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| Unit 1: Introduction to Biology & Community Health | | |
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| **Biology Unit Topics** | **Learning Objectives** | **Essential Knowledge** |
| 1.1 - Introduction to Public Health | • Differentiate between individual health and public health.<br>• Define “public health” and explain its purpose in improving population health.<br>• Identify the three broad categories of the determinants of health and identify what factors belong to each category.<br>• Describe the different approaches of public health for understanding and addressing health issues, including behavioral, biomedical, & social approaches.<br>• Describe the different determinants of health (environmental, social, & biological)<br>• Describe how social determinants of health contribute to health disparities between communities (e.g., comparing outcomes in low-income vs. affluent areas).<br>• Explain how non-biological factors (like income, neighborhood, and education) can influence biological health outcomes (e.g., asthma, obesity, life expectancy).<br>• Identify public health careers and the scientific skills used in those roles (e.g., epidemiologist, health educator, environmental health scientist). | • Health is defined as “a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity” - WHO<br>• Public Health is “the art and science of preventing disease, prolonging life and promoting health through organized efforts of society.” - WHO. Its goal is to promote and protect the health of people and the communities where they live, learn, work, and play. --- APHA<br>• Public health practitioners rely on available knowledge about the stages, mechanisms, and causes of disease to determine the most appropriate time and manner to intervene. The goal of any intervention is to alter the natural history of a disease in a favorable way--either by preventing it entirely, delaying its onset, or by reversing it.<br>• There are three broad categories of the determinants of health<br>  ○ Environmental determinants of health, i.e. water supply, exposure to pollution, & climate change.<br>  ○ Social determinants of health, i.e. income, education, health policies, race, etc.<br>  ○ Biological determinants of health, i.e. age, genes, and sex, etc. |

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| 1.2 - Experimental Design | • Identify or pose a scientific question based on an observation, data, or a model.<br>• State a hypothesis, or predict the results of an experiment.<br>• Identifying dependent and independent variables.<br>• Identify and justify the use of positive and negative control groups in an experiment.<br>• Identify variables that need to remain constant in an experiment<br>• Design and evaluate experiments to test a hypothesis, including identifying variables, controls, and potential sources of bias. | • Scientific questions are questions that can be answered via observation or experimentation.<br>• Independent variables are variables that are manipulated in the experiment, while dependent variables measured in response to the independent variable.<br>• Control groups improve the reliability and validity of an experiment. They help identify whether a change is really due to the treatment or condition being tested.<br>  ○ Negative control groups are groups not exposed to the experimental treatment or condition. They show what happens in the absence of treatment, ensuring no effect occurs when there should be none (i.e. placebo)<br>  ○ Positive control groups |
| 1.3 - Analyzing Data | • Calculate and interpret mean, median, mode, and range<br>• Explain what standard deviation shows about the spread or variability of data<br>• Calculate standard error to estimate uncertainty in the mean, and use standard error bars to evaluate whether differences between two data sets are statistically significant.<br>• Create bar graphs, line graphs, & box plots of a given or collected set of data.<br>• Construct bar graphs, line graphs, and box plots to accurately represent and communicate data.<br>• Describe data from a table or graph, including:<br>  ○ Identifying specific data points.<br>  ○ Describing trends and/or patterns | • Bar graphs are used to represent categorical data, while line graphs represent continuous data.<br>• Scatter plots are used to identify correlation between two variables.<br>• Box plots compare means, IQR, and the spread of data. Larger whiskers on a |

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| | in the data.<br>○ Describing relationships between variables.<br>● Use patterns and statistical analysis from data to draw evidence-based conclusions. | |
| 1.4 - Epidemiology & Epidemiological Studies | ● Define epidemiology and describe its role in protecting public health.<br>● Identify key terms used in epidemiology (e.g., incidence, prevalence, outbreak, epidemic, pandemic, case, exposure).<br>● Compare the structure of observational studies (e.g., cohort, case-control) to experimental studies (e.g., randomized controlled trials).<br>● Identify key features of study design:<br>○ Independent and dependent variables<br>○ Control groups<br>○ Randomization<br>○ Sample size and selection<br>○ Bias and confounding variables<br>● Evaluate a public health study or outbreak report to determine:<br>○ What type of study was used<br>○ How reliable the conclusions are based on the design<br>○ Any potential sources of error or bias<br>● Bioethics? | |
| **Public Health Topics/Illustrative Examples** | **Unit Resources** | |
| Flint Water Crisis | UCCI Teacher Exchange Slides<br>Epidemiology Crash Course VIdeo<br>What is Public Health Infographic<br>Health Equity Video<br>Epidemiological Studies Video<br>Gapminder Data Correlation | |

