

Workshop Topics and PA Science and Technology Standards

| DAY | WORKSHOP TOPICS | PA STATE STANDARDS http://www.pdesas.org/Standard/Views |
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| 1 | <p>SWEET</p> <p>2. Cellular Biology: What do taste receptors look like and how do they work?</p> <p style="padding-left: 20px;">A. Plasma membrane structure</p> <p style="padding-left: 40px;">i. phospholipid bilayer, proteins – some are receptors</p> <p style="padding-left: 40px;">ii. structure of taste receptors within membrane (characteristic seven transmembrane “sea monster” shape)</p> <p style="padding-left: 20px;">B. Protein synthesis and transport to membrane</p> <p style="padding-left: 20px;">C. Nerve cell (neuron) structure and function</p> <p style="padding-left: 20px;">D. Chemical/ligand-gated vs. voltage-gated channels</p> <p style="padding-left: 20px;">E. Intracellular signaling</p> <p style="padding-left: 20px;">E. Taste bud structure</p> <p style="padding-left: 20px;">F. Sensing the five tastes – bitter, sweet, umami, salty, sour</p> <p style="padding-left: 20px;">G. Sweet receptors (T1R) and bitter receptors (T2R)</p> <p style="padding-left: 20px;">H. Taste pathway from taste receptors to the brain</p> <p style="padding-left: 20px;">I. Activity:</p> <p style="padding-left: 40px;">i. Taste thresholds for the five tastes</p> <p style="padding-left: 40px;">ii. Protein visualization and analysis using the Protein Data Bank</p> <p>3. Comparative Biology: Do taste differences exist in the animal world?</p> <p style="padding-left: 20px;">A. Taste / chemical receptors across the animal phyla (rats, mice similar to humans)</p> <p style="padding-left: 20px;">B. Evolution of taste receptors</p> <p style="padding-left: 20px;">C. Phylogenetics and cladistics using taste receptors</p> <p style="padding-left: 20px;">D. Activities:</p> <p style="padding-left: 40px;">i. Bioinformatics and the evolution of the PTC receptor gene (<i>TAS2R38</i>)</p> | <p>PA STATE STANDARDS http://www.pdesas.org/Standard/Views</p> <p>Standard Area - 3.1: Biological Sciences</p> <p>Organizing Category - 3.1.A: Organisms and Cells</p> <p>Grade Level - 3.1.10.A: GRADE 10</p> <p>Standard</p> <p>3.1.10.A1: <u>Explain the characteristics of life common to all organisms.</u></p> <p>3.1.10.A2: Explain cell processes in terms of chemical reactions and energy changes.</p> <p>3.1.10.A5: <u>Relate life processes to sub-cellular and cellular structures to their functions.</u></p> <p>3.1.10.A6: Identify the advantages of multi-cellularity in organisms.</p> <p>3.1.10.A7: <u>Describe the relationship between the structure of organic molecules and the function they serve in living organisms.</u> <u>Explain how cells store and use information to guide their functions.</u></p> <p>3.1.10.A8: Investigate the spatial relationships of organisms’ anatomical features using specimens, models, or computer programs.</p> <p>3.1.10.A9:</p> <ul style="list-style-type: none"> • <u>Compare and contrast scientific theories.</u> • <u>Know that both direct and indirect observations are used by scientists to study the natural world and universe.</u> • <u>Identify questions and concepts that guide scientific investigations.</u> • <u>Formulate and revise explanations and models using logic and evidence.</u> • <u>Recognize and analyze alternative explanations and models.</u> • <u>Explain the importance of accuracy and precision in making valid measurements.</u> <p>Standard Area - 3.1: Biological Sciences</p> <p>Organizing Category - 3.1.A: Organisms and Cells</p> <p>Grade Level - 3.1.12.A: GRADE 12</p> |

ii. Behavioral response of invertebrates to chemical stimuli

iii. Tasty Visions Lab: Color and Taste

The Botany of Desire:

<http://www.pbs.org/thebotanyofdesire/>

<http://www.pbs.org/thebotanyofdesire/lesson-plan-sweetness.php>

signal transduction:

<http://ats.doit.wisc.edu/biology/ap/st/st.htm>

Neuroscience for Kids:

<http://faculty.washington.edu/chudler/introb.html>

Taste:

<http://www.cf.ac.uk/biosi/staffinfo/jacob/teaching/sensory/taste.html>

Tasty Visions - Color and Taste:

<http://faculty.washington.edu/chudler/coltaste.html>

Standard

3.1.12.A5:

Analyze how structure is related to function at all levels of biological organization from **molecules** to **organisms**.

