



Monarch Migration Adventure



Authors

<p>Julia Frederick PhD Candidate, UGA Environmental Health Sciences</p> <p>“My research focuses on the genetic variation present in the Lyme disease system throughout the ticks geographic range. This research includes focus on the vector (<i>Ixodes scapularis</i>), the disease agent (<i>Borrelia burgdorferi</i>), and other pathogens co-occurring within the system.”</p>	<p>Alexandria Purcell PhD Candidate, UGA Infectious Diseases</p> <p>“My research focuses on multi-drug resistant bacteria and how modification to the outer membrane lipid species contributes to the resistance level. I mainly work with an ESKAPE pathogen, <i>A. baumannii</i>, and focus on lipid A modification in relation to drug resistance.”</p>
<p>Anna Willoughby PhD Student, UGA Odum School of Ecology</p> <p>“My research interests are human-wildlife interactions, One Health, multi-species and zoonotic pathogens.”</p>	<p>Cece Working PhD Student, UGA Odum School of Ecology</p> <p>“My research interests include disease ecology, the role of the environment in parasite development, and community ecology in domestic and wildlife populations.”</p>

Point of Contact for Lesson Plan:

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Intended Audience:

Grades 9-12

Activity Characteristics:

- Classroom Setting
- Requires independent thinking
- Small and large group discussion
- Applying specific cases to a broad picture

Class time: 55 minutes in class; 40 minutes in homework

Teacher Preparation Time: Low – Computers and Handouts

Group Sizes: Independent, 2-4 students, whole class

Introduction

Recognizing all the threats that exist in an environment is an important step to understanding how individuals behave and species evolve. Knowledge of species interactions provides context for how we can support the survival of a vulnerable species. Species can be threatened by environmental conditions, predators, parasites, competition, and human interaction.

Environmental conditions such as temperature are changing throughout the world. Changes in environmental conditions result in new pressures to the individuals. Thus, wildlife must either adapt to the changed environment or move to new areas where their historic environmental conditions remain.

Predators are a major threat to individual survival. However, many prey species have developed behaviors to deter or avoid predation which increase their chances for survival.

Parasites affect species across all taxa. These species live on or in another organism, and include many taxa including bacteria, viruses, arthropods, or helminths. In some cases, two or more infectious organisms infect a host at the same time, resulting in a co-infection. Being infected by a single parasite or multiple affects an individual's ability to survive in their environment.

Individuals of the same and different species compete with each other for resources. An individual's ability to out-compete others for critical resources is an important factor for individual survival.

Human interaction (intentional or not) poses a threat to wildlife in many environments. Human driven changes to the environment is a major cause for habitat loss, which directly affects the survival of individuals and species. In other cases, humans act as a predator species harvesting wildlife for food or sport.

In this lesson, students will experience different threats as a monarch butterfly. They must make behavioral decisions that give them the best chance at completing the monarch butterfly's yearly migration to Mexico while recognizing trade-offs between energetic outputs, resource acquisition, and exposure to threats.

Keywords: parasite, predation, competition, human interaction, environment, behavior

Learning Objectives:

- Identify the life cycle of an arthropod
- Describe threats that can affect survival and longevity
- Host-parasite interactions
- Apply and understand ecological principles of species persistence
- Design methods human can use remedy these threats
- Describe how individual behavior scales up to population trends

Georgia Science Standards:

Ecology

SEC3. Obtain, evaluate, and communicate information to construct explanations of community interactions.

- a. Construct an argument based on evidence to support how species interactions (e.g., predation, parasitism, mutualism, commensalism, and competition) and adaptations are a response to selective pressures.

Entomology

SEN2. Obtain, evaluate, and communicate information about how insect morphology and adaptation is related to insect success.

- b. Construct arguments based on evidence to explain how different insect life cycles impact insect survival and success.
- d. Analyze and interpret data on how insect structure and function are integrated and reflect evolved adaptations to different environments.

Zoology

SZ4. Obtain, evaluate, and communicate information to assess how animals interact with their environment and one another.

