

The Effects of Salt on Tadpoles

A student science project

What are Tadpoles?

- ⊗ Frogs have a complex life cycle with several progressions.
 - ⊗ Egg → Tadpole → Froglet → Adult
- ⊗ Tadpoles are juvenile frogs that emerge from the egg stage.
- ⊗ Characteristics of this stage:
 - ⊗ Live in water – have specialized tail for swimming
 - ⊗ Eat underwater plants like algae or periphyton
 - ⊗ Breathe through gills like fish



http://commons.wikimedia.org/wiki/File:Litoria_littlejohni_tadpole.jpg



<http://science.howstuffworks.com/zoology/reptiles-amphibians/frog.htm>

Where do tadpoles live?

- ⊗ In freshwater wetlands around the world
- ⊗ Live in bogs, swamps, lakes, ponds, even roadside ditches!
- ⊗ In coastal wetlands, salt can contaminate freshwater
 - ⊗ Storm surges, intrusion from aquifers, flooding events



<http://www.greglasley.net/nonBirds/cypresswamp.html>



<http://www.sheepsheadbites.com/tag/marine-park-salt-marsh/>



http://en.wikipedia.org/wiki/Hurricane_Isabel

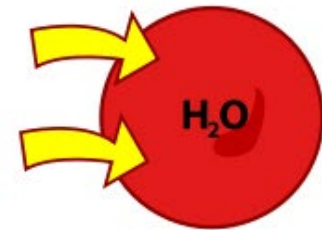
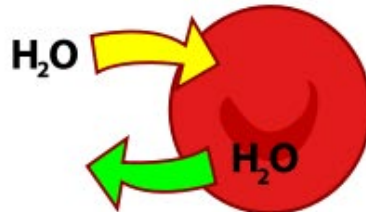
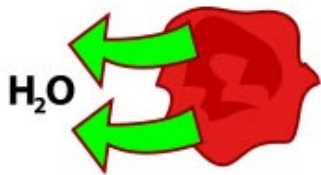
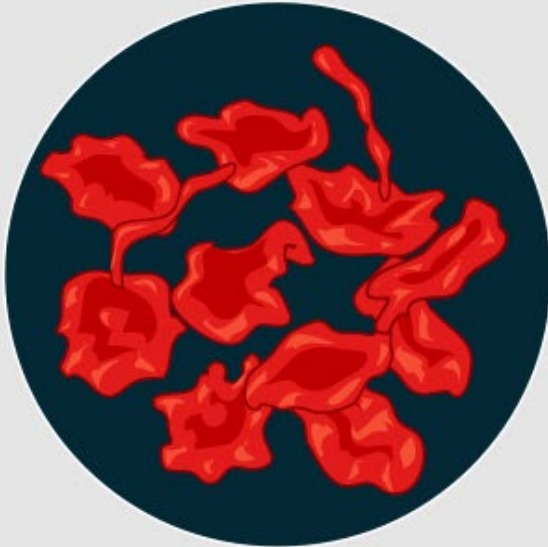
Why should we care about saltwater into freshwater habitats??

- ⊗ When solute concentrations are high OUTSIDE the cells, water will passively flow out of the cell, shriveling the cell like a raisin.
 - ⊗ Why? Because there is less water outside the cell and therefore the water will naturally flow from high to low concentrations.
 - ⊗ This is a hypertonic solution
- ⊗ When there are more solutes INSIDE the cell, water will passively flow into the cell, causing the cell to swell up.
 - ⊗ Why? Because there is less water inside the cell and therefore the water will naturally flow from high to low concentrations.
 - ⊗ This is a hypotonic solution.

Hypertonic

Isotonic

Hypotonic



More solutes outside the cell
Compared to the inside

Iso = same
Same concentrations

More solutes inside the cell
Compared to the outside

Saltwater!

Freshwater!

Tadpoles in Saltwater

- ❁ Tadpoles are HYPERtonic to saltwater – and they can't leave the water either!
- ❁ Cells will shrink, tadpoles will dehydrate, and cannot survive for long.