3.1.12.A6: Analyze how cells in different tissues/organs are specialized to perform specific functions.

Organizing Category - 3.1.C: Evolution

Grade Level - 3.1.12.C: GRADE 12

3.1.12.C2:

Analyze how **genotypic** and **phenotypic** variation can result in **adaptations** that influence an **organism's** success in an environment.

Standard Area - 3.1: Biological Sciences

Organizing Category - 3.1.A: Organisms and Cells

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Grade Level - 3.1.12.A: GRADE 12

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Standard

3.1.12.A9:

- Compare and contrast scientific theories.
- Know that both direct and indirect observations are used by scientists to study the natural world and universe.
- Identify questions and concepts that guide scientific investigations.
- Formulate and revise explanations and models using logic and evidence.
- Recognize and analyze alternative explanations and models.
- Explain the importance of accuracy and precision in making valid measurements.
- Examine the status of existing theories.
- Evaluate experimental information for relevance and adherence to science processes.
- Judge that conclusions are consistent and logical with experimental conditions.
- Interpret results of experimental research to predict new information, propose additional investigable questions, or advance a solution.
- Communicate and defend a scientific argument.

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| <p>2</p> | <p>SOUR</p> <p>1. Chemistry: How does the three-dimensional structure of molecules determine their function and activity?</p> <p>A. Molecular Structure</p> <p>i. protein structure (primary, secondary, tertiary, quaternary)</p> <p>ii. functional groups</p> <p>iii. typical structure of taste receptor molecules</p> <p>B. Taste receptors can detect shape and charge of molecules</p> <p>C. pH</p> <p>Neuroscience for Kids: http://faculty.washington.edu/chudler/introb.html Taste: http://www.cf.ac.uk/biosi/staffinfo/jacob/teaching/sensory/taste.html</p> | <p><u>Standard Area - 3.2: Physical Sciences: Chemistry and Physics</u></p> <p><u>Organizing Category - 3.2.A: Chemistry</u></p> <p><u>Grade Level - 3.2.10.A: GRADE 10</u></p> <p><u>3.2.10.A1:</u> <u>Predict properties of elements using trends of the periodic table.</u> <u>Identify properties of matter that depend on sample size.</u> <u>Explain the unique properties of water (polarity, high boiling point, forms hydrogen bonds, high specific heat) that support life on Earth.</u></p> <p><u>3.2.10.A2:</u> <u>Compare and contrast different bond types that result in the formation of molecules and compounds.</u> <u>Explain why compounds are composed of integer ratios of elements.</u></p> <p><u>3.2.10.A3:</u> <u>Describe phases of matter according to the kinetic molecular theory.</u></p> <p><u>3.2.10.A4:</u> <u>Describe chemical reactions in terms of atomic rearrangement and/or electron transfer.</u> <u>Identify the factors that affect the rates of reactions.</u></p> <p><u>3.2.10.A5:</u> <u>SCALE</u> <u>Apply the mole concept to determine number of particles and molar mass for elements and compounds.</u></p> <p><u>3.2.10.A6:</u></p> <ul style="list-style-type: none"> • <u>Compare and contrast scientific theories.</u> • <u>Know that both direct and indirect observations are used by scientists to study the natural world and universe.</u> • <u>Identify questions and concepts that guide scientific investigations.</u> • <u>Formulate and revise explanations and models using logic and evidence.</u> • <u>Recognize and analyze alternative explanations and models.</u> • <u>Explain the importance of accuracy and precision in making valid measurements.</u> <p><u>Standard Area - 3.2: Physical Sciences: Chemistry and Physics</u></p> <p><u>Organizing Category - 3.2.A: Chemistry</u></p> <p><u>Grade Level - 3.2.12.A: GRADE 12</u></p> <p><u>3.2.12.A4:</u> <u>Apply oxidation/reduction principles to electrochemical reactions.</u> <u>Describe the interactions between acids and bases.</u></p> |
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| <p>3</p> | <p>BITTER</p> <p>4. Genetics: Do people vary in their ability to taste different substances?</p> <p>A. Bitter receptors (T2R) i. <i>TAS2R38</i> (PTC) and alleles</p> <p>B. Genotypes vs. environment in determining taste preference phenotypes</p> <p>C. Punnett squares using PTC taste alleles</p> <p>D. Hardy-Weinberg and population genetics calculations using PTC taste data</p> <p>E. Activities:</p> <p>i. Gel electrophoresis basics and micropipetting; (http://www.edvotek.com/101.html) DNA extraction; PCR; visualization and analysis of individual <i>TAS2R38</i> DNA profiles (Carolina Biological - PTC PCR Lab)</p> <p>ii. Biostatistics - correlating <i>TAS2R38</i> (PTC) genotypes and phenotypes</p> <p>iii. Supertaster Lab - taste buds/PTC</p> <p>signal transduction: http://ats.doit.wisc.edu/biology/ap/st/st.htm Neuroscience for Kids: http://faculty.washington.edu/chudler/introb.html Taste: http://www.cf.ac.uk/biosi/staffinfo/jacob/teaching/sensory/taste.html</p> <p>Picky Eaters: http://www.pbs.org/wgbh/nova/sciencenow/0404/01.html</p> | <p><u>Standard Area - 3.1: Biological Sciences</u></p> <p><u>Organizing Category - 3.1.A: Organisms and Cells</u></p> <p><u>Grade Level - 3.1.10.A: GRADE 10</u></p> <p>3.1.10.A7: Describe the relationship between the structure of organic molecules and the function they serve in living organisms. Explain how cells store and use information to guide their functions.</p> <p><u>Organizing Category - 3.1.B: Genetics</u></p> <p><u>Grade Level - 3.1.10.B: GRADE 10</u></p> <p>3.1.10.B1: Describe how genetic information is inherited and expressed.</p> <p>3.1.10.B2: Explain the process of meiosis resulting in the formation of gametes. Compare and contrast the function of mitosis and meiosis.</p> <p>3.1.10.B3: Describe the basic structure of DNA and its function in genetic inheritance. Describe the role of DNA in protein synthesis as it relates to gene expression.</p> <p>3.1.10.B4: Explain how genetic technologies have impacted the fields of medicine, forensics, and agriculture.</p> <p>3.1.10.B5: <u>PATTERNS</u> Use models to demonstrate patterns in biomacromolecules. Compare and contrast Mendelian and non-Mendelian patterns of inheritance.</p> <p>3.1.10.B6:</p> <ul style="list-style-type: none"> • <u>Compare and contrast scientific theories.</u> • <u>Know that both direct and indirect observations are used by scientists to study the natural world and universe.</u> • <u>Identify questions and concepts that guide scientific investigations.</u> • <u>Formulate and revise explanations and models using logic and evidence.</u> • <u>Recognize and analyze alternative explanations and models.</u> • <u>Explain the importance of accuracy and precision in making valid measurements.</u> <p><u>Organizing Category - 3.1.C: Evolution</u></p> <p><u>Grade Level - 3.1.10.C: GRADE 10</u></p> <p>3.1.10.C1: Explain the mechanisms of biological evolution.</p> |
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3.1.10.C2:

Explain the role of mutations and gene recombination in changing a population of organisms.

3.1.10.C3:

CONSTANCY AND CHANGE

Interpret data from fossil records, anatomy and physiology, and DNA studies relevant to the theory of evolution.

3.1.10.C4:

- Compare and contrast scientific theories.
- Know that both direct and indirect observations are used by scientists to study the natural world and universe.
- Identify questions and concepts that guide scientific investigations.
- Formulate and revise explanations and models using logic and evidence.
- Recognize and analyze alternative explanations and models.
- Explain the importance of accuracy and precision in making valid measurements.

Organizing Category - 3.1.C: Evolution

Grade Level - 3.1.12.C: GRADE 12

3.1.12.C1:

Analyze how natural **selection** leads to **speciation**.

3.1.12.C2:

Analyze how **genotypic** and **phenotypic** variation can result in **adaptations** that influence an **organism's** success in an environment.

3.1.12.C3:

CONSTANCY AND CHANGE

Analyze the evidence to support various theories of **evolution (gradualism, punctuated equilibrium)**.

Evaluate survival of the fittest in terms of **species** that have remained unchanged over long **periods** of time.

3.1.12.C4:

- Examine the status of existing theories.
- Evaluate experimental information for relevance and adherence to science processes.
- Judge that conclusions are consistent and logical with experimental conditions.
- Interpret results of experimental research to predict new information, propose additional investigable questions, or advance a solution.
- Communicate and defend a scientific argument.