- a. Construct explanations to relate structure and function of animals to ecological roles, including morphological, physiological, and behavioral adaptations
- c. Construct an explanation based on evidence of the effects of symbiotic relationships between animals (i.e., parasites and disease vectors) and between animals and other organisms (i.e., algae in coral; protists in termites; parasites).

SZ5. Obtain, evaluate, and communicate information to analyze the relationship between humans and animals within various phyla.

- a. Ask questions and define problems identifying the cause and effect of human activities on the biodiversity of organisms (including habitat destruction, overharvesting, water consumption, and pollution).



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For TEACHERS

Student Background Knowledge

Students should understand and be able to identify threats to individual survival through biotic and abiotic factors (e.g. predation, competition, human interaction, disease, temperature, weather events). Students should be able to explain the life cycle of arthropods.

Activity Outline

- I. Introduction to Monarchs (Preferably done at home – 20 minutes)
- II. Individual Activity – Monarch Migration Adventure (15 minutes)
- III. Small Group Activity and Discussion (15 minutes)
- IV. Whole Classroom Activity and Discussion (20 minutes)
- V. Wrap-Up Questions (Preferably done at home – 20 minutes)

Materials and Equipment

- Access to internet for each student
- Handout per student

Lesson Plan Instructions

Prior to this activity, educators may review the lesson plan materials. During the lesson, students should answer the Lab Questions in the Student Handout by themselves or with the designated group. Optional: Have students take home the Pre-Lab Questions to answer for homework and review as a class at the start of activity.

Following completion of the activity students should answer the Wrap-Up Questions as an assessment.



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For STUDENTS

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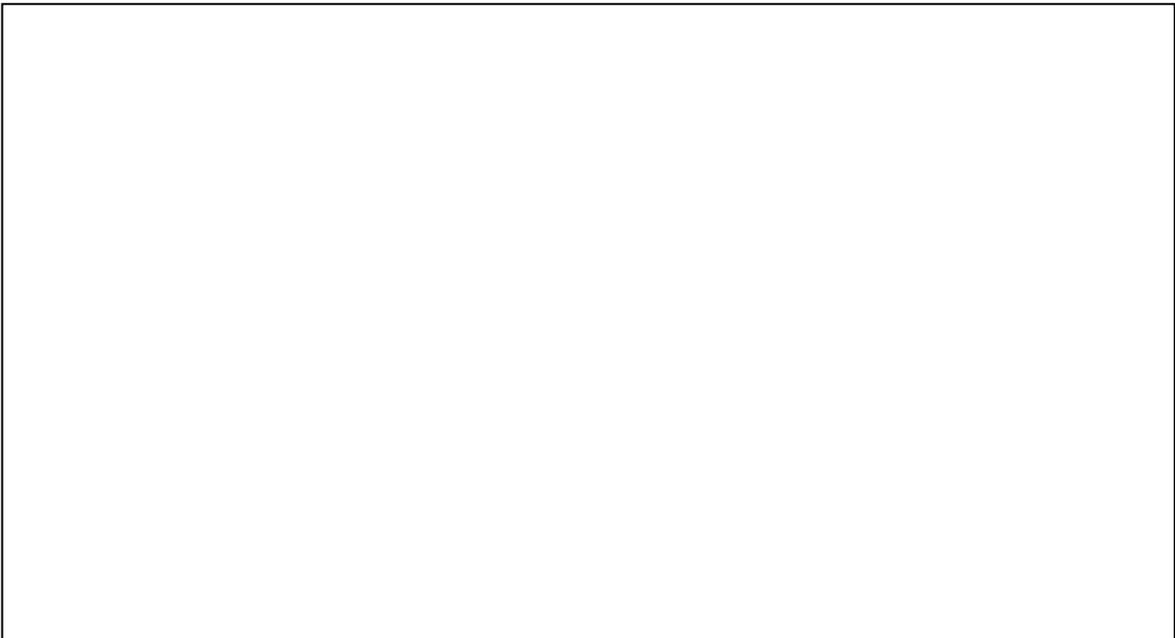
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Pre-Lab Questions

1. Define the follow vocabulary words:

- Abiotic
- Arthropod
- Biotic
- Co-infection
- Competition
- Ecology
- Host
- Mortality
- Morbidity
- Parasite
- Predation
- Resources

2. Monarchs are an arthropod species that has different life stages. Describe the monarch life cycle below using a diagram. (Online resources may be used, please cite your resources).



