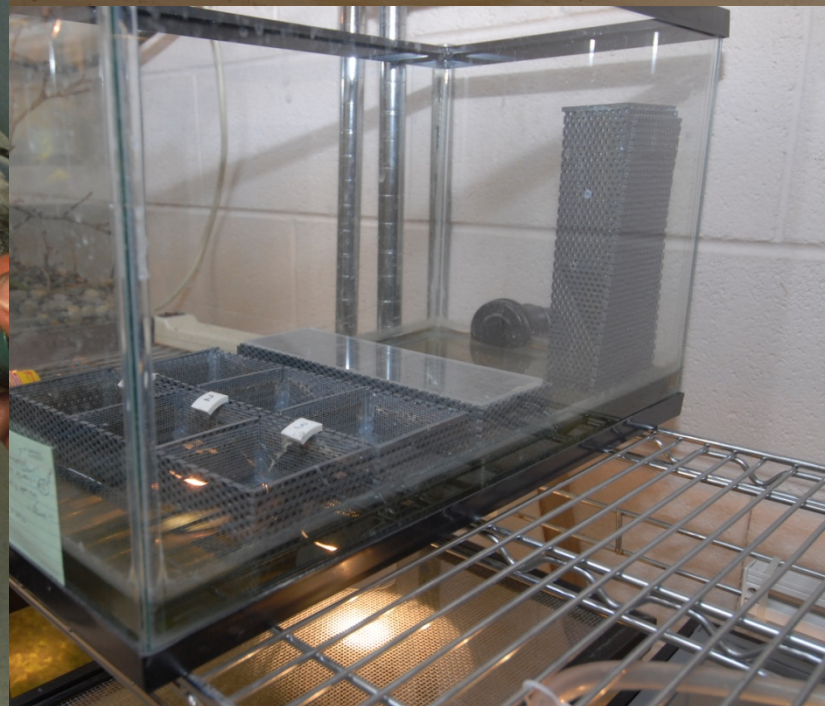
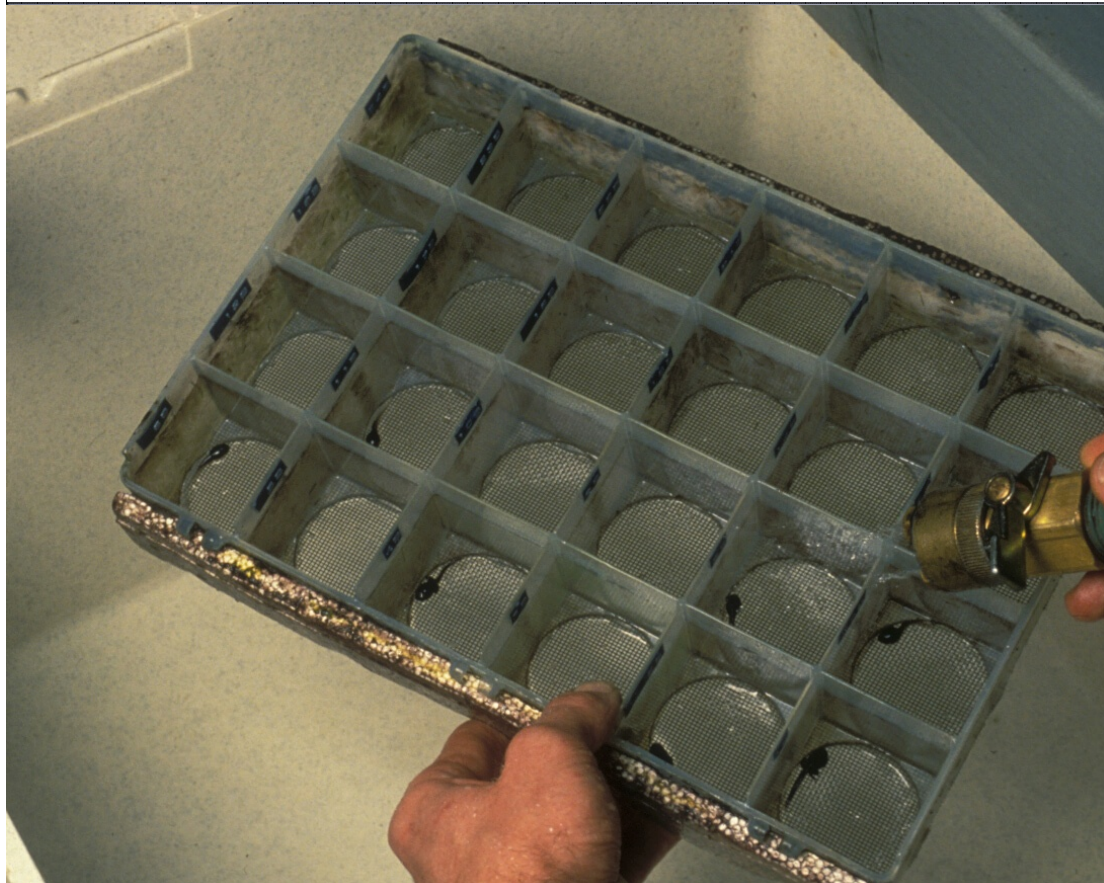
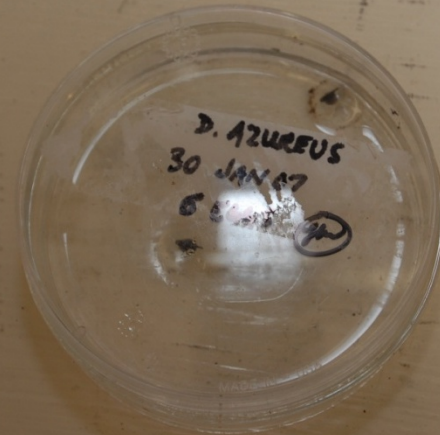