Organizing Category - 3.1.B: Genetics

Grade Level - 3.1.12.B: GRADE 12

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| | | <p>3.1.12.B1: Explain gene inheritance and expression at the molecular level.</p> <p>3.1.12.B2: Evaluate the process of sexual reproduction in influencing genetic variability in a population.</p> <p>3.1.12.B3: Analyze gene expression at the molecular level. Explain the impact of environmental factors on gene expression.</p> <p>3.1.12.B4: Evaluate the societal impact of genetic engineering techniques and applications.</p> <p>3.1.12.B5: <u>PATTERNS</u> Relate the monomer structure of biomacromolecules to their functional roles.</p> <p>3.1.12.B6:</p> <ul style="list-style-type: none"> • Examine the status of existing theories. • Evaluate experimental information for relevance and adherence to science processes. • Judge that conclusions are consistent and logical with experimental conditions. • Interpret results of experimental research to predict new information, propose additional investigable questions, or advance a solution. • Communicate and defend a scientific argument. |
| 4 | <p>SALTY</p> <p>1. Chemistry: How does the three-dimensional structure of molecules determine their function and activity?</p> <p style="padding-left: 40px;">A. Molecular Structure</p> <p style="padding-left: 80px;">i. protein structure (primary, secondary, tertiary, quaternary)</p> <p style="padding-left: 80px;">ii. functional groups</p> <p style="padding-left: 80px;">iii. typical structure of taste receptor molecules</p> <p style="padding-left: 40px;">B. Taste receptors can detect shape and charge of molecules</p> <p style="padding-left: 80px;">i. bonding (ionic, covalent, polar covalent)</p> <p style="padding-left: 80px;">ii. ions and ionic compounds</p> <p style="padding-left: 80px;">iii. intermolecular forces</p> <p style="padding-left: 120px;">a. hydrogen bonds, London dispersion forces</p> <p style="padding-left: 80px;">iv. lock and key model of molecular</p> | <p><u>Organizing Category - 3.4.E: The Designed World</u></p> <p><u>Grade Level - 3.4.10.E: GRADE 10</u></p> <p>3.4.10.E1: <u>Assess how medical technologies over time have impacted prevention and rehabilitation, vaccines and pharmaceuticals, medical and surgical procedures, and genetic engineering.</u></p> |

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| | <p>interactions</p> <p>C. Molecules of similar structure bind to the same receptor</p> <p>i. structure of molecule determines its taste</p> <p>D. Bioinformatics (NCBI Resources)</p> <p>E. Activities:</p> <p>i. Specificity of taste receptor <i>TAS2R38</i> (PTC) – students taste propylthiouracil, PTC, quinine, and Dulcin (4-ethoxyphenylurea, a sweet ligand)</p> <p>ii. Determine structural similarities and receptor binding based on taste</p> <p>iii. Bioinformatics webquest</p> <p>Neuroscience for Kids: http://faculty.washington.edu/chudler/introb.html</p> <p>Taste: http://www.cf.ac.uk/biosi/staffinfo/jacob/teaching/sensory/taste.html</p> | |
| 5 | <p>UMAMI</p> <p>Neuroscience for Kids: http://faculty.washington.edu/chudler/introb.html</p> <p>Taste: http://www.cf.ac.uk/biosi/staffinfo/jacob/teaching/sensory/taste.html</p> | <p><u>Standard Area - 3.4: Technology and Engineering Education</u></p> <p><u>Organizing Category - 3.4.A: The Scope of Technology</u></p> <p><u>Grade Level - 3.4.12.A: GRADE 12</u></p> <p>3.4.12.A1: Compare and contrast the rate of technological development over time.</p> <p>3.4.12.A2: Describe how management is the process of planning, organizing, and controlling work.</p> <p>3.4.12.A3: Demonstrate how technological progress promotes the advancement of science, technology, engineering and mathematics (STEM).</p> <p><u>Organizing Category - 3.4.B: Technology and Society</u></p> <p><u>Grade Level - 3.4.12.B: GRADE 12</u></p> <p>3.4.12.B1: Analyze ethical, social, economic, and cultural considerations as related to the development, selection, and use of technologies.</p> <p>3.4.12.B2: Illustrate how, with the aid of technology, various aspects of the environment can be monitored to provide information for decision making.</p> |

Organizing Category - 3.4.C: Technology and Engineering Design

Grade Level - 3.4.12.C: GRADE 12

3.4.12.C2: Apply the concept that engineering design is influenced by personal characteristics, such as creativity, resourcefulness, and the ability to visualize and think abstractly.

3.4.12.C3: Apply the concept that many technological problems require a multi-disciplinary approach.

Organizing Category - 3.4.D: Abilities for a Technological World

Grade Level - 3.4.12.D: GRADE 12

3.4.12.D2: Verify that engineering design is influenced by personal characteristics, such as creativity, resourcefulness, and the ability to visualize and think abstractly.