

# Amherst Regional High School

## 9<sup>th</sup> Grade Science Program



# ARHS Science Sequence

9th Grade	10th Grade (MCAS)	11th Grade	12th Grade
Ecology & Environmental Science  College Prep or Honors	Biology Honors Biology	ChemCom Chemistry Honors Chemistry or Electives	Physics Honors Physics AP Physics or Electives
	Honors Chemistry	AP Biology (3 Trimesters)	Physics Honors Physics AP Physics or Electives



# 9<sup>th</sup> Grade Options

## Ecology & Environmental Science

- Open to all 9<sup>th</sup> graders

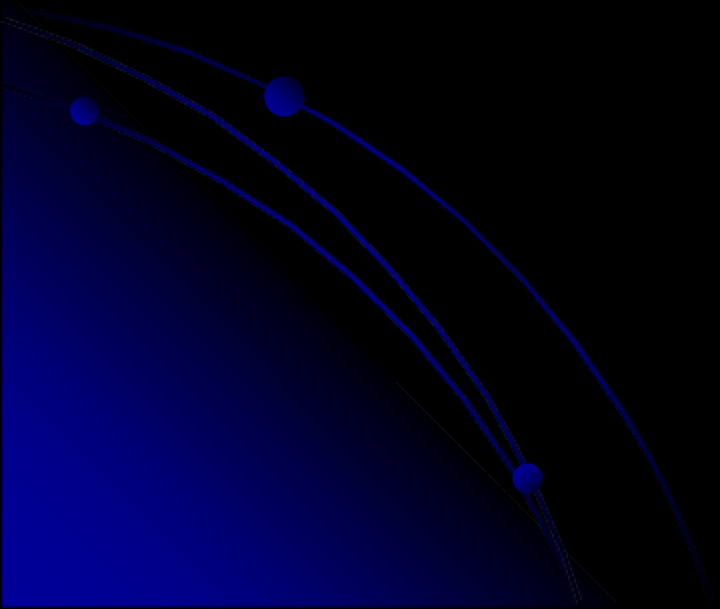
## Honors Ecology & Environmental Science

- Open to 9<sup>th</sup> graders who meet one of the following prerequisites:
  - Successful completion of Algebra I or
  - A “B” or better in 8<sup>th</sup> grade math or
  - Permission of Department Head

# Goals of the 9<sup>th</sup> Grade Course:

- To provide core biological, chemical, physical and mathematical content and skills to all students
- To meet student needs for academic challenge and support
- To engage students in meaningful field and laboratory investigations of the Earth's physical-biological systems
- To educate students on the effects of human impact on the Earth's systems, as recommended by leading scientific and educational organizations

# Trimester 1: Ecology



# Unit 1: The Physical Environment

- **Topics:** Dimensions and components of the biosphere, Physical and chemical properties of soils, Cation exchange (Honors), Global climates and their influence on soils, Survey of Earth's soils (Honors)
- **Principal Lab:** Determination of Phosphorous and pH from different Pioneer Valley soils and the use of histograms, means, and standard deviations to evaluate conclusions.
- **Problem Sets:** Atomic structure, Ionic/Covalent Bonding, Inorganic formulas, Cation exchange and leaching (Honors)
- **Time:** 3.5 weeks

# Unit 2: Ecosystems

- **Topics:** Energy as electromagnetic radiation, chemical bonds, and heat, Bio geochemical cycles, Chemical equations (Honors), Food chains, food webs, and ecological pyramids
- **Principal Lab:** Quantitative modeling of ecosystem driven by wildlife management question: Number of red tailed hawks that can be supported by laboratory forest and implications of findings.
- **Problem Sets:** Ecosystem productivity, 10% rule and its flaws, Productivity efficiency (Honors)
  - **Time:** 3.5 weeks