| Unit 2: Chemistry of Life | | |
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| **Biology Unit Topics** | **Learning Objectives** | **Essential Knowledge** |
| 2.1 - Chemistry Basics & Elements of Life | • 2.1.a - Describe the structure of an atom, including protons, neutrons, and electrons.<br>• 2.1.b - Identify the six most abundant elements in living organisms (CHONPS)<br>• 2.1.c - Identify a key trace element, describe its biological function, and explain one health condition caused by its deficiency.<br>• 2.1.d - Explain how carbon is able to create diverse molecular structures, which contribute to the diversity of life.<br>• Explain how carbon is central to biological molecules.<br>• 2.1.e - Compare and contrast ionic, covalent (polar and nonpolar), and hydrogen bonds, and their relative strengths.<br>• 2.1.f - Define acids and bases in terms of hydrogen ion ($H^+$) concentration and use the pH scale to classify solutions as acidic, neutral, or basic.<br>• 2.1.h - Identify the normal pH range of human blood and explain how the body maintains this range. | • Atoms are composed of a nucleus containing protons (positive charge) and neutrons (neutral), with electrons (negative charge) arranged in energy levels around the nucleus.<br>• The six most abundant elements in living organisms are carbon, hydrogen, oxygen, nitrogen, phosphorus, and sulfur (CHONPS).<br>• Trace elements, though required in small amounts, are critical to health (e.g., iron for oxygen transport; magnesium for muscle and nerve function, energy production, and bone health). A deficiency in these elements can cause health conditions such as anemia (iron deficiency) or muscle weakness and irregular heartbeat (magnesium deficiency).<br>• Valence electrons determine how atoms bond. Carbon, with four valence electrons, can form diverse and stable bonds, making it central to biological molecules.<br>• Ionic bonds involve the transfer of electrons, covalent bonds involve sharing electrons (polar vs. nonpolar), and hydrogen bonds are weak attractions between polar molecules. These bond types influence biological functions such as solubility, DNA base pairing, and protein folding.<br>• Acids increase hydrogen ion ($H^+$) concentration in a solution, while bases decrease it.<br>• The pH scale (0–14) measures the concentration of hydrogen ions: values below 7 are acidic, 7 is neutral, and values above 7 are basic.<br>• Human blood is normally maintained within a narrow pH range of 7.35–7.45. Buffer systems, breathing rate, and kidney function work together to regulate this range. |
| 2.2 - Properties of Water | • Describe the structure of a water molecule | • Structure of water |

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| | and explain how polarity leads to hydrogen bonding.<br>● Explain how hydrogen bonding gives water its unique properties (cohesion, adhesion, surface tension, high specific heat, universal solvent, density of ice).<br>● Relate the properties of water to their biological importance (e.g., temperature regulation, nutrient transport, cellular homeostasis).<br>● Analyze examples of how organisms depend on water's properties for survival. | ● Polarity of water<br>● Hydrogen bonds<br>● Properties of water<br>● pH scale<br>● Hydrophilic vs hydrophobic |
| 2.3 - Biological Macromolecules | ● Define monomers and polymers and explain how they relate to biological macromolecules.<br>● Describe the chemical reactions that build and break biological macromolecules<br>● Describe the structure and function of carbohydrates<br>● Describe the structure and function of lipids<br>● Describe the structure and function of proteins<br>● Describe the structure and function of nucleic acids.<br>● Identify everyday examples of monomers and polymers of biological molecules (e.g., glucose → starch, amino acids → proteins). | ● Monomers and Polymers<br>● Dehydration Synthesis & Hydrolysis |
| 2.4 - Enzymes | ● Define enzymes and explain how they affect the rate of biological reactions.<br>● Describe the relationship between enzyme structure and function, including the role of the active site.<br>● Model the interaction between an enzyme and its substrate (lock-and-key or induced fit).<br>● Analyze how environmental factors (temperature, pH, salinity) affect enzyme structure and activity.<br>● Distinguish between competitive and noncompetitive inhibition and describe their effects on enzyme activity. | ● Enzymes are biological catalysts<br>● Enzyme structure and function is dependent upon its environmental pH, temperature, salinity, etc.<br>● Denaturation |