3. Each year monarchs from the Northeastern United States complete a round trip migration to Mexico. How many generations of monarchs are needed to complete a single migration cycle? How are they distributed amongst the trip?

4. Describe 4 threats to monarch survival. Be specific and give examples.

5. In what ways do you think humans can help and hurt the monarch population?

Individual Activity – Monarch Migration Adventure

This portion of the activity is to be done individually. Should take a total of 15 minutes to complete (10 minutes to work through the Adventure and 5 minutes to answer the questions).

1. Go to (<https://youtu.be/oW03HCwf9II>), and complete one monarch life. Record how your life ended (if you did not survive, record what caused it) and what you believe were the important decisions that led you there.

2. What threats did you encounter during your monarch life?

3. Throughout the Monarch Adventure there are two parasite threats that are possible (OE, and tachinid flies). Even if you were not infected in your play through, research and explain here what OE and tachinid flies are, and how they affect the morbidity of the Monarch.

Small Group Activity – Monarch Migration Adventure

This portion of the activity is to be done in small groups. Should take a total of 15 minutes to complete. Record your own answers.

1. In your small group discuss the different endings each of you experienced. Create a categorization system for the endings and record how you categorize each of your individual endings.

2. Go to (<https://youtu.be/oW03HCwf9II>), and complete two monarch lives. Record how the lives ended (if you did not survive, record what caused it), include these in the categorization scheme you created above. What were the major decisions that led to the end of your lives?

3. What threats did you encounter during your Monarch life? What behaviors were (or could have been) important to your survival of these threats?

Large Group Discussion – Monarch Migration Adventure

This portion of the activity is to be discussed with large groups or the full class led by a designated student or the instructor. Record your own answers.

1. What categories did the class decide on for the endings, and what interactions occurred to cause those endings?

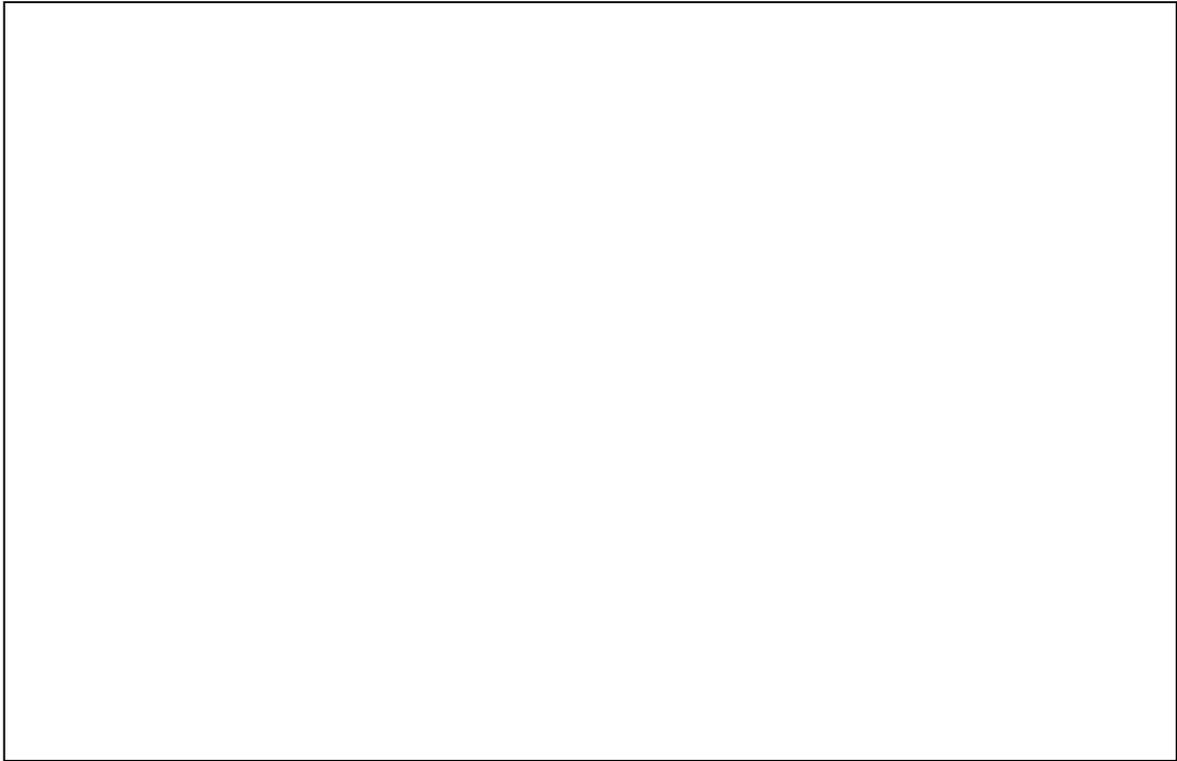
2. Go to (<https://youtu.be/oW03HCwf9II>) and attempt to complete the monarch migration cycle. Discuss and vote on each decision as a class. Use previous knowledge from your other attempts to support your argument for each decision. Record how each decision helped move you along on the adventure.