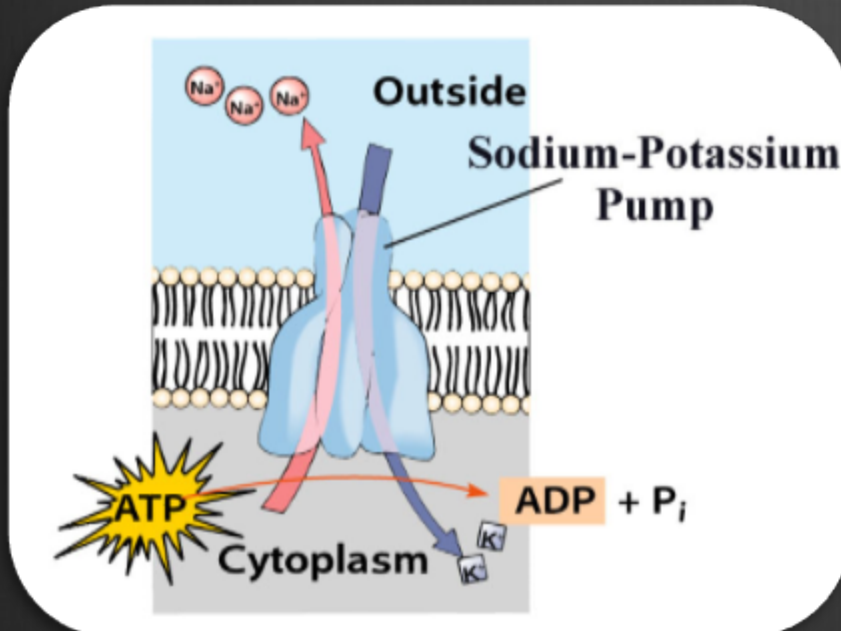
UNLESS...

- ⊗ Tadpoles will die quickly in saltwater unless they have an adaptation to maintain homeostasis
- ⊗ Homeostasis: maintaining constant internal conditions



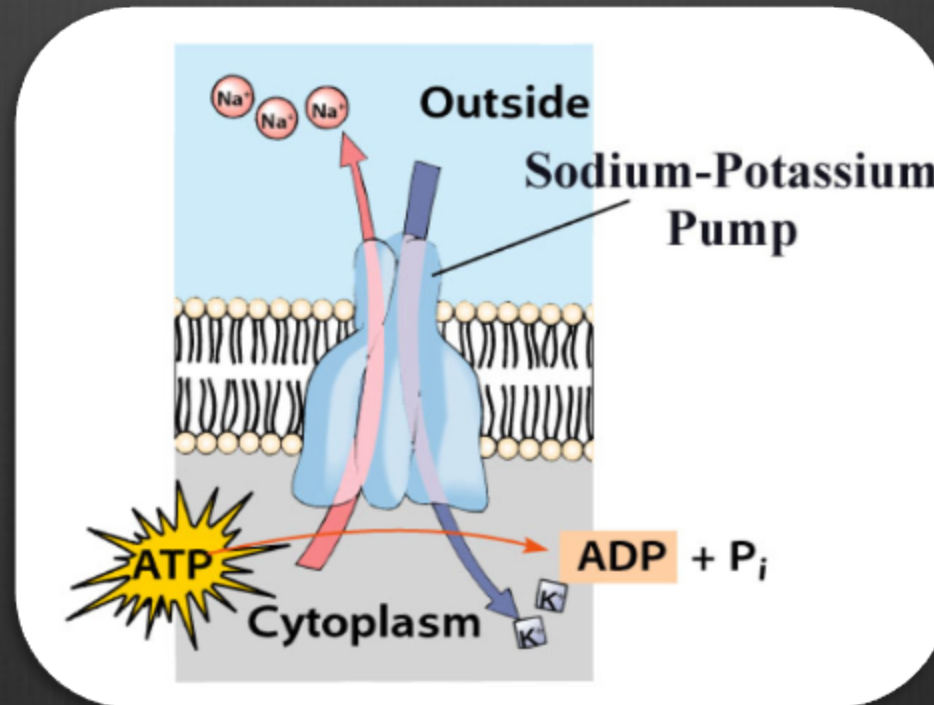
How do tadpoles maintain water balance?

