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Course Description

A. COVER PAGE

Date of Submission (Please include Month, Day and Year) **January 31, 2008**

1. Course Title
Mission To Planet Earth Systems (MTPES)

2. Transcript Title(s) / Abbreviation(s)
MTPES (Earth & Space Science Lab Course)

3. Transcript Course Code(s) / Number(s)

4. School
Orcutt Academy

5. District
Orcutt USD

6. City
Orcutt, CA 93455

7. School / District Web Site
www.orcutt-schools.net

8. School Course List Contact

Name: Dr. Ken Parker

Title/Position: Assoc. Superintendent

Phone: (805) 938-8933 **Ext.:**

E-mail: kparker@orcutt-schools.net

9. Subject Area

- [ ] History/Social Science
- [ ] English
- [ ] Mathematics
- [X] Laboratory Science
- [ ] Language other than English
- [ ] Visual & Performing Arts
  - [ ] Intro [ ] Advanced
- [ ] College Prep Elective

10. Grade Level(s) for which this course is designed

[X] 9 [ ] 10 [ ] 11 [ ] 12

11. Seeking "Honors" Distinction?

[ ] Yes [ ] No

12. Unit Value

- [ ] 0.5 (half year or semester equivalent)
- [X] 1.0 (one year equivalent)
- [ ] 2.0 (two year equivalent)
- [ ] Other: _____

13. Is this an Internet-based course? [ ] Yes [X] No

If "Yes", who is the provider? [ ] UCCP [ ] PASS/Cyber High [ ] Other _____

14. Complete outlines are not needed for courses that were previously approved by UC. If course was previously approved, indicate in which category it falls.

- [ ] A course reinstated after removal within 3 years. Year removed from list? _____
  - Same course title? [ ] Yes [ ] No
  - If no, previous course title? _____
- [ ] An identical course approved at another school in same district. Which school? _____
  - Same course title? [ ] Yes [ ] No
  - If no, course title at other school? _____
- [ ] Approved Advanced Placement (AP) or International Baccalaureate (IB) course
- [ ] Approved UC College Prep (UCCP) Online course
- [ ] Approved CDE Agricultural Education course
- [ ] Approved P.A.S.S./Cyber High course
- [ ] Approved ROP/C course. Name of ROP/C? _____
- [ ] Approved A.V.I.D. course
- [ ] Approved C.A.R.T. course
- [ ] Approved Project Lead the Way course
- [ ] Approved CSU Early Assessment Program (EAP) course
- [ ] Other. Explain: _____

Funding provided by Department of Labor, Employment & Training Administration: WIRED Initiative

15. Is this course modeled after an UC-approved course from another school outside your district? ☐ Yes ☒ No

If so, which school(s)? _____

Course title at other school _____

16. Pre-Requisites

17. Co-Requisites

Enrolled in Algebra I

18. Is this course a resubmission? ☐ Yes ☒ No

If yes, date(s) of previous submission? _____

Title of previous submission? _____

19. Brief Course Description

This is an applied science and engineering , project-based Earth and Space Science lab course. Students undertake study of Astronomy, Geology, Oceanography and Meteorology from an Earth Systems Science perspective. Laboratory, project work, and research are carried out to gain understanding of Earth Systems and to apply that knowledge, and an appreciation of how this science can be applied to planetary and other bodies. An integrated project finishes the year where students design and implement an Earth Science Systems mission. All California Earth Science content standards are also covered in the course.

B. COURSE CONTENT

Please refer to instructions

20. Course Goals and/or Major Student Outcomes

1. Develop an understanding of Earth Systems, how they are linked and the natural cycles that affect them.
2. Develop laboratory science tools and skills so as to investigate the Earth Systems Science.
3. Design and build a series of mission systems to investigate a range of Earth Systems and Space Science facets.
4. Understand and investigate how renewable energy can be looked at globally and in terms of the research in Earth Systems Science.
5. Develop an Earth Systems Science mission to carry out an investigation, designing, building, testing/evaluating and reporting on the mission system.

21. Course Objectives

By the end of this course students will be able to:

1. Use a model to describe the location and motion of the Earth and its Moon in the solar system.
2. Identify the other planets in the solar system on a diagram or in the night sky, and describe their motions, as well as the motion of the planetary moons and comets.
3. Describe the characteristics of Earth and other planets in the solar system in terms of their ability to support life.
4. Describe the current scientific theory relating to the origin and geologic evolution of the Earth and the solar system.
5. Explain phases of the Moon in terms of relative positions of the Earth, Moon, and Sun.
6. Draw inferences from celestial and terrestrial observations relating frames of reference for time and Earth motion.
7. Use maps and globes to identify surface features of the Earth.
8. Establish a correlation between different locations using rock and fossil evidence.
9. Identify common soil conservation methods.
10. Relate common cycles such as the water cycle, the nitrogen cycle, and the carbon cycle to each other.
11. Describe the motions of ocean waters and identify their causes and effects on climate.
12. Identify the composition and physical characteristics of the atmosphere.
13. Explain the roles of water and weather in distributing the Sun's heat energy.
14. Explain weather-related phenomena such as thunderstorms, tornados, hurricanes, drought, or acid precipitation.
15. Use a variety of weather measurement instruments and recording methods such as barometers, anemometers, and charts.

