HOUSTON MUSEUM
of NATURAL SCIENCE

Ecology and Symbiosis Knowledge Hunt: High School Biology

As you explore the Hamman Hall of Texas Coastal Ecology, the Farish Hall of Texas Wildlife, and the Frensley/Graham Hall of African Wildlife, you'll discover the complex interactions between organisms and their environments. These three halls provide exceptional opportunities to observe diverse ecosystems and the interdependent relationships that sustain them. By examining these exhibits, you'll gain insights into how energy flows through ecosystems, how species adapt to their environments, and how different types of symbiotic relationships function in nature.

Note: You can use your phone to research additional information if you need more background details to answer a question, and this information is not available on the exhibit text panels or through direct observation.

Hamman Hall of Texas Coastal Ecology: Food Web Construction

The Texas coast stretches for 367 miles and features remarkably diverse habitats, from salt marshes and oyster reefs to seagrass beds and wind-tidal flats. Each ecosystem supports distinctive communities of organisms connected through feeding relationships, all of which can be influenced by human activities.

Salt Marsh Food Web

Locate the salt marsh exhibit. Salt marshes are one of the most productive ecosystems on Earth and serve as crucial nursery grounds for numerous marine species.

Observe the display carefully and identify:

- Primary producers (plants and algae)
- Primary consumers (herbivores)
- Secondary consumers (carnivores)
- Tertiary consumers (top predators)
- Decomposers

Create a food web diagram showing at least 8 organisms from the salt marsh ecosystem. Include:

1. Arrows indicating the direction of energy flow
2. Labels for each trophic level

3. Identification of keystone species, if present
4. Explanation of how removing one species might affect the entire food web

Questions to consider:

- How does the salt marsh cordgrass function in this ecosystem beyond serving as a food source?
- How do abiotic factors (tides, salinity, temperature) influence the food web structure?

Human Impacts on Salt Marsh Ecosystems:

1. Identify at least two human activities that might disrupt the salt marsh food web you created.
2. Recent research shows that nutrient enrichment (from agricultural runoff, urban development, etc.) affects salt marshes even without causing oxygen depletion. Explain how excess nutrients might initially stimulate fish production but eventually lead to decline.
3. Observe the exhibit and research: How have human-built structures (jetties, seawalls, etc.) altered coastal hydrology and affected salt marsh ecosystems?

Questions to consider:

- How does pollution from urban and agricultural runoff affect the primary producers in the salt marsh food web?
- If nutrient loading disrupts relationships between species that normally exchange nutrients beneficially, what cascading effects might occur throughout the food web?
- What conservation efforts or technologies are being implemented to mitigate human impacts on coastal ecosystems? Which appear most effective?

Farish Hall of Texas Wildlife: Symbiotic Relationships

The Farish Hall showcases the diverse biomes of Texas, from Piney Woods to Coastal Prairie.

Types of Symbiosis

As you explore the exhibits, you will identify and explore examples of the three main types of symbiotic relationships:

1. **Mutualism:** Both species benefit
    - **Find the American Alligator and Wading Birds**—Recent ecological research has revealed a fascinating relationship between American alligators and wading birds (such as herons and egrets) in wetland habitats. Wading birds often nest in colonies

above areas where alligators live. The birds benefit because the alligators deter mammalian nest predators (like raccoons), increasing the birds' nesting success.

- Formulate a specific hypothesis explaining how alligators might benefit from this relationship in terms of nutrition and reproductive success.
- What specific evidence would you seek to support or refute your hypothesis?

2. **Commensalism:** One species benefits while the other is neither helped nor harmed
    - **Find the Black-tailed Prairie Dog and Burrowing Owl**— Black-tailed prairie dogs create extensive burrow systems in Texas grasslands. Burrowing owls often use these burrows.
    - Formulate a specific hypothesis explaining how burrowing owls benefit from using prairie dog burrows in terms of survival or reproductive success.
    - What specific evidence would you seek to support or refute your hypothesis?
3. **Parasitism:** One species benefits while the other is harmed
    - The recent detection of the New World Screwworm (*Cochliomyia hominivorax*) in Mexico has raised concerns for Texas ecosystems. This parasitic fly lays its eggs in open wounds or orifices of warm-blooded animals, and the larvae burrow into the living flesh, causing severe tissue damage and sometimes death. Wildlife species such as deer and birds are at risk if the screwworm spreads into Texas.
    - **Pick a Texas ecosystem** and an animal species that could be affected by the New World Screwworm.
    - Formulate a specific hypothesis explaining how the introduction of the New World Screwworm might impact the population dynamics of your chosen animal in that ecosystem.
    - What specific evidence would you seek to support or refute your hypothesis?