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| | • Connect enzyme activity to human health and public health (e.g., lactose intolerance, PKU, enzyme use in bioremediation). | |
| **Public Health Topics/Illustrative Examples** | **Unit Resources** | **Projects/Labs** |
| Macromolecules:<br>• Hunger & Poverty in California<br>• Do you meet your DRI?<br>• Food Deserts & Health Disparities<br>• Bodybuilding Supplements & Liver/Kidney Damage<br>• Fad diets that aren't healthy<br>Enzymes:<br>• PKU- Newborn Genetic Screens<br>• Environmental Enzymes: Use of enzymes to clean oil spills or sewage—bioremediation as a public health measure.<br>• Lactose Intolerance & Lactase<br>• Enzyme Related health conditions | Calculating Digestion & Absorption Rates<br>Food Insecurity Article<br>https://calmatters.org/explainers/california-hunger-crisis/#4674104a-8712-4b6f-8fe1-bf878c867a30<br>https://givesanbenito.org/blog/food-insecurity-in-san-benito-county<br>https://www.canada.ca/content/dam/hc-sc/migration/hc-sc/fn-an/alt_formats/hpfb-dgpsa/pdf/nutrition/dri_tables-eng.pdf<br>Guest Speaker from Food Bank? Youth Alliance? Food pantry? Esperanza Center? What food is available to low income community members in Hollister? | Projects:<br>• Create a 1 day meal plan to feed an individual on a $10 budget. Meal plans will be printed on cards and brought to the food pantry?<br>○ Have the kids actually do their meal and write a reflection<br>○ What tools are needed to prepare these meals?<br>○ Provide substitutions for common health problems (heart disease, diabetes, lactose intolerance)<br>○ Get feedback from culinary students on meal plan<br>• Research an enzyme/protein related health condition and create a brochure or infographic about it<br>Labs:<br>• Environmental Effects on Enzymes<br>• Properties of Water stations lab? |

| **Unit 3: Cell Structure & Function** | | |
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| **Biology Unit Topics** | **Learning Objectives** | **Essential Knowledge** |
| 3.1 - Cell Structure | | • Functions of organelles |
| 3.2- Membrane Structure & Function | | • Structure & function of cell membranes |

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| 3.3 - Tonicity | | • Isotonic<br>• Hypertonic<br>• Hypotonic |
| 3.4 - Cell Transport | | |
| 3.5 - Cell Size | | |
| 3.6 - Photosynthesis | | |
| 3.7 - Cellular Respiration | | |
| 3.8 - Microbiology | • Identify the 5 distinct kinds of microbes<br>• Differentiate between prokaryotic and eukaryotic cells<br>• Explain what viruses are and their relevance to public health<br>• | |
| **Public Health Topics/Illustrative Examples** | **Unit Resources** | |
| Cell structure:<br>• Include most common diseases that occur with malfunctions to each organelle OR have students research a disease tied to issues with an organelle & present to class<br>Membrane Structure & Function:<br>• Drug Delivery Systems: How medications are designed to cross cell membranes (e.g., insulin, chemotherapy drugs).<br>• Nanomedicine - COVID vaccine with lipid-based nanoparticles<br>• Mercury absorption into skin<br>• Fentanyl and Narcan function<br>Tonicity:<br>• IV Fluid Administration: Importance of isotonic fluids in hospitals to prevent cell damage.<br>Cell Transport:<br>• Cystic Fibrosis | | Labs:<br>• HR, breathing rate, and exercise lab<br><br>Projects:<br>• Model how drugs move through membranes<br>• Climate & Health Debate: Students explore how photosynthesis connects to broader health impacts of environmental change. |

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| • Environmental Toxins - Heavy metals prevent transport - Flint Water Crisis<br>Photosynthesis<br>• Climate Change & Health: Deforestation impacts $CO_2$ levels and respiratory health.<br>• Case Study: Vitamin A deficiency and biofortification (e.g., Golden Rice) to address blindness in children.<br>Cellular Respiration:<br>• Carbon monoxide poisoning | | |

| **Unit 4: Cell Communication, Homeostasis, & Cell Cycle** | | |
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| **Biology Unit Topics** | **Learning Objectives** | **Essential Knowledge** |
| 4.1 - Cell Communication | | • Design a model to show how certain drugs work by binding to cell receptors |
| 4.2 - Feedback & Homeostasis | | |
| 4.3 - Immune System & Vaccines | • Microbial mechanisms of disease & epidemiology (pg. 34 of PHB Text) | • Types of pathogens, viruses, bacteria, parasites<br>• Why do antibiotics not work on viruses? |
| 4.4 - Cell Cycle | | |
| 4.5 - Mitosis | | |
| 4.6 - Cancer | | |
| **Public Health Topics/Illustrative Examples** | **Unit Resources** | |
| Homeostasis:<br>• Diabetes | | |