16. Relate observed weather conditions to large and small-scale weather systems, e.g. highs, lows, and fronts.
17. Demonstrate how living things alter the Earth's atmosphere, lithosphere, and hydrosphere.
18. Describe the relationship of plate tectonics to earthquakes and volcanism.
19. Investigate how human activities such as reducing the amount of forest cover and increasing the amount and variety of chemicals released into the atmosphere have changed the Earth's land, ocean, and atmosphere.
20. Cite evidence that our fresh water supply is essential for life and also for most industrial processes.
21. Describe possible consequences of reducing or eliminating some of the Earth's natural resources.
22. Identify natural, as well as human-induced factors, which contribute to changes in the Earth's systems.
23. Put into practice an understanding of laboratory tools to produce systems that will carry out a range of investigations in Earth Science systems
24. Demonstrate an understanding of Earth Systems and Mission Systems developed for investigation and experimentation.

22. Course Outline

Unit 1 - Earth Systems Science

1. Students understand the nature of Earth Systems science.
    a. They can describe how Earth Systems science differs from earlier approaches to the Earth sciences.
    b. They can describe the five major systems found on Earth.
        i. The atmosphere, hydrosphere, cryosphere, geosphere and biosphere.
    c. They can describe each of the four main Earth sciences.
        i. Astronomy, geology, oceanography and meteorology.
    d. They can describe the interactions between these five systems.
    e. They can describe how mankind interacts with these five systems.
2. Students are aware of how experimental science is used in Earth Systems science.
    a. Can list experimental techniques used in the study of the five major Earth systems.
    b. They have carried out experiments from each branch of Earth Systems science.
        i. Astronomy, geology, oceanography and meteorology.
3. Students are aware of Earth System science quantities and their measurement.
    a. Units of measure.
    b. Scientific, prefix and decimal notations.
    c. Measurement tools

Unit 2 - The Universe and Earth's Place In It

1. A study of the universe
    a. Students understand the different theories on the origin on the Universe.
        i. The "Big Bang" theory, the "Steady State" theory, the "Oscillating Universe" theory.
    b. Students understand key characteristics of the Universe
        i. Background radiation, red shift.
        ii. Galaxies.
            (1) Their formation, and types.
            (2) Clusters of galaxies.
        iii. Stars.
            (1) What a star is, and how they are formed.
            (2) Types of star.
    c. Students understand a range of tools used for studying the Universe.
        i. Remote sensing.
            (1) Telescopes - Reflecting, refracting, and radio telescopes.
            (2) Other remote sensing devices - Satellite probes, landers and rovers.
        ii. Mathematical models.
            (1) Orbital mechanics, Newton, Kepler et al
            (2) Simulations (Celestia and/or Orbiter)
    d. Students are aware of the procedures used to determine astronomical distances.
        i. What is a light year?
        ii. Parallax methods.
        iii. Apparent brightness versus absolute brightness.
2. The Solar system
    a. The sun and planets.
        i. Nuclear fusion in the sun.
    b. Formation of the sun and planets.
    c. Characteristics of the sun and planets.
    d. Artificial satellites and spacecraft.
        i. A brief history of space exploration.

3. The Earth-Moon System
    a. Students understand the basic aspects of the Earth-Moon system.
    b. Students are aware of the how the Moon interacts with the Earth (Eclipses, and tides).
4. Students design and build a mission system.
    a. Mission title, objectives, and the results expected from the mission.
    b. A description of the complete mission system.
    c. A mission proposal presentation
    d. A scale model of the mission system.

<u>Unit 3 – A Study of Earth's Surface and its Interior</u>

1. Students are aware of the properties and uses of rocks and minerals
    a. Students understand the basic chemistry of rocks and minerals.
        i. Students understand the mineral groups and their properties.
        ii. Students are aware of the use of minerals and rocks.
    b. Students have an understanding understand the properties of the three different rock types.
        i. Formation, classification, common and local types of rock.
        ii. The Rock Cycle.
2. Students understand the principals of geologic time and the dating of rocks
    a. What is geologic time?
    b. What is relative dating, and the methods used?
    c. What is absolute dating, and the methods used?
3. Volcanoes are understood
    a. In terms of their formation.
    b. In terms of their types and properties.
4. Students understand that the Earth is a dynamic system
    a. Students are aware of continental drift
    b. Students are aware of convection cells and how they interact with the mantle.
    c. Students understand the importance of tectonic plate boundaries, tectonic activity and earthquakes.
5. Students understand the forces affecting the Earth's surface
    a. Students understand the effects on the Earth's surface of weathering and erosion.
    b. Students understand the mechanisms involved in the formation and change of mountains.
    c. Students understand how the surface of the Earth is deformed over time.
    d. Students are aware of how the surface of the Earth is viewed.
        i. Topographic maps.
        ii. Imaging, infrared and other.
        iii. Applying these techniques to other planets.
6. Happenings beneath the Earth's surface
    a. Earthquakes – types and processes involved.
7. Students design a remote sensing, mapping project
    a. Propose a mapping/remote sensing mission for part of the Earth, or another planet
        i. Build a model representing part of the Earth, or other planet.
        ii. Use remote sensors to analyze and map the model.

<u>Unit 4 – Oceanography and Water on Earth</u>

1. Water, water everywhere