**Coral Reefs: Healthy to Disaster**

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**Introduction**

St. Georges Technical High School is one of four public vocational-technical high schools in New Castle County, Delaware. The students are representative of diverse backgrounds – urban Wilmington, suburban Newark, and rural Middletown. The unique draw for a technical high school like ours is the ability for students to study a trade and graduate with a certification or license. Our students apply to St. Georges for a variety of reasons: learn a family trade, learn in a safer school environment when compared with a feeder high school, or earn a certification to join the workforce instead of continuing to a post-secondary school. With each graduating class, approximately fifty percent of students directly join the workforce, an apprenticeship, or trade school. The remaining fifty percent continue on to a four-year college/university, or a branch of the military.

 The technical school environment offers students a distinctive high school experience. Each student earns a certificate or license in their field of study upon graduation. The trades offered to our students are as diverse as the students themselves; ranging from nursing to carpentry, web design to culinary, automotive technology to early childhood education, and a dozen other options. In the school year 2018—2019, out of 802 upperclassmen (sophomores, juniors, and seniors), 20% study a trade in the Public/Consumer Services cluster, 23% study a Construction trade, 35% study in the Health Career cluster, and 23% study in the Business and Technology cluster.

 St. Georges, as a technical trade school, is considered a branch of the public-school system. Therefore, students have access to their career classes in addition to the state-mandated academic courses offered within St. Georges. I am one of the science instructors within the building; teaching biology to sophomores. This unit has been developed for biology, a required course for graduation by the state of Delaware. The topics covered in this course are as follows: ecology, genetics, and evolution. This unit is intended to be incorporated into both the ecology and evolution sections of the course and can be revisited throughout the genetics unit.

 As a fully-inclusive school, students of all ability levels, both regular education and special education students, are placed in the same class and therefore it becomes important for the instructor to be able to differentiate each lesson. Following the blended learning educational model, this unit provides students with several choices in how they learn, express their knowledge, the pace at which they learn, and utilize technology to enhance their overall learning experience. Within the blended model, the teacher becomes a facilitator while the student becomes the gatherer and organizer of information. My role as a facilitator is to provide students with appropriate resources and experiences to extract information and scaffold the lesson. It is important that the teacher carefully identifies a limited set of videos, articles, and simulations to provide the students with a choice in gathering information.

 The state of Delaware has adopted the Next Generation Science Standards (NGSS) and is currently implementing them into the high schools. There has been an increase in the number of standards being taught in tenth-grade biology; therefore, the amount of depth able to reach is limited. The goal is to increase student engagement and motivation into their own learning through the exploration of skills. Beginning with a phenomenon, students create their own questions, cultivating their own interest in Biology. The main skills assessed in this unit are engineering and supporting claims using evidence.

**Rationale**

This unit is designed to integrate biodiversity, ecosystem interactions, and natural selection concepts with the school-wide focus on literacy. The multiple components included in this unit are taught throughout the school year; partially during ecology and partially during evolution. With the enormous shift in standards for Biology, human impact and sustainability have been added to the traditional topics of evolution, cells, and genetics. Creating a common thread based around a phenomenon is a key component in the Next Generation Science Standards that encourages integration between topics. Coral reef ecosystems are the common theme in this unit that will span the entire course – what determines a healthy reef ecosystem, how humans have impacted the bleaching of reefs, subsequent changes the reef ecosystem, and how natural and man-made disasters influence natural selection of a species. All content is related back to healthy and unhealthy reef systems.

 The unit will be introduced using two images: a healthy coral reef and a bleached coral reef. The ecology component is focused around symbiotic interactions, specifically mutualism and predation, in coral reefs and how these relationships impact population levels in a given ecosystem. Students have previous knowledge on population dynamics and carrying capacity which is required of them to incorporate into their scientific reasoning during written expression at the end of this activity. It delves into how humans are negatively impacting the natural ecosystem in coral reefs through the lens of coral bleaching and how these impacts can be reflected in population graphs. Students also have prior knowledge on the conservation of matter and energy; specifically, the carbon cycle. This content assists students in their understanding of human impact on the carbon cycle and the resulting impacts on coral species. Students study natural selection at the end of the biology course, where the idea of a changing environment impacting the biodiversity of coral reef ecosystems is implemented. We look at how disasters, both man-made and natural, impact the mortality and success of various species. Students are able to determine what phenotypic characteristics are favorable during changing conditions in an aquatic reef ecosystem. Throughout the multiple sections of this unit, students will be completing group research, individual writing, peer editing, online simulations, and the playing of games to apply and assess content understanding.

 As a result of completing the curriculum unit, students have the ability to explain using evidence ways in which humans are impacting coral reef ecosystems and the resulting impacts on biodiversity from an ecology and evolution stand point. Students are able to incorporate previous knowledge learned about the carbon cycle, Earth’s spheres, and population dynamics into their written responses. Groups will have the ability to design and evaluate a solution for preventing and improving disasters impacting reefs. Peers have the opportunity to evaluate and provide feedback on each other’s writing. By the end of the unit, students have a greater understanding of natural selection as it applies to current conditions on reef ecosystems and are able to apply it to disaster scenarios in other ecosystems.

**Content Objectives**

With the completion of this unit, students will be able to:

* Explain symbiotic relationships and their impacts on population dynamics.
* Design a way to reduce human impacts on coral reef ecosystems.
* Explain using evidence how disasters influence natural selection.

**Standards**

**HS-LS2-6:** Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions but changing conditions may result in a new ecosystem.

**HS-LS2-7**: Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

**HS-LS4-5:** Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.