Human Disruption of Symbiotic Relationships:

For each symbiotic relationship you explored, describe one way human activities might disrupt this relationship. Be specific about:

- The type of human activity (pollution, habitat fragmentation, climate change, etc.)
- How might this disruption change the nature of the symbiotic relationship
- Potential consequences for both species involved and the broader ecosystem

Frensley/Graham Hall of African Wildlife: Comparative Ecosystems

The Frensley/Graham Hall features seven distinct African biomes. This provides an opportunity to compare natural ecological variations and differing human impacts across ecosystems.

Ecosystem Comparison: Serengeti Grassland and Congo Basin

Locate the Serengeti Grassland and Congo Basin exhibits. These two ecosystems represent dramatically different environments with distinct ecological relationships.

For each ecosystem, create a detailed ecological profile including:

1. **Food Web Analysis**
    - Identify at least 2 predator-prey relationships
    - Determine the primary energy source
    - Identify omnivores that connect multiple trophic levels
2. **Symbiotic Relationships**
    - Document examples of mutualism, commensalism, and parasitism that you can identify
    - Compare and contrast the symbiotic relationships between these ecosystems
    - Explain how these relationships contribute to biodiversity
3. **Adaptation and Niche Specialization**
    - Select two species from each ecosystem with specialized adaptations
    - Explain how these adaptations relate to their ecological niche
    - Analyze if these adaptations affect their role in symbiotic relationships and if so, explain how

Comparative Human Impacts:

1. For each ecosystem, identify:
    - The primary human threats to biodiversity (deforestation, poaching, agricultural expansion, etc.)
    - How these human activities affect the food web you documented
    - One example of how human activities have disrupted a symbiotic relationship in each ecosystem

2. Compare and contrast conservation approaches in these two ecosystems:
    - What conservation strategies are being implemented in each ecosystem?
    - How do these approaches differ based on the unique ecological characteristics of each system?
    - Which approach do you think will be more successful and why?

After Your Visit

After completing your exploration of all three halls, reflect on the following:

1. Identify three examples of how human activities are negatively impacting ecosystems in ways that weren't immediately obvious to you before this knowledge hunt.
2. Describe three positive actions humans are taking to mitigate their impact on ecosystems and support biodiversity.
3. How can understanding ecological relationships and symbiosis help us design more effective conservation strategies?
4. As a citizen scientist, what personal actions could you take to contribute positively to ecosystem health in your local community?

TEKS

Social Studies

- WG.4.A: Analyzing how physical and human geographic factors have influenced the development of Indigenous cultures and settlement patterns
- WG.5.B: Explaining how people adapt to and modify their environment, including Indigenous resource management and sustainability practices
- WG.8.A: Describing how cultural processes shape the characteristics of places and regions, including the diffusion of beliefs, languages, and traditions
- WH.15.A: Examining the development and impact of cultural traditions, art, and belief systems in world history
- USH.17.A: Analyzing the relationship between the arts and the times during which they were created, including Indigenous artistic expression
- GOVT.1.A: Understanding the principles and structures of Indigenous governance and confederations
- ECO.3.A: Identifying economic activities and trade networks among Indigenous groups and the economic principles they demonstrate

Science

- BIO.1.A: Asking questions and defining problems based on observations or information from text, phenomena, models, or investigations2
- BIO.1.G: Developing and using models to represent phenomena, systems, processes, or solutions to engineering problems2
- BIO.12.A: Investigating and describing how organisms, populations, and communities respond to external factors in their environment, including Indigenous ecological knowledge4
- ESS.4.A: Evaluating human impacts on Earth systems, including sustainable resource management practices of Indigenous societies
- ENV.5.A: Analyzing the importance of sustainability in the use of natural resources, as demonstrated by Indigenous practices

English Language Arts and Reading

- ELA.III.6.A: Generating and clarifying questions for inquiry and research based on exhibit content
- ELA.III.6.C: Synthesizing information from a variety of sources, including artifacts and exhibit panels
- ELA.III.7.A: Analyzing genre-specific characteristics, structures, and purposes within and across diverse texts, including museum displays and artifact descriptions

Mathematics

- GEOM.2.A: Analyzing geometric patterns and structures in Indigenous art and architecture
- ALG.1.G: Displaying, explaining, and justifying mathematical ideas and arguments using precise mathematical language in written or oral communication

Fine Arts

- ART.I.2.A: Creating original artworks based on direct observations and cultural research, including Indigenous art forms
- ART.I.3.A: Comparing and contrasting historical and contemporary styles, identifying general themes and trends in Indigenous art

Technology Applications

- TECH.1.A: Creating original products using a variety of resources and technology, such as using phones for research during the knowledge hunt