Larval Production Tank



Larva Habitats

Dendrobates



Quick Cups

Dendrobatids

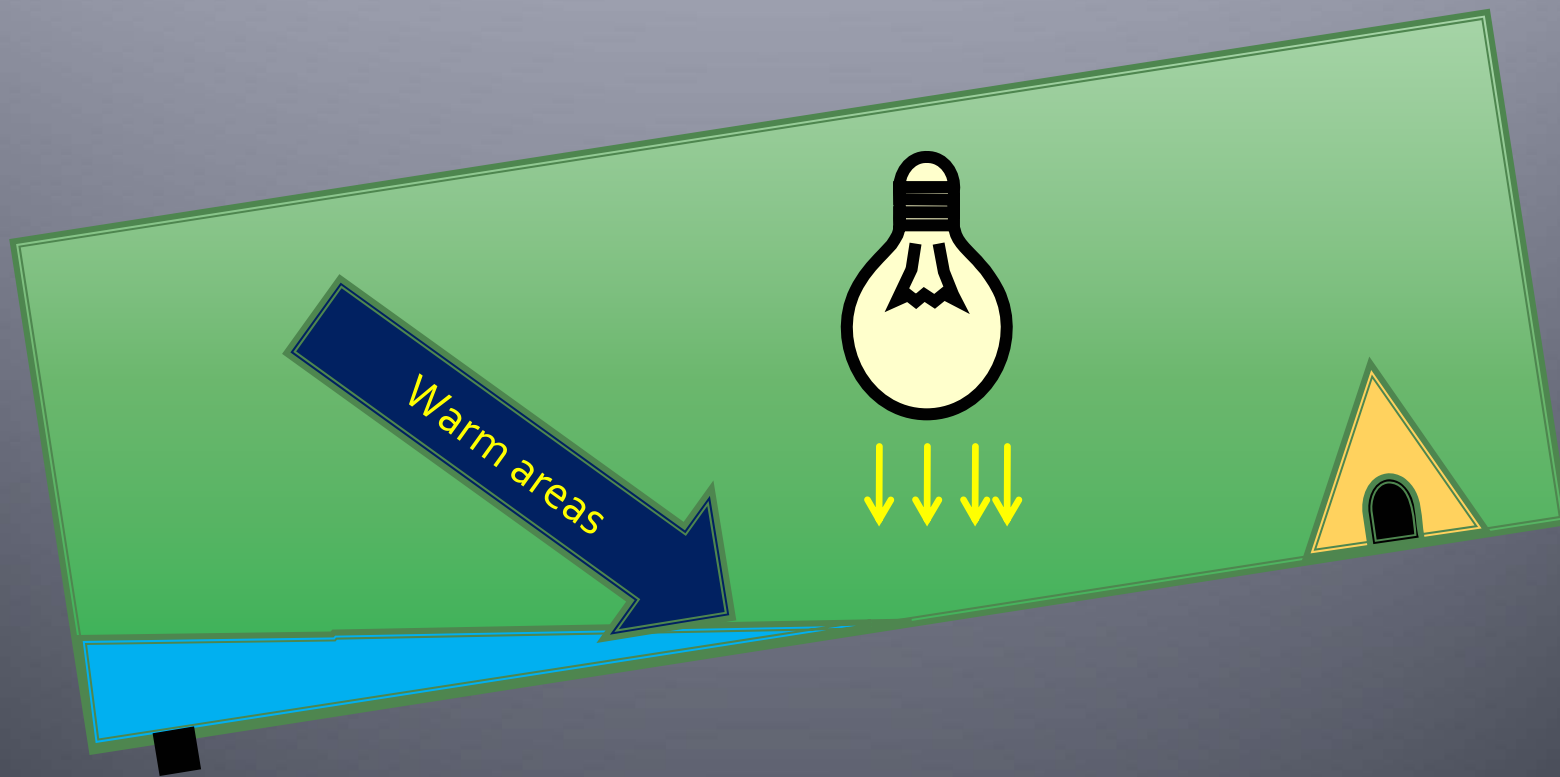


A second birth

Metamorphosis

Simple Metamorphosis Chamber

All stages must be accommodate Larval → Juvenile



Metamorphosis enclosures



Bring it all together



