Thermoregulation, Activity, and Physiology Game

**Learning Objectives**

Students will be able to:

**1)** Understand how temperature affects reptile activity and behavior

**2)** Identify behaviors influenced by changes in activity

**3)** Explain how temperature-induced activity shifts have “costs”

**4)** Identify “costs” associated with changes in activity and behavior

**5)** Critically think about how climate and habitat change can influence ectotherms

Students will experience how:

**1)** Behaviors used to avoid lethally hot temperatures causes animals to be inactive

**2)** Activity reduction makes it harder to get food and find a mate with direct fitness

consequences

**3)** Failure to be active and find food costs reptiles the ability to reproduce, yet staying active

for too long away from refuge (searching for food/mates) risks death

**4)** Activity increases chances of eating and mating, but risks predation

 **5)** Climate warming makes it harder for animals to survive, eat, and reproduce while

habitat disturbance makes it harder to get refuge from predators and heat causing

population declines

**Background**

 As ectotherms, most reptiles are faced with regulating body temperature on a daily basis. As temperatures increase outside of the optimum range for a reptile, it becomes more challenging to regulate body temperature. As a result of extreme temperatures, reptiles may cease activity for greater periods of the day to prevent overheating. However, ceases in activity can come at the expense of foraging and finding mates. Reptiles (and all animals) must obtain energy from food in order to reproduce. Thus, temperature-induced changes in activity resulting in lower foraging rates can have important fitness consequences. Even more, habitat destruction can make finding suitable temperatures, food, and mates even harder.

 In this activity students will role play lizards and snakes under different scenarios of habitat disturbance and climate warming. Under each condition, lizards and snakes must obtain food while regulating temperature to prevent overheating and dying. Once enough food is obtained, lizards and snakes must a conspecific who has also obtained enough food, and mate with them to achieve high fitness. However, as temperatures warm less time can be spent active. Additionally, under conditions with poor habitat there will be fewer places to retreat and thermoregulate. There will also be predators present who can eat a lizard or snake. Therefore, students will have to balance their time to survive, forage, and reproduce despite a warming climate with poor habitat.

**Activity**

*Materials:*

* Paper crickets (20 per lizard)
* Paper Rocks (see scenarios for set-up)
* Red (5 per snake and lizard) and yellow (one per snake and lizard) clothes pins
* Timers (one per snake and lizard and one for the hawks)
* Pre-game and post-game assessments

*Roles:*

A quarter of the students should be assigned the role of Hawks.

Remaining students should be evenly divided into the following roles:

* Male lizards
* Female lizards
* Male snakes
* Female snakes
* Timers

Students should rotate roles each round. Timers should be assigned lizards and snakes to time during play.

*Instructions:*

The objective of the game is to achieve high fitness: long survival and high reproductive output. There will be four rounds:

1) undisturbed habitat (high rock abundance for refuge) and optimal temperatures

2) disturbed habitat (low rock abundance for refuge) and optimal temperatures

3) undisturbed habitat and hot temperatures

4) disturbed habitat and hot temperatures.

Under optimal temperatures lizards and snakes can be active for 30 seconds before seeking refuge. They must remain in their refuge for at least 10 seconds to thermoregulate before returning to activity. For hot temperatures, lizards and snakes can be active for 10 seconds before seeking refuge and they must remain in their refuge for at least 30 seconds to thermoregulate before returning to activity. The “timers” enforce activity times by watching the lizards and snakes as they move from active to refuge points. Lizards and snakes die of heat if they do not find a refuge in time, which must be enforced by the timers. All lizards and snakes are given colored clothes pins – a single green pin should be worn on their shirt indicate survival and ten red pins should be stored in their pocket indicating reproduction. The student should write their initials on all of their red pins.

During activity, lizards and snakes must search for food – crickets (1 point) for lizards indicated by paper crickets scattered throughout the room, and lizards (the students acting as lizards; 2 points) for snakes. After getting 4 points total, lizards and snakes should place their red pin on their shirt indicating that they have enough energy to breed. In order to breed, the lizard or snake must find an animal of the opposite sex and same species with a red pin and exchange reproduction pins to indicate a successful reproductive event. Reproduction pins collected are worth 6 points.

While active, lizards must avoid being eaten by snakes while snakes must avoid being eaten by hawks, which circle every two minutes for 10 seconds. The instructor should cue the hawks to circle and time them. Death is indicated when the survival pin is removed from the person’s shirt by a predator. The game will last 8 minutes, and the person who is alive with the most points wins. The class should rotate through all scenarios at least one time, if not more. Students are not permitted to run! Students who run immediately die in the game.

*Game Set-Up:*

 The instructor should set up a room or a place outdoors where students can easily walk around. The rocks and crickets should be randomly placed throughout. For undisturbed habitat scenarios there should be two rocks per lizard and snake. For the disturbed habitat scenarios there should be one fewer rock than the number of lizards and snakes combined. Snakes and lizards should write their initials on ten red clothes pins and hide them in their pockets. They should also get one green pin to wear. Timers should be positioned in a place where they can track their snake or lizard player.

*Reflection:*

After running through all scenarios, students will reflect on the questions below related to how temperature and habitat influence organisms. After students complete their own questions, they should form small groups for discussion. After at least five minutes for discussion, the class should reconvene and students should discuss as a group the major take-aways with the instructors help.

Thermoregulation, Activity, and Physiology Game Pre-Assessment Questions

1. How do you think warming temperatures influences activity in reptiles?
2. Provide three examples of how warming temperatures and habitat destruction may influence survival and reproduction of a reptile.
3. How do you think warming temperatures can cause populations to decline, aside from directly causing mortality from overheating?

Thermoregulation, Activity, and Physiology Game Post-Assessment Questions

1. How did warming temperatures influence the ability of lizards and snakes to A) find food and B) reproduce?

2. How did habitat destruction influence the ability of lizards and snakes to A) find food and B) reproduce?

3. How do you think each scenario could influence populations of lizards and snakes over time? Explain your answers.

4. What surprised you about being a lizard or snake under warming conditions and/or poor habitat?

5. What are the costs associated with warming temperatures and disturbed habitat for lizards and snakes? How does this affect fitness? Explain your answer.