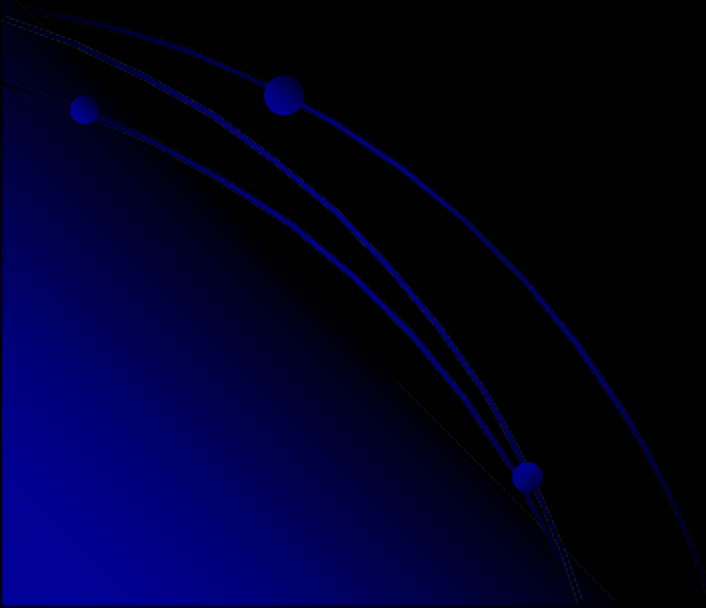
# Unit 3: Communities and Populations

- **Topics:** Niche and community interactions, Natural selection, evolution, and biodiversity in communities, Abiotic and biotic factors effecting population size, Reproductive strategies and survivorship curves (Honors), Growth rate and carrying capacity
- **Principal Lab:** *Chlamydomonas* algae cultures of different inorganic nutrient regimes used to study growth rates and carrying capacities. Microscopes hemocytometers used to quantify populations
- **Problem Sets:** Growth rates, Carrying capacity (Honors), Doubling time
- **Time:** 3 weeks

# Unit 4: Biomes

- **Topics:** Terrestrial vs aquatic ecosystems, Chemical and physical parameters of aquatic ecosystems (Honors), Major terrestrial biomes, Most significant human impact on each major terrestrial biome.
- **Principal Investigation:** Research project that covers the major terrestrial biomes and integrates concepts from all four trimester units. Serves as culminating experience before the final exam.
- **Problem Sets:** Climographs, latitude vs. altitude, Lake turnover (Honors)
  - Time: 2 weeks

# Trimester 2: Environmental Science



# Unit 1: Human Population and Biodiversity Decline

- **Topics:** Human populations, resource consumption, and settlement patterns, Causes of world biodiversity decline, Conservation biology
- **Principal Lab:** Invasive species analysis in forest laboratory using randomized plot selection and linear regression to evaluate impact on native flora
- **Problem Sets:** Age structure diagrams, Human doubling time problems, Shannon - Wiener biodiversity index (Honors)
  - **Time:** 2 weeks

# Unit 2: Energy Resources

- **Topics:** Chemical and nuclear fuels and their impacts, Heat exchange, power vs energy, and kwh, Alternate energies and their impacts, basic chemistry/physics of PV cells, turbines, and generators (Honors), Efficiency and Conservation technologies
- **Principal Lab:** Determination of Amherst house hold efficiencies in  $\text{BTU}/(\text{DD})(\text{ft}^2)$  and the use of regression to determine the community average defined by the slope of a line
- **Problem Sets:** Structure efficiency, Power plant efficiency, Half life, Nuclear equations (Honors)
  - **Time:** 3 weeks

# Unit 3: Water and Soil Resources

- **Topics:** Water resources and water uses , Water pollutants, Sewage/biological  $O_2$  demand/dissolved  $O_2$  (Honors), Sustainable soil use, Pesticides and toxic waste, Introduction to organic chemistry and transition metals (Honors)
- **Principal Lab:** Dose response curves for seedling cohorts with curve fitting to determine threshold doses and regression to find effective dose-50% ( $ED_{50}$ ) and/or lethal dose-50% ( $LD_{50}$ )
- **Problem Sets:** Nutrient (Nitrogen) loading in Amherst, Dose response curves,– Sewage BOD DO (Honors)
- **Time:** 3.5 weeks

# Unit 4: Air Pollution and Global Atmospheric Change

- **Topics:** Evolution and composition of the atmosphere, Air pollution, Global warming, Physics of greenhouse gasses (Honors), Ozone depletion, Acid rain, Logarithms and pH calculations (Honors)
  - **Principal Lab:** Estimation of Amherst's transportation CO<sub>2</sub> footprint and percent uptake by local vegetation. Question addressed through the use of gas detecting tubes, ecological data, and regression to establish CO<sub>2</sub> output of vehicles.
  - **Problem Sets:** Regression of anthropogenic CO<sub>2</sub>, CH<sub>4</sub>, and NO<sub>x</sub> vs average global temperature rise, chemical equations of ozone depletion, and acid rain formation, logarithms and pH calculations (Honors).
- Time: 3.5 weeks

# Summary of 9<sup>th</sup> Grade Science Course

- Ensures that all students are educated in the key areas of Ecology and Environmental Science
- Ensures that all students are trained and receive frequent practice in key scientific skills
- Exposes all students to the insights and challenges of applied and interdisciplinary Science
- Provides multiple opportunities for inquiry, field biology and classroom investigations

# Summary of 9<sup>th</sup> Grade Science Course (continued)

- Offers College Preparatory and Honors options
  - Honors option provides a high degree of rigor, with more objectives covered, more in-depth text materials, and more complex analyses required
- Allows us to cover Biology in greater depth in 10<sup>th</sup> grade and to better prepare students for the Biology MCAS
- Educates students on Earth's life support systems and the interdependence of living things, preparing them to be scientifically informed, thoughtful and engaged citizens.