Bringing it all together

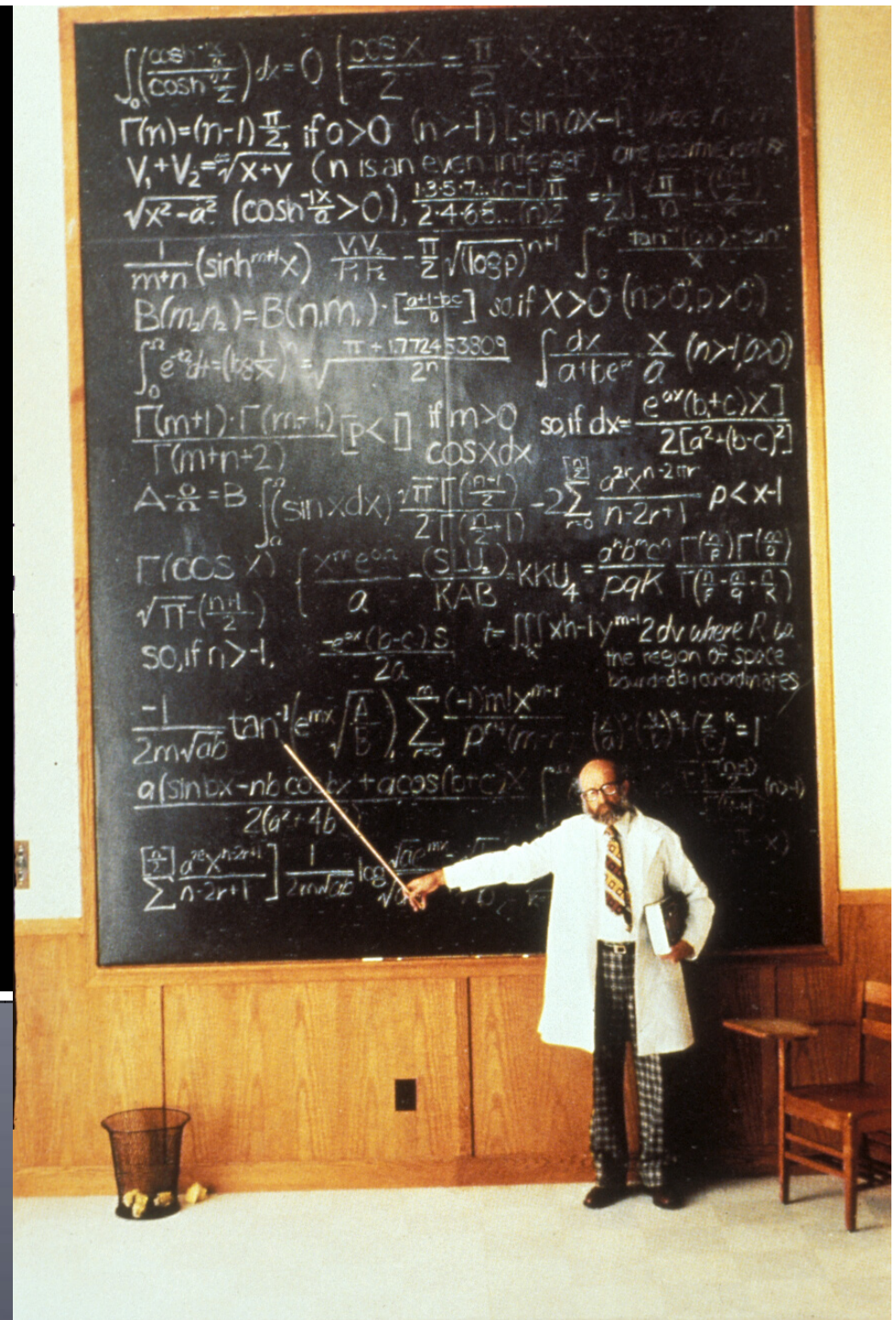


Brining it all together

Display



Science and Husbandry



Husbandry



Should be considered
a discipline



Science

Helps us get closer to
understanding the truth

Problem Solving

What keepers do
every day!

