

## **Integration and Development of Climate Change Content in the Environmental Science Program at HMHS**

### **General Statement**

All aspects of ecology, biodiversity and environmental science involve themes, case studies and application of climate change science. Over the past 20 years the development of curricula and lab and field investigations have connected to climate change content though the current science, data and policy applications for interdisciplinary climate change studies warrants continued integration and emphasis. The following sequence of AP and CP Environmental science topics include studies for the development of climate change lessons and data collection in the existing curriculum while also allowing for additional opportunities to explore mitigation, adaptation and community science projects.

Field Study protocols have been outlined and all materials/ equipment needed for studies are accessible within the department.

### **General Ecology**

Range of Tolerance is a key theme in studying how species are connected to their community and adapted to their physical environment. One of the main investigations conducted during this study is to connect forest cover, human disturbance and land use changes to abiotic and biotic factors in ecosystems.

Field Study - Students use a transect data collection effort to compare the soil temperature of forested and non-forested habitats in Cooper River Park. Using statistics students determine the potential impacts on soil processes and ground level communities from loss of forest. Additional data collection may include measuring soil moisture content in the same two plots - forested and cleared. Trees are an integral biological factor in climate regulation, change and mitigation. This study goes beyond carbon sequestration to emphasize the ecological ramification in the soil community and structure as a result of tree cover loss.

### **Population Ecology**

There are various applications for population ecology studies - endangered species, pest management, fisheries and forestry to name a few. The students of HMHS have been monitoring the population of the Asian Clam - *Corbicula* - in the Cooper River system over the past 8 years.

Field Study - It is hypothesized that Asian clam survival depends on winter water temperature. In this study students will hypothesize about the population at our study site based on average winter temperatures so as to predict population increase or decrease. Other invasive species

found in our region will also be examined as to their connection to seasonal changes in temperature and climate change data.

## **Community Ecology**

How species interact and the overall function at ecosystem scale depends heavily upon the species present in a specific ecological community. Climate change affects community composition, structure and diversity in various ways.

Field Study - Students collect invertebrate diversity data at various sites using pitfall traps. Total abundance, species richness and ecological niche diversity will be documented in the samples collected and students will develop hypotheses on how each of these measurements can potentially change as a result of climate change and develop how those proposed impacts can affect community function over time.

## **Aquatic Ecology/ Water Pollution**

Climate change has the capacity to alter dramatically the ecology of freshwater, estuarine and marine environments. Bleaching coral, sea level rise along our coastlines and reductions in fresh water availability are all connected to climate change science.

Field Study - The students of HMHS have been collecting physical and chemical data in lentic and lotic systems in western Camden County for over 20 years. Climate change driven disturbances - temperature and precipitation changes - has the potential to affect dissolved oxygen levels, runoff and nonpoint source pollution events, suspended solids and turnover events which, in turn, can affect biodiversity and ecosystem function in local aquatic systems. Students will continue to collect aquatic parameters during aquatic ecology, water pollution and watershed study lessons and connect data collected to climate change.

## **Biodiversity and Conservation**

The current biodiversity crisis, the massive reduction in the populations of species across most taxa and the extinction of some species, is intricately linked the effects of climate change. Haddonfield students have studied migratory shorebirds, horseshoe crabs, frog communities, freshwater mussels and sea turtles through the lens of conservation. Though climate change is not the only anthropogenic stressor that has compromised these species, it is a factor in all groups. To effectively address the conservation status of these species requires climate change study and action.

Field Study - all biodiversity studies included in future investigations will emphasize the climate change connections and seek to develop Species Recovery Plans that will demonstrate how

climate action, alongside other strategies, will stabilize populations and improve habitat. Google Earth Projects, as has been used for horseshoe crab studies by HMHS students, will be an effective tool to shed light on climate impacts potential conservation strategies.

## **Energy and Air Pollution**

Even today CO<sub>2</sub> emissions have not been categorized with the same priority of other air pollutants. The combustion of fossil fuels is not only responsible for the release of hundreds of different air pollutants that threaten human health and environmental quality (including the common criteria air pollutants which were the original focus of the 1970 Clean Air Act), but also the emissions that are amplifying the warming effect of the troposphere.

Lab Study - study of energy and fuel resources will focus on CO<sub>2</sub> and other GHG and look to examine not only the ways in which industry can address emissions and transition to cleaner renewable sources, but also the contributions of the Haddonfield high school and individual students. Students will keep a climate log to document reductions in CO<sub>2</sub> eq based on modified activities and other actions and the environmental program will set a collective emission goal that will culminate with an Earth Day exhibit that seeks to promote and educate continued reductions of CO<sub>2</sub> and the IPCC science of climate change.

## **Waste Management**

The generation of waste is an exclusively human activity, accessing raw materials, processing and manufacturing and the fate of “waste” all have significant carbon footprints. Recycling has long been emphasized as the key strategy for waste management, however the most effective approach in an integrated waste management plan is to reduce the production of waste at all levels of generation. The HMHS environmental program has conducted waste audits of the high school and has revealed key strategies are necessary if we are to reduce waste production, increase the responsible management of waste produced and, by extension, reduce climate impact.

Lab Study - waste management studies - including downtown assessments of waste and recycling bins, in-house high school quantification of waste generated and proposals to improve building, community and individual practices will focus not only on human health and environmental quality historically the focus on waste management, but also the quantified benefits of climate mitigation strategies that can be scaled from individual, building and community. We will seek to increase effective partnership with custodial, buildings and grounds, cafeteria/ catering staff and the school community at large.

## **Agriculture**

There is perhaps no environmental topic that brings the level of consistent focus to the environmental impacts of humans than the food we eat. From production, harvest, diversity, transport and packaging, preparation and waste, the food industry and culture has an impact on pollution, biodiversity, energy use, waste management and climate change. Mitigation and adaptation strategies employed to address climate change also have the potential for us to bring into focus all of the environmental concerns for the Agriculture Industry. In fact, it is the very approach to food production that we have used over the past century (an Industrial approach) that has brought about most of the problems associated with food and people.

Lab and Field Study - students from the environmental science classes at HMHS have grown food crops as part of studies of organic production and food diversity, soil amendments, and agricultural productivity. Additionally students have assessed community properties and used indicator plant species to predict the use of pesticides as a garden management practice. Moving forward, these studies will also include specific climate impact focus as we seek to establish the importance of soil carbon sequestration, reduced energy use in food production and waste management, the practice of composting and the importance of food choices in terms of trophic level energy loss and foodsheds in the greater Philadelphia area. Additionally, we will partner with the Rancocas Creek Regenerative Farm of Pinelands Preservation Alliance to develop educational and practical lab opportunities for study and community development (as well as possible internships for students interested in food and the environment as an undergraduate focus). Finally, we will reach out to the community for a climate garden tour so as to bring focus to the gardens of Haddonfield that are not only using sustainable practices, but also have climate mitigation benefits as a result of treating a garden like an ecosystem and not an industry.