

ADVANCED NANOSCALE SCIENCE & ENGINEERING NANO BIOLOGY SEMESTER

| Month | CONTENT | LAB THEMES | SKILLS | ASSESSMENTS |
|-----------|---|---|--|---|
| September | <p><i><u>Nano-Intro. (Same topics for nanophysics and nanochem)</u></i></p> <p><u>Topic I: GOT NANO?</u></p> <p><u>Unit 1 Nano-Calculations</u></p> <ul style="list-style-type: none"> ➤ Metric Review ➤ 2 Dimensional Analysis ➤ 3 Dimensional Analysis ➤ Scientific Notation and Significant Figures ➤ NanoDefinitions ➤ Scaling from Macro to Nano ➤ Basic Nano Terminology <p><u>Unit 2 Nano- The Next Big Thing</u></p> <ul style="list-style-type: none"> ➤ NanoScience in our lives ➤ Nanotechnology Overview ➤ Branches of NanoScience ➤ Tools and Fabrication overview ➤ Advanced NanoTerminology | <ul style="list-style-type: none"> ❖ Cutting it down to Nano Lab ❖ NanoLinear Measurements Lab (scale own objects) ❖ NanoAnalogies 1,2, and 3 (nano applications) ❖ NanoNotations Lab | <ul style="list-style-type: none"> ❑ Understand the approximate values of micro and nano ❑ Convert using small scale metric units ❑ Correctly present values in scientific notation ❑ Define Basic NanoTerminology ❑ Compare and Contrast various branches of the Nanotechnology ❑ Understand the basic and advanced equipment and use of such in NanoScience ❑ Define Advanced NanoTerminology | <p>Nano Pre Quiz</p> <p>Lab Activities</p> <p>Homework</p> <p>Unit Tests</p> <p>Quizzes</p> <p>Marking Period Exam</p> <p>NanoComp Book</p> |

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| <div style="display: flex; flex-direction: column; align-items: center;"> <div style="writing-mode: vertical-rl; transform: rotate(180deg); font-size: 2em; font-weight: bold;">October</div> <hr style="width: 50%; margin: 5px 0;"/> <div style="writing-mode: vertical-rl; transform: rotate(180deg); font-size: 2em; font-weight: bold;">February</div> </div> | <p><u>TOPIC II: NANO MACRO & CHEESE</u></p> <p><u>Unit 3 Nanobiology vs. Macrobiology</u></p> <ul style="list-style-type: none"> ➤ Foundations of Molecular Biology and Biochemistry ➤ Macromolecules ➤ Nanomolecules <p><u>Unit 4 Biotechnology related to Macro & Nanobiology</u></p> <ul style="list-style-type: none"> ➤ DNA, DNA Cloning, PCR, and Genetic Engineering. ➤ Ethics related to the use of nanotechnology to alter or modify genomes. ➤ Related Terminology | <ul style="list-style-type: none"> ❖ What is DNA? ❖ What does DNA look like? ❖ How do we get all of that (DNA) in there (cell)? ❖ Transcription / Translation ❖ What is PCR and how does it work? ❖ How to clone a gene: Back to Dolly. ❖ Genes in a bottle! ❖ DNA Fingerprints ❖ Research and debates related to Genetic Engineering. | <ul style="list-style-type: none"> ❑ Create DNA models using proper scaling. ❑ Describe how a Macro-molecule, DNA, can fit inside a cell. ❑ Create posters describing DNA's role in life and producing characteristics in individuals. ❑ Decoding the DNA code in genes. ❑ Presenting and defending arguments for/against modifying genomes. ❑ Use of proper lab techniques: adhering to safety rules, following exact procedures and logging/recording information accurately. | <p>Lab Activities</p> <p>Models</p> <p>Posters</p> <p>Homework</p> <p>Unit Tests</p> <p>Quizzes</p> <p>Marking Period Exam</p> <p>NanoComp Book</p> <p>Debates</p> |

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| <div style="writing-mode: vertical-rl; transform: rotate(180deg); font-size: 2em; font-weight: bold;">November</div> <div style="writing-mode: vertical-rl; transform: rotate(180deg); font-size: 2em; font-weight: bold;">March</div> | <p><u>TOPIC III: NANO BIO GONE BAD</u></p> <p><u>Unit 5 Qualifying Normal and Abnormal</u></p> <ul style="list-style-type: none"> ➤ What is normal? ➤ Genetic Diseases and Defects. <p><u>Unit 6 How can we tell: Diagnostics</u></p> <ul style="list-style-type: none"> ➤ Macroscopic/diagnostic tools used in the detection of pathogens. ➤ Microscopic/diagnostic tools used in the detection of pathogens. ➤ The use of Nanoscience and nanotechnology in real time, speedy diagnosis (Dx) of illnesses and disease causing DNA, organisms and/or particles. ➤ Microarrays vs. Nanoarrays ➤ Related terminology. | <ul style="list-style-type: none"> ❖ The bell curve! ❖ Why do people look different? ❖ How clean is our home? ❖ Classifying microbes based on macro structures (morphology). ❖ Why biochemical testing? ❖ ELISA Immuno Explorer Kit. ❖ Nanoscale research and its uses in detecting potential pathogens. ❖ Size does matter: Micro/nanoarrays. | <ul style="list-style-type: none"> ❑ Compare and contrast normal hemoglobin to sickle cell. ❑ Create visual display on how changes in DNA may lead to diseases or physical defects. ❑ Sample various areas in home/school, culture, characterize the growth colonies morphology. ❑ Precise use of procedures and tools to detect microbes. ❑ Identify microbes based on physical structures and biochemical properties. ❑ Compare and contrast procedures/equipment used in analyzing DNA to help predict the probability of contracting illnesses like cancer, Huntington’s disease, and other genetic diseases. | <p>Lab Activities</p> <p>Visual Displays</p> <p>Homework</p> <p>Unit Tests</p> <p>Quizzes</p> <p>Marking Period Exam</p> <p>NanoComp Book</p> |