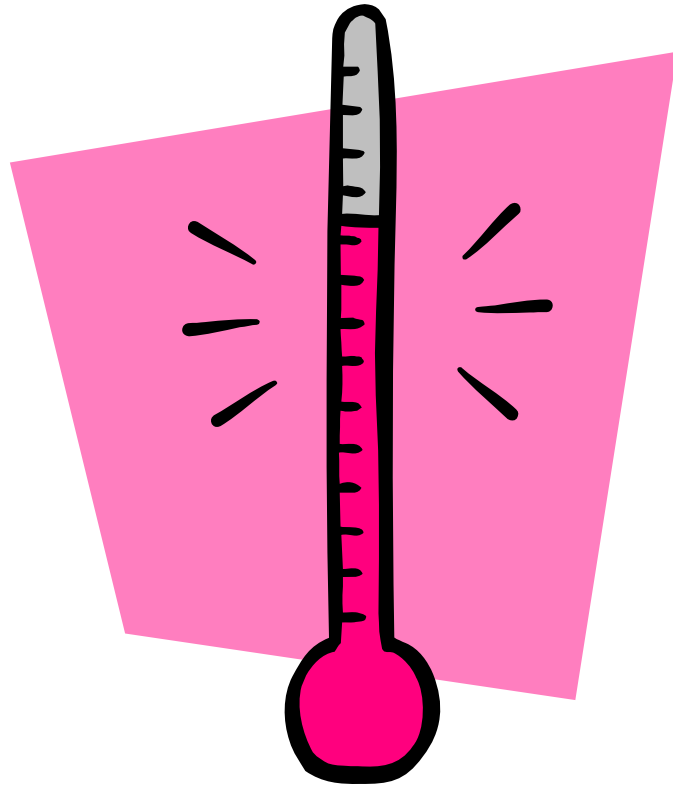
**What you can't measure,
you can't understand.**



Measurements

- Temperature
- Mass
- Length
- Light
- Events
- Observable behavior
- Etc.

Measuring Technology



Infrared remote temperature sensing



Newer Technology Data Loggers



Digitized Data

Launch [X]

HOB0 Temp,RH,2x External (C) 1999 Onset S/N: 280810
Date: 04/21/99 21:20:44 Deployment: 3

[Start] [Cancel] [Help]

Description: Zone 1 Temperature and RH
Interval (Duration): 1 Mins (2 Days, 18 Hrs, 11 Mins) [v]

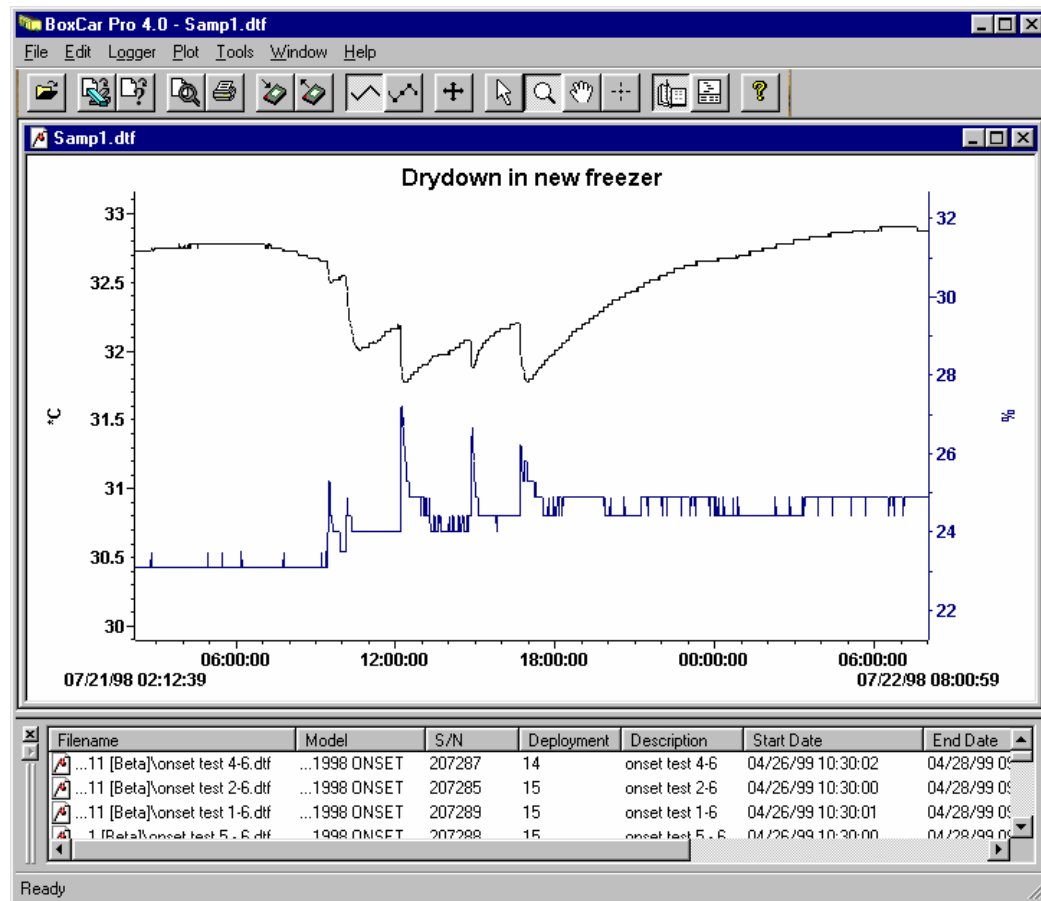
Measurement	Channels	Unit	Reading
Temperature	1	*F	69.71
Temperature	1	*C	20.95
RH	1, 2	%	38
Dew Point	1, 2	*F	44.92