3. Did you encounter either OE or the tachinid flies in the path for the complete migration? Do you think Monarchs with either of these parasites complete the migration each year? Why or why not?

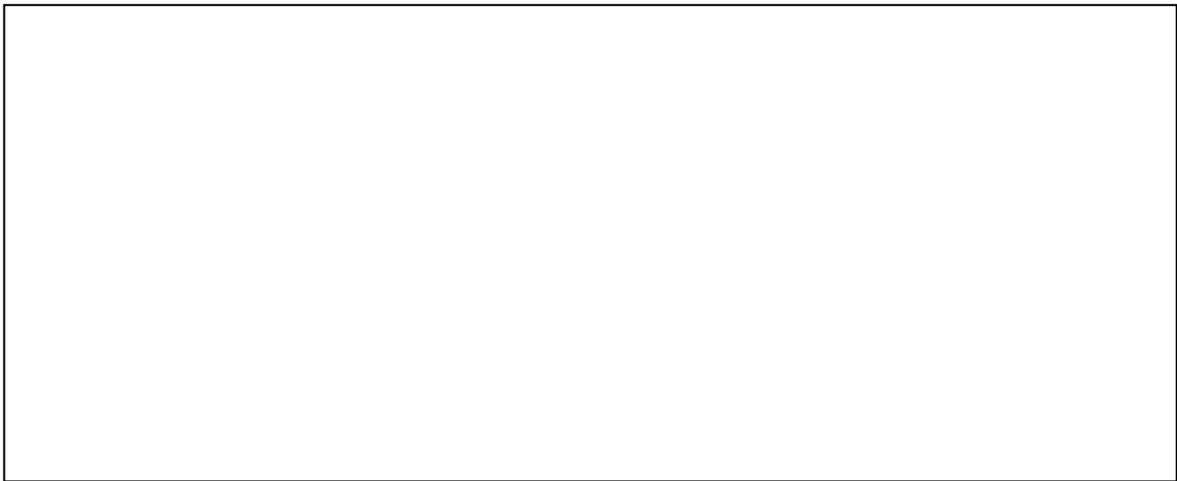
Wrap Up Questions – Monarch Migration Adventure

This portion of the activity is to be done individually after the completion of the Large Group Discussion.