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| <div style="display: flex; flex-direction: column; align-items: center;"> <div style="writing-mode: vertical-rl; transform: rotate(180deg); font-size: 48pt; font-weight: bold; margin-bottom: 20px;">December</div> <hr style="width: 100%;"/> <div style="writing-mode: vertical-rl; transform: rotate(180deg); font-size: 48pt; font-weight: bold;">April</div> </div> | <p><u>TOPIC IV: NANO TO THE RESCUE!</u></p> <p><u>Unit 7 Prevention: Better than medicine.</u></p> <ul style="list-style-type: none"> ➤ The role of nanoscience and nanotechnology in the prevention of disease (genetic, bacterial or viral diseases, etc.). <p><u>Unit 8 Treatments: Curing or slowing down the effects of disease..</u></p> <ul style="list-style-type: none"> ➤ The role of nanoscience and nanotechnology in the treatment (Rx) of disease (genetic, bacterial, viral or environmental diseases, etc.). Using the BuckyBall for tagging, imaging, and drug delivery. ➤ Gene Therapy. ➤ Related terminology. ➤ Medical field guest speakers. Opthamologists, Urologists, Internal Medicine, etc. | <ul style="list-style-type: none"> ❖ Using cellular markers to aid in the prevention of disease. (Antagonists and inhibitors) ❖ Simulating the use of the Buckyball as a vector for drug delivery. ❖ Tagging specific cell receptors for enhanced targeting of medicines. ❖ Using viral particles to deliver normal functioning genes. ❖ PGLO Bacterial Transformation. | <ul style="list-style-type: none"> ❑ Identifying specific characteristics on cell receptors. ❑ Creating informational posters on the uses of Buckyballs in disease prevention. ❑ Displaying BuckyBall models showing how they target specific cells: cancer or specific organ /tissue/ cells. ❑ Create informational posters showing the various applications of Buckyballs in medicine: diagnosis, prevention, and treatment. ❑ Write essay on one of the topics of interest from a quest speaker. | <p>Lab Activities</p> <p>Posters</p> <p>Models</p> <p>Homework</p> <p>Unit Tests</p> <p>Quizzes</p> <p>Marking Period Exam</p> <p>NanoComp Book</p> |

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| <div style="display: flex; flex-direction: column; align-items: center;"> <div style="writing-mode: vertical-rl; transform: rotate(180deg); font-size: 2em; font-weight: bold; text-decoration: underline;">January</div> <div style="writing-mode: vertical-rl; transform: rotate(180deg); font-size: 2em; font-weight: bold;">May</div> </div> | <p><u>TOPIC V: NANO MANIPULATIONS AND MEDICINE</u></p> <p><u>Unit 9 Using nanoscience to reverse evolution.</u></p> <ul style="list-style-type: none"> ➤ The principles of evolution. ➤ Traits/genes: where are they. ➤ Natural vs. forced mutations. ➤ Using genetic engineering to reverse pathogenic evolutionary processes. ➤ Related terminology. ➤ Medical field guest speakers. | <ul style="list-style-type: none"> ❖ What is evolution? ❖ Comparing evolutionary processes in Unicellular vs. Multicellular ❖ How do mutations cause changes in individuals, offspring, and a population? ❖ PGLO Bacterial Transformation. ❖ Internet exploration of human genes: Where are they on the chromosome and what is the sequence of DNA? | <ul style="list-style-type: none"> ❑ Create pamphlets ❑ Create visual displays describing the process of evolution. ❑ Compare and contrast evolution in various organisms and particles. ❑ Change the genetic makeup of a bacterium. ❑ Locate the sequence of a specific, single gene trait. ❑ Compare and contrast technologies being used by local medical professionals. | <p>Lab Activities</p> <p>Pamphlets</p> <p>Displays</p> <p>Homework</p> <p>Unit Tests</p> <p>Quizzes</p> <p>Marking Period Exam</p> <p>NanoComp Book</p> |

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| <h1 style="font-size: 4em; margin: 0;">June</h1> | <p><u>TOPIC VI: NANO AND YOU AND IN YOUR FUTURE</u></p> <p><u>Unit 10 NanoProducts</u></p> <ul style="list-style-type: none"> ➤ Commercial ➤ Military ➤ Medical ➤ Existing vs. Future ➤ Material Applications ➤ Computer Applications ➤ NanoRobotics ➤ Nubots <p><u>Unit 11 NanoPolitics</u></p> <ul style="list-style-type: none"> ➤ US Marketing Initiatives ➤ European Marketing Initiatives ➤ Objectives ➤ Vision ➤ Measures ➤ Environmental Impact | <ul style="list-style-type: none"> ❖ NanoPants Lab ❖ Cutting Edge Lab ❖ Societal Impact Study ❖ How does nanotechnology effect me? | <ul style="list-style-type: none"> ❑ List and Categorize Nano-Products currently in use. ❑ List and Categorize Nano-Products being developed. ❑ List and Categorize Nano-Products being conceptualized. ❑ Discuss current theory, research and development of nubots. ❑ Compar and Contrast NanoRobotics facts from fiction. ❑ Compare and Contrast US vs. Euro visions ❑ Discuss the EPA stance on Nanotechnology | <p>Lab Activities</p> <p>Homework</p> <p>Unit Tests</p> <p>Quizzes</p> <p>Marking Period Exam</p> <p>NanoComp Book</p> |

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