[*] Next to channel identifier denotes a selectable sensor channel. Battery: Bad Good [Progress Bar]

☐ Wrap around when full (overwrite oldest data)
☒ Delayed Start: 04/22/99 [v] 12:00:00 [v]

[Enable/Disable Channels...]

Digitized Data



Example

Halogen Bulbs
D₂ – D₃ Conversion

Question?

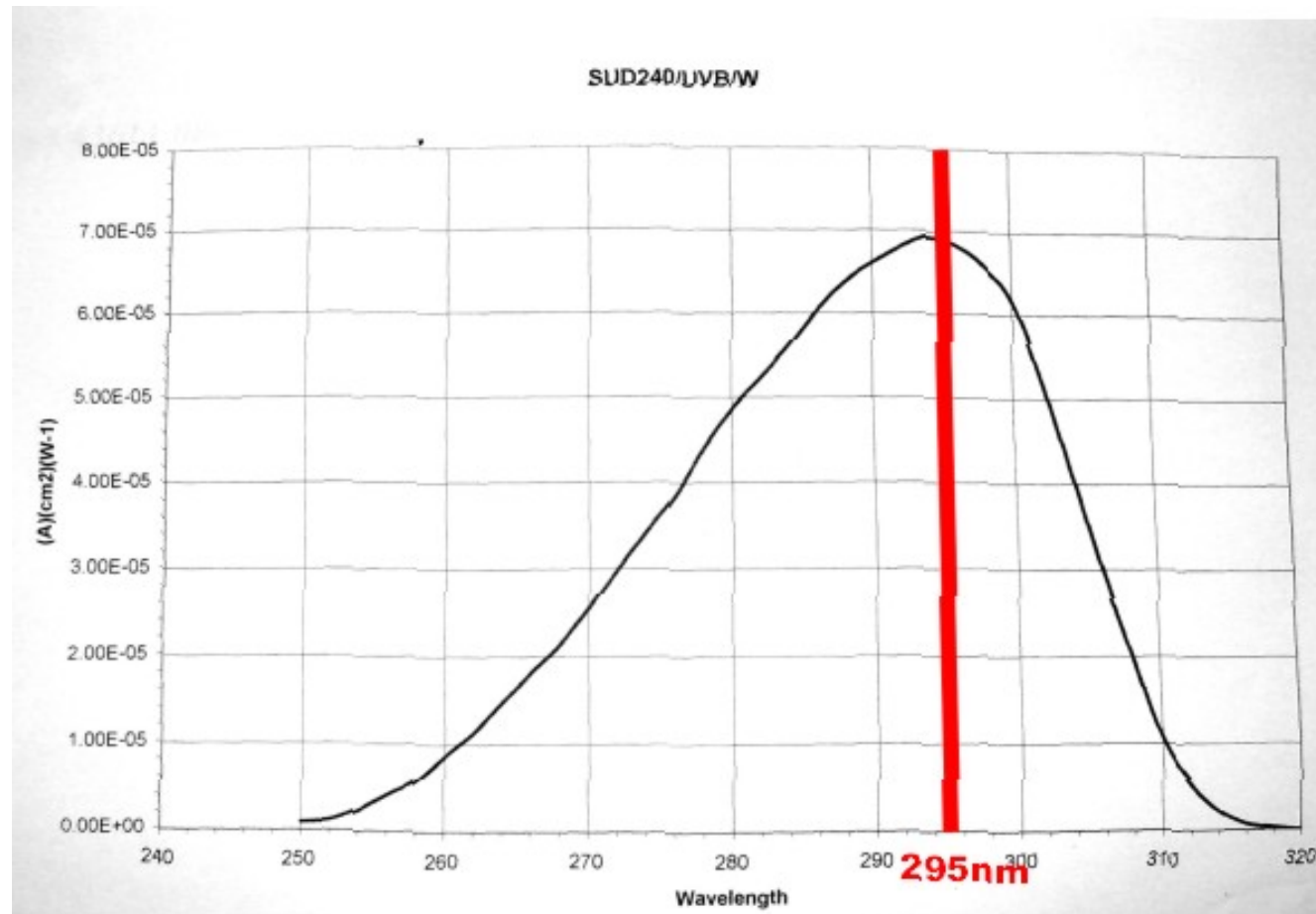
**Is there a low cost source for UVB
that could be used for amphibian
husbandry?**