| Unit 5: Gene Expression & Heredity | | |
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| **Biology Unit Topics** | **Learning Objectives** | **Essential Knowledge** |
| 5.1 - Meiosis | | |
| 5.2- Transcription | | |
| 5.3 - Translation | | |
| 5.4 - Mendelian Genetics | | |
| 5.5 - Non Mendelian Genetics | | |
| 5.6 - Chromosomal Inheritance & Chromosomal Disorders | | |
| 5.8 - Regulation of Gene Expression | | |
| 5.9 - Mutations | | |
| **Public Health Topics/Illustrative Examples** | **Unit Resources** | |
| Transcription/Translation:<br>● mRNA vaccines<br>● mTOR inhibitors to treat cancer<br>● miRNA & siRNA to treat disease<br>● Cystic Fibrosis<br>Genetics<br>● Newborn Screening<br>● Carrier Testing - High Risk populations like ashkenazi jewish for tay sachs<br>● Multifactorial traits - Type II diabetes, hypertension<br>Chromosomal Inheritance & Disorders<br>● Prenatal Testing & Karyotyping<br>● Chromosomal Disorders: Turner syndrome, klinefelter syndrome, trisomies<br>Regulation of Gene Expression:<br>● Epigenetics & Environment: Effects of smoking, pollution, and diet on gene | | |

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| expression.<br>● Public Health Campaigns: Maternal nutrition and toxin exposure affecting fetal gene expression.<br>● Case Study: Dutch Hunger Winter – how famine during pregnancy influenced gene expression in offspring decades later.<br>Mutations:<br>● Cancer & Mutations: BRCA1/2 mutations and risk management strategies.<br>● UV Exposure and DNA Damage: Skin cancer prevention campaigns.<br>● Mutagens in the Environment: Tobacco, radiation, pollution—policy and education.<br>● Case Study: Genetic mutations and public health decisions on breast cancer screening. | | |

| **Unit 6: Evolution & Natural Selection** | | |
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| **Biology Unit Topics** | **Learning Objectives** | **Essential Knowledge** |
| 6.1 - Evidence of Evolution | | ● Read a phylogenetic Tree |
| 6.2- Natural Selection | | |
| 6.3 - Population Genetics | | ● Hardy weinberg? |
| 6.4 - Human Evolution? | | |
| 6.5 - Antibiotic Resistance | | |
| **Public Health Topics/Illustrative Examples** | **Unit Resources** | |
| Evidence of Evolution<br>● Comparative Genomics in Medicine: Studying genetic similarities between | | ● Public Health PSA: Students create campaigns on antibiotic stewardship or vaccine importance tied to evolution. |

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| humans and other species to develop treatments (e.g., insulin from pigs, model organisms like mice or fruit flies).<br>● Case Study: Use DNA evidence to trace HIV origins and track how viruses jump species barriers. (or COVID)<br>Natural Selection<br>● Sickle Cell & Malaria Resistance<br>● Flu vaccine changes yearly due to natural selection of viral strains<br>Population Genetics<br>● Tracking Disease Genes: Use of allele frequencies in public health genetics (e.g., Tay-Sachs carrier rates).<br>● Founder Effects & Isolated Populations: High prevalence of certain diseases (e.g., BRCA mutations in Ashkenazi Jews).<br>Human Evolution:<br>● Haplogroups, genetic disease origins.<br>Antibiotic Resistance:<br>● Gonorrhea becoming resistant to multiple antibiotics -CDC & WHO intervention strategies | | |

| **Unit 7: Ecology** | | |
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| **Biology Unit Topics** | **Learning Objectives** | **Essential Knowledge** |
| 7.1 - Energy Flow Through Ecosystems | | |
| 7.2- Population Ecology | | |
| 7.3 - Effect of Density on Populations | | |
| 7.4 - Community Ecology | | |
| 7.5 - Biodiversity | | |
| **Public Health Topics/Illustrative Examples** | **Unit Resources** | |

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| Effect of Density on Populations:<br>● Effects of natural disasters on public health<br>● Contact tracing<br>Biodiversity:<br>● Importance of biodiversity of our microbiome (skin & GI tract) | | Stop the spread lab |