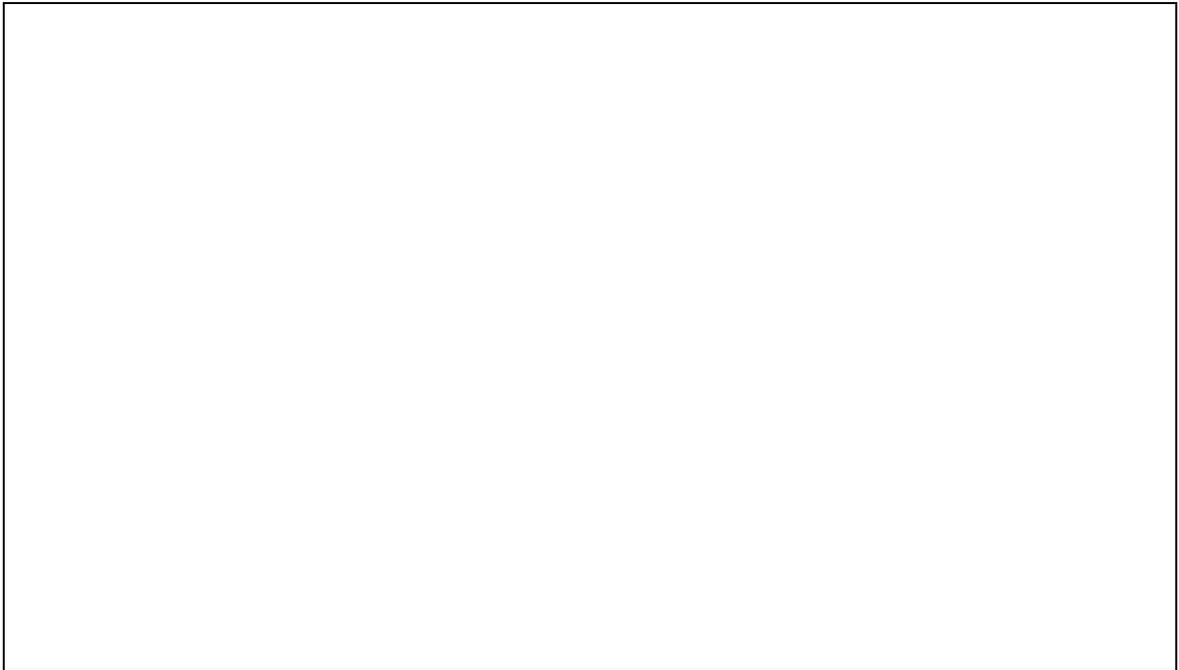
1. In the Pre-Lab Questions you created a diagram of the monarch life cycle. Re-create a diagram of the monarch life cycle and include how the tachinid fly and OE life cycles overlap with it.



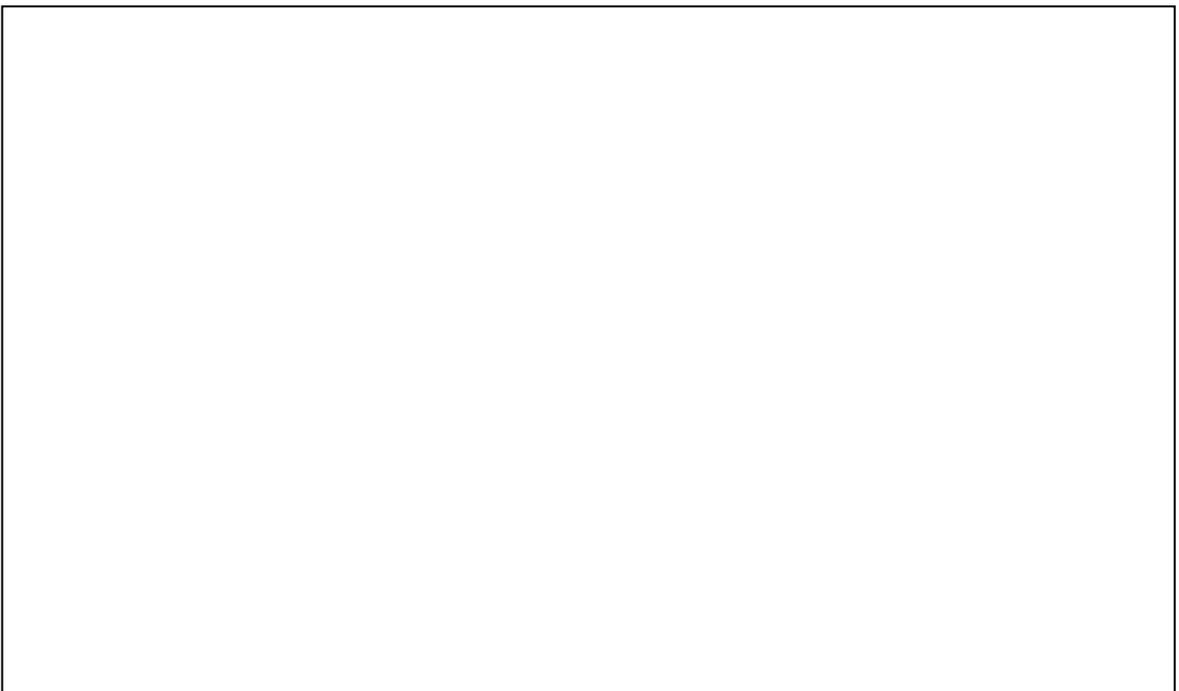
2. How do you think the overlapping of these life cycles impact the survival and success of monarchs and tachinid flies?