Timothy Herman

The Ability to Measure



Precision



Discovery



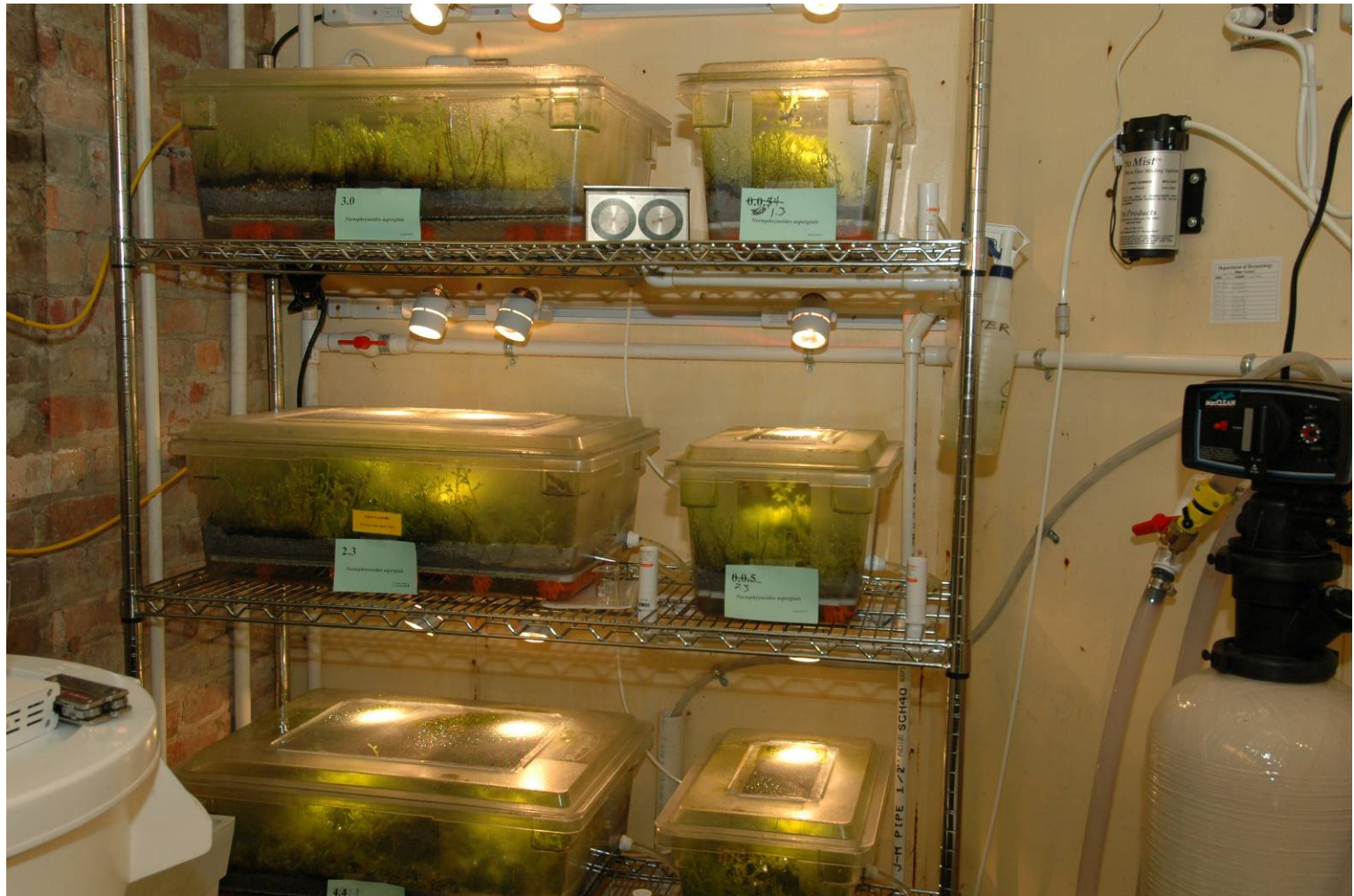
Confirmation with a Biological Metric

Source	Irradiance ($\mu\text{W}/\text{cm}^2$) @36cm	% product synthesized
20W Reptisun 5.0	6.8	0.22
20W Sylvania 350 Blacklight	3.8	0.63
<u>50W Eiko EXT 13 degree</u>	<u>4.4</u>	<u>3.49</u>
<u>50W Eiko Supreme 10,000hr</u>	<u>10.7</u>	<u>9.83</u>
<u>50W Eiko Supreme 6,000hr</u>	<u>11.3</u>	<u>10.8</u>
160W Westron MV Spot	89.8	2.11