- ⊗ Tadpoles breathe through gills
- ⊗ Gills also excrete excess salts
- ⊗ How? Sodium-potassium pumps!



Sodium-Potassium Pumps

- ⊗ These pumps are located in the cells membrane of the gills
- ⊗ They actively (i.e., use energy) pump the extra sodium out of the cell, thereby allowing the tadpole to maintain osmotic balance
- ⊗ This animation shows how sodium potassium pumps work:
 - ⊗ Click [here](#)

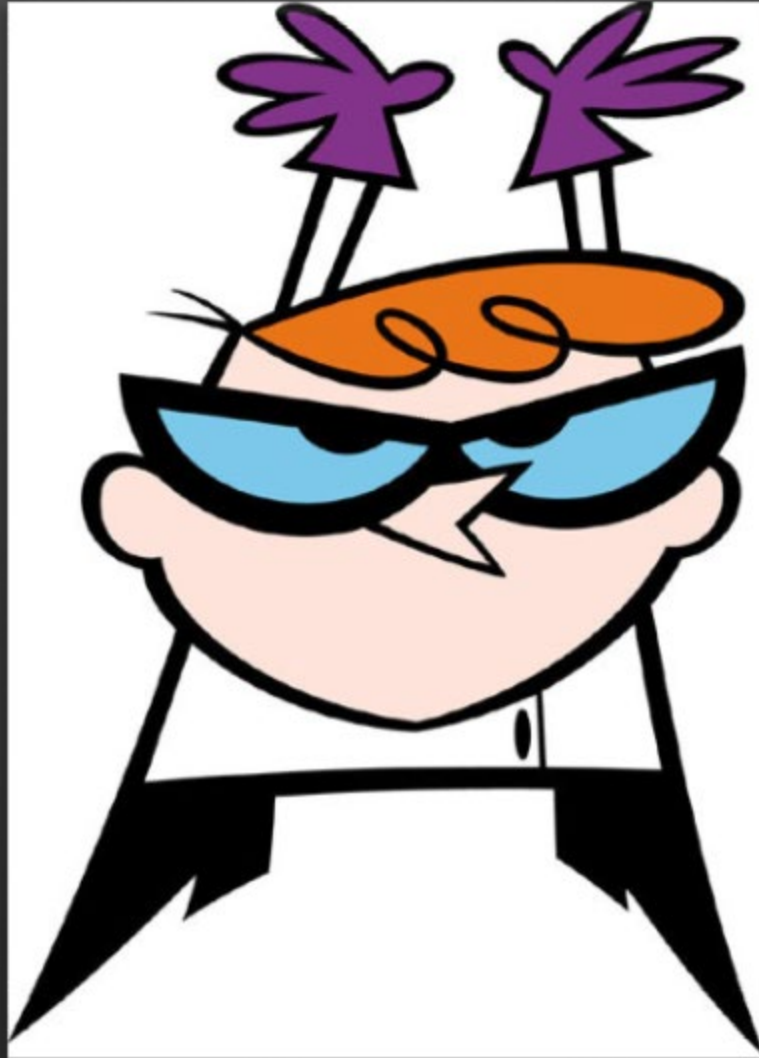


But there's a catch...

- ❁ Tadpoles spend their time foraging for food to find energy to grow.
- ❁ Getting lots of food means that tadpoles can metamorphose faster and avoid a drying pond, aquatic predators, and food shortages.
- ❁ When tadpoles have to divert the energy into energy to run the sodium-potassium pumps (rather than using it to grow), they grow slower and are smaller at metamorphosis.



Let's do a Science Project!