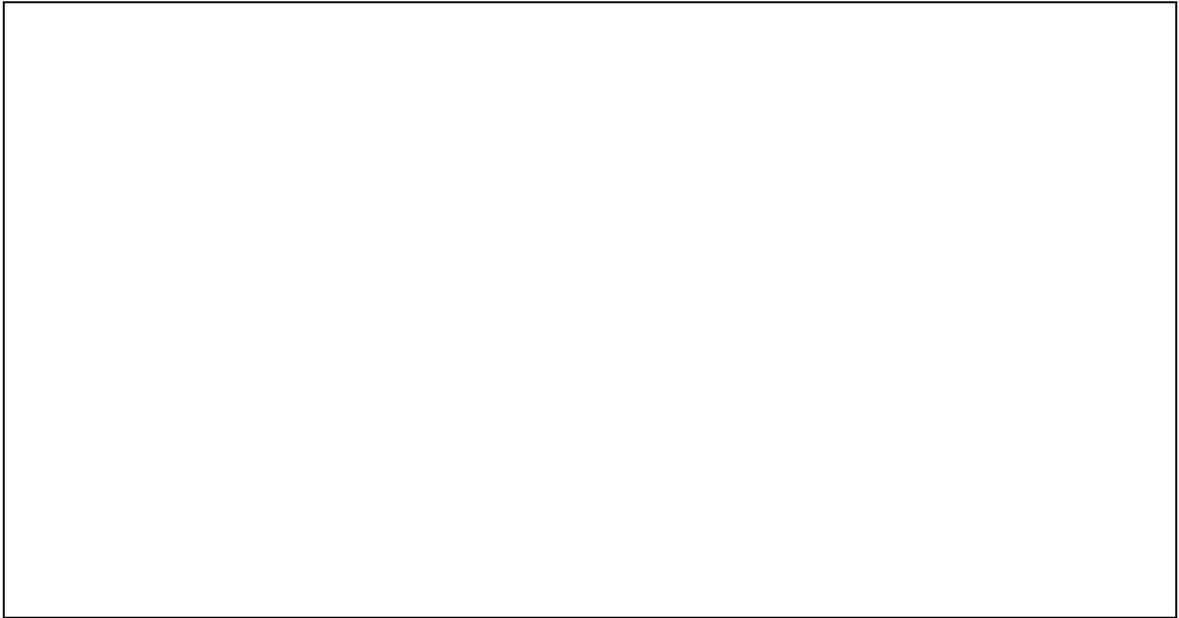
3. In what ways have monarchs adapted to overcome certain obstacles or threats? Provide specific examples. Are there other adaptations that other species have that could also help the survival of monarchs?



4. Human interaction is one way that can cause monarch death. What are examples of negative human interactions (intentional or not)? In what ways can humans change their behavior to limit their effect on monarch health and how can we raise awareness of these behaviors?



5. How do you think climate change will affect monarch health into the future? How do you think it will affect the monarch migration cycle?

A large, empty rectangular box with a thin black border, intended for the user to write their response to the question above.