Sunlight 1200hrs Dallas, TX, 1 Apr 2004	128	10.01
Sunlight 1200hrs Dallas, TX, 9 Aug 2004	124	10.07

Applied Science



Kihansi Spray Toads



Example:

You start feeding your frogs a new vitamin supplement. They breed a month later. Did the vitamins help them to breed?

The three Cs

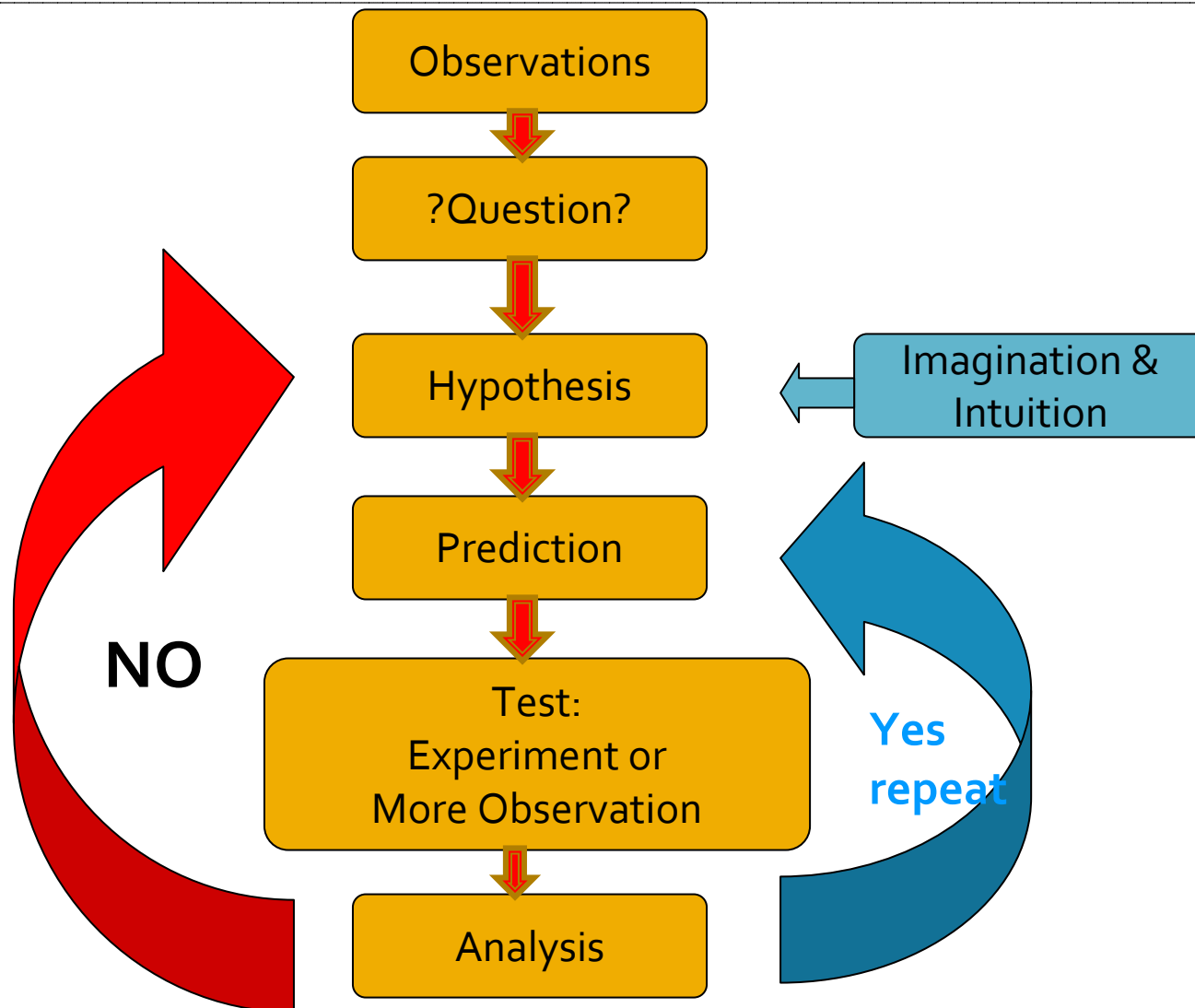
The three Cs

- Coincidence
- Correlative
- Causative

Life's complexities

- Life is a very complex system
- Reptiles and Amphibians are very complex
- Rarely Black and White