Research Question

- ⊗ Do tadpoles that live in salty water grow more slowly compared to tadpoles in freshwater?
- ⊗ **Hypothesis**: proposed explanation made on the basis of limited knowledge as a starting point for further investigation
- ⊗ Using your knowledge about the tradeoff between energy for growth and energy to run the sodium-potassium pumps:

What is your hypothesis for this question?

My hypothesis is that _____.



Experimental Design

- ⊗ **Experimental Design:** process to gather information (data) to help answer our question.
- ⊗ For our experimental design, we need two treatments.

Treatment one: Tadpoles in saltwater

Treatment two: Tadpoles in freshwater

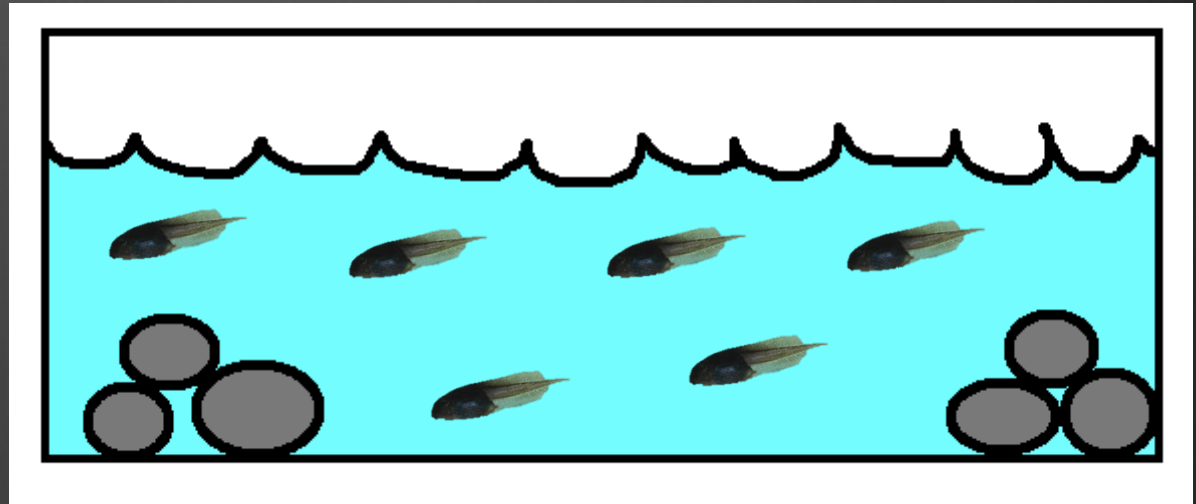
- ⊗ Except for the salinity of the water, we should make every effort to make these treatments identical. Why?

Our Experimental Design:

Treatment 1:

½ Tadpoles in Tank 1

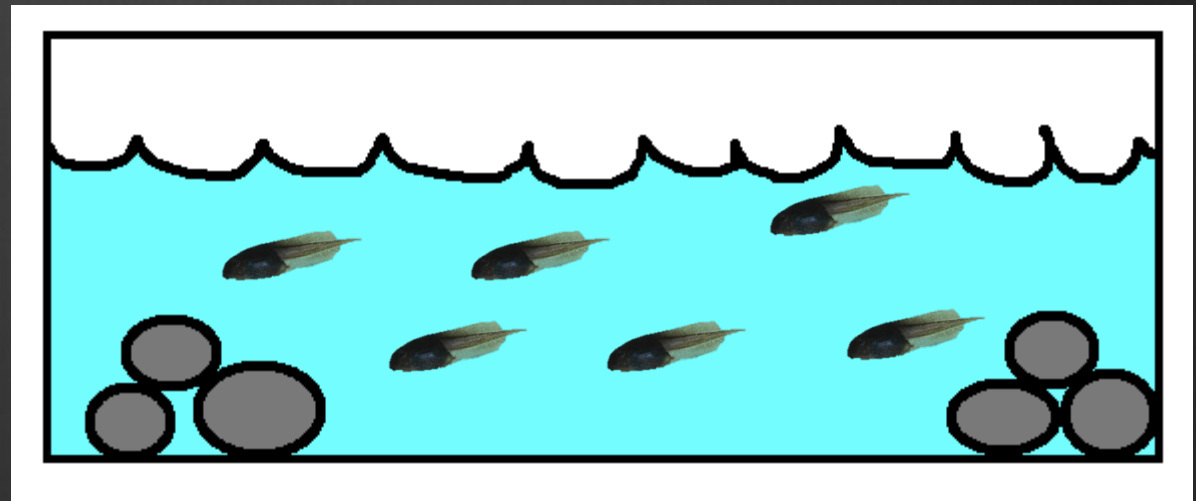
1 tsp. of salt mixed in



Treatment 2:

½ Tadpoles in Tank 2

No salt mixed in



Methods

- ⊗ Now that we have the two tanks set up, we can sit and observe the tadpoles as they grow and develop!
- ⊗ It is important to feed the tadpoles, but make sure you feed the same amount to each tank.
- ⊗ Record observations periodically.
- ⊗ We will collect our data once the tadpoles begin to metamorphose!



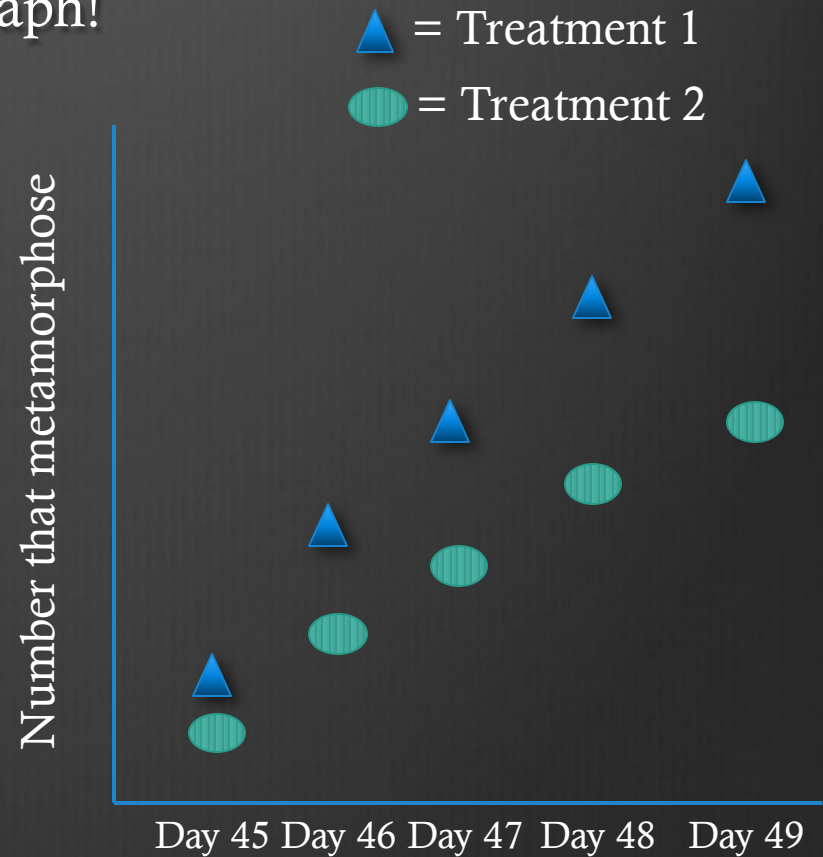
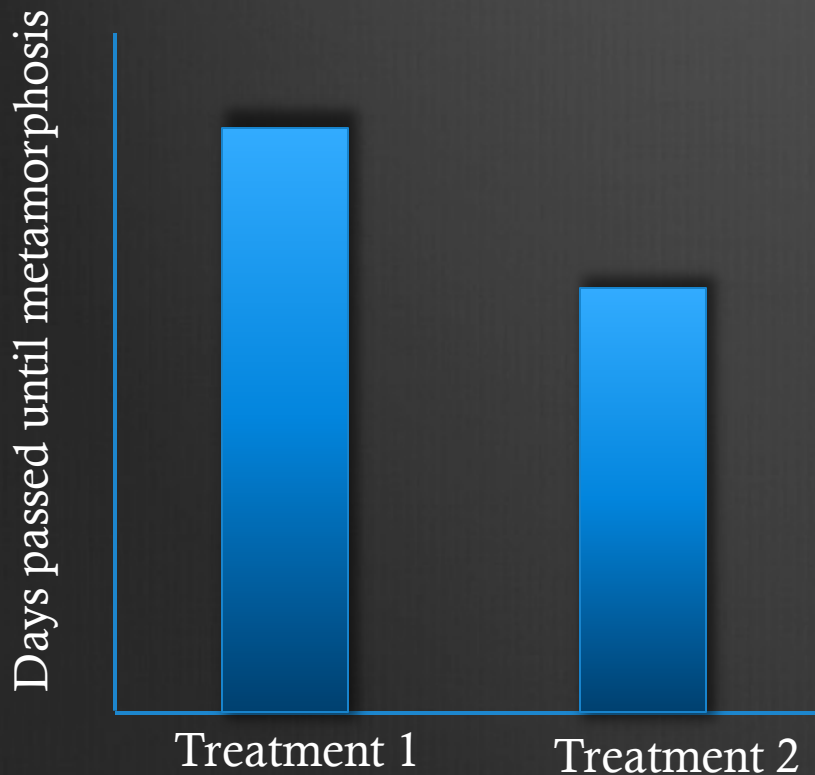
Data Collection

