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**MSU Coastal Research & Extension Center**

Lesson 3: Ecosystem Stability

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**Theme**

* Environmental Science/Ecology

**Grade Level**

* 9th – 12th

**Class Size**

* 10-30 Students

**Length**

* 1.5 hours

**Materials**

* Whiteboard or computer/projector,
* A spring large enough for classroom to appreciate

(optional prop)

* 2-3 empty aluminum cans (optional prop)

**Evaluation Method**

* Discussion, Attached Worksheet

**Date Prepared / Modified:**

* August 10th, 2022

## Goal: Understanding of ecosystem stability, including ecosystem resistance, resilience, stable states, and disturbances/pressures.

## Learning Objectives:

## Define ecosystem resistance and ecosystem resilience

## Explain carrying capacity in its relationship to ecosystem stability

## Distinguish disturbance events from stress

## Question the relative importance of an array of environmental factors on ecosystem stability

## Recognize Shifting Baselines in evaluating ecosystem stability

**Mississippi College and Career-Readiness Standards:**

ENV.1 Students will investigate the interdependence of diverse living organisms and their interactions with the components of the biosphere.

* Aligns with ENV.1.6, ENV.1.7, ENV.1.8, & ENV.1.9.

**Prerequisite Instructor Knowledge:**

Carrying capacity, resilience vs. resistance, stable state, disturbances.

**INTRODUCTION**

**Ecosystem Stability Lesson Overview:**

* Engage with students prior to the lecture to determine their background knowledge on ecosystem stability
* Explore and explain the concept of resistance vs. resilience
* Conduct optional ball (resistance & forces) activity
* Apply understanding to complete ecosystem stability activity and worksheet
* Evaluate understanding of concepts by answering accompanying questions at end of worksheet

**LECTURE**

**Engage with students to gauge pre knowledge (5 min)**

1. In the Energy Transfer lesson, students learned about energy limitations for organisms eating at higher trophic levels and consumers’ quantifiable dependence upon producers (The 10% Rule).

* Ask: Considering the 10% rule, how many kilograms of plant material are needed to sustain an herbivore that weighs 1 kg?
  + - * 1kg (90% of energy is lost)

1. For this simple system containing 10kg of producers and just this one herbivore species, we could say the “carrying capacity” of this herbivore population is 1kg. Generally though, we think of carrying capacity in terms of the number of individuals (*e.g.* 50 grasshoppers) that can be sustained within an ecosystem, based upon resources available (*e.g.* 10kg of marsh grass).

* Ask: What will happen to a population of 28 grasshoppers in a system with 10kg of marsh grass?
* It will increase (up to 50, assuming food resources remain constant)
* Ask: What about a population of 62 grasshoppers?
* It will decrease (down to 50, assuming food resources remain constant). Either by mortality or migration. (or grasshoppers may respond physiologically/behaviorally, like being stunted)

1. In this way, an ecosystem with 1kg of grasshoppers is *balanced* by 10kg of marsh grass in the same system.

* Ask: What would happen to the *grasshopper population* if a disease killed off half of the marsh grass (5kg of marsh grass remaining)?
* It would decrease (to 25 grasshoppers if the relationship is linear).

1. Illustrate the basic notion of carrying capacity using setup similar to that in PowerPoint slide: [**Ecosystem Stability**](https://docs.google.com/presentation/d/1eAqlhYzm-FuCsDiUy2F8lxG5i9-qBKUUzxSsCpTd4bs/edit#slide=id.p6)

**Explore and explain the concept of resistance vs. resilience (5 min)**

1. Briefly go over resistance and resilienceusing the cup and ball figure in PowerPoint slides.

[**Ecosystem Stability**](https://docs.google.com/presentation/d/1eAqlhYzm-FuCsDiUy2F8lxG5i9-qBKUUzxSsCpTd4bs/edit)**- \*PPT SLIDES PROVIDED\***

1. You may use a spring and aluminum cans to demonstrate resilience (spring returning to its form) and resistance (aluminum cans, very resistant to stress from above but not from the side, or from the top if the side has been compromised…relate to a combination of ecosystem stresses).

**Apply concepts to complete ecosystem stability activity (30 minutes)**

1. Students apply their understanding of ecosystem stability to a hypothetical disturbance scenario.
2. Use accompanying worksheet activities (in this order):
   1. [Ecosystem Stability Activity](https://docs.google.com/presentation/d/1BumLFsnMEhyyGJ-siqZemsg6QwY6ChOTYpXrGShQ86c/edit?usp=sharing) (PPT- use this to run the activity)
   2. [Ecosystem Stability Activity Student Sheet](https://docs.google.com/document/d/1ufaaC6kM7a3SyJImvwdKqdvCiK-12ebUWpqaKfxbG0U/edit?usp=sharing) (Worksheet - PRINT for students)
   3. [Disturbances Outcomes Sheet](https://docs.google.com/document/d/1n8R8uGXTaKVp8qYrrPALfeX3ypMnldpEctzhNkzar7c/edit?usp=sharing) (Use to determine disturbance outcomes for activity)

OR Alternate Activity

* 1. [Alternate Activity\_ecosystem\_stability](https://docs.google.com/document/d/1y8f8ISXlnzQHnNfvKvaBijoMw3JAlCvxK8CIj-iTUpE/edit?usp=sharing) (PRINT for students, materials and ?s are included in this doc)

**EVALUATION**

**Gauge Students Retention of Knowledge (20 minutes or leave for homework)**

1. Use the questions provided at the end of the worksheet(s) to test students’ understanding of the material.
2. Can have a class discussion / go over questions together or leave questions for homework.