The scientific method



Water quality and development

Example



Phyllobates vittatus

Which water supply is better for rearing *Dendrobatid* larvae?

- Aged Water
- Carbon Filter Water
- Softened Carbon Filtered Water
- RO water

Hypothesis: RO water, which is closest to rainwater, will be a superior medium for rearing *Phyllobates*.

The Experiment

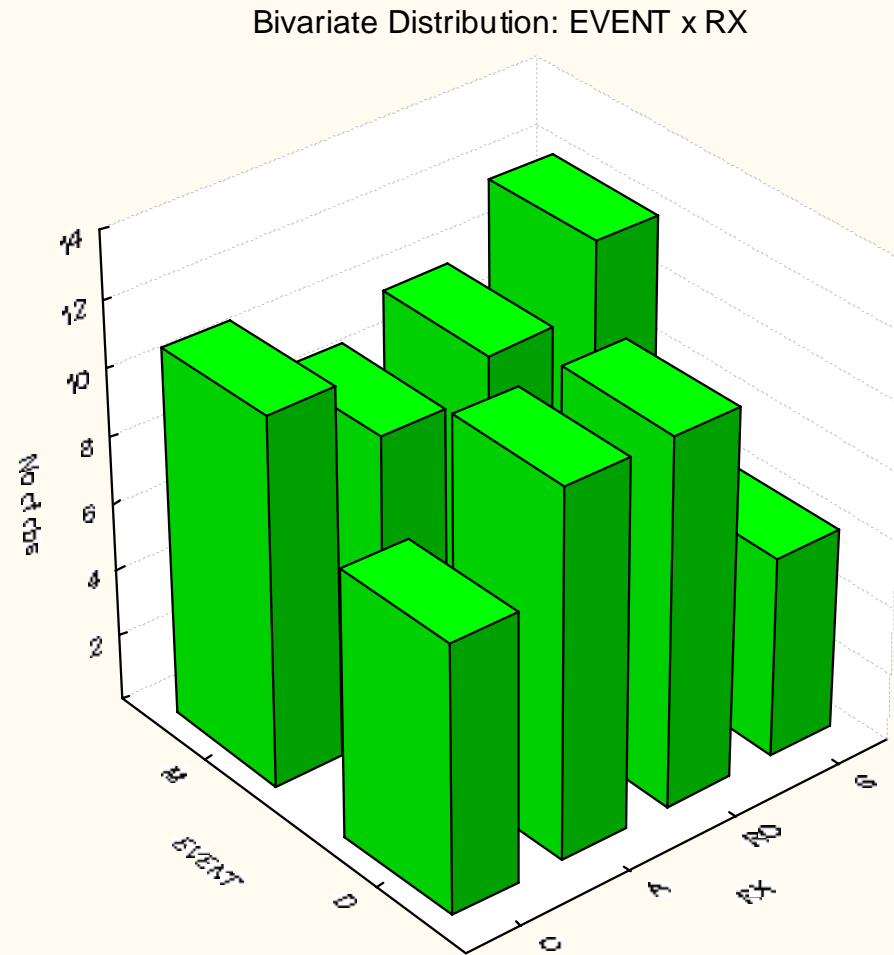
- Four Groups
- Four Different Water Sources
- Each Fed Same Diet
- Each Provided Same Husbandry
(enclosures, water volume, temperature,
light, water changes, etc.)
- Compare Metamorphic Success and Deaths

Data

Treatment	Died	Meta.	Row Totals
Carbon	8	11	<u>19</u>
Aged	11	9	<u>20</u>
RO	11	10	<u>21</u>
Softened	6	12	<u>18</u>
All Groups	<u>36</u>	<u>42</u>	<u>78</u>

Using data analysis tools

Visualization



P=0.518

Learn what others have done

- Library
 - Books
 - Articles
- The value of peer review
- INTERNET
- Contact others that work with the species

**Few groups of animals in
zoos afford more
opportunity for research
than the Amphibia!**

Focus on what is needed to save them



Finish