- ❁ Tadpoles will sprout legs before they metamorphose.
- ❁ They will sprout their back legs first, and will only sprout their front legs right when they are ready to emerge from the water.
- ❁ After sprouting all 4 legs, tadpoles will climb out of the water and will cling to the sides of the tank.
- ❁ On the data sheet, record how many tadpoles emerge and how many days have passed since hatching until they have all left the water.
- ❁ After you have recorded the individuals that have left the water, scoop them out and place them in a separate container (lined with a moist paper towel – but not fully in water or they will drown!)



Results!

- ⊗ To determine if there are any differences in the time to metamorphosis, let's average the results from each treatment and then plot our data in a graph!



Conclusions

- ⊗ What patterns did your data reveal from the experiment?
- ⊗ Did the results support or refute your original hypothesis?
- ⊗ What might be some reasons behind the different observations between the treatments?

Lab Report

- ⊗ This lab report will be about this experiment. It is different from an essay because it is divided into sections.
- ⊗ Section 1: Introduction
 - ⊗ Use this section to cover the background of the topic. You may want to cover frog life cycles, how tadpoles handle salt stress, and the tradeoffs associated with osmoregulation.
 - ⊗ Include information that you gather from outside sources
 - ⊗ Be sure to cite your works!
 - ⊗ Important! Include your hypothesis in this section.

Lab Report

- ⊗ Section 2: Methods and Materials.
 - ⊗ The purpose of this section is to outline our experimental design. It should be detailed enough for another student to run the same experiment from the information in your report.
 - ⊗ Diagrams and drawings are always helpful!

Lab Report

⊗ Section 3: Results!

- ⊗ This section is where you put your data. Since we made graphs, the graphs will go in this section.
- ⊗ Be sure to label your axes, include a legend, and put a figure caption below the graph so that people reading your report understand the data.
- ⊗ Important note: Do not discuss what your results mean in this section. All you want in the results section are the data and graphics.

Lab Report

- ⊗ Section 4: Conclusion/Discussion
 - ⊗ This is the section where you discuss what your results mean.
 - ⊗ Discuss whether your results supported your original hypothesis
 - ⊗ Why do you think they supported your hypothesis? Why not?
 - ⊗ What are some explanations for your observed data?
 - ⊗ Can you tie in natural selection into these results?
 - ⊗ How might it be adaptive to tolerate salty environments?

Congratulations!

- 🎯 You have just gone through the scientific method just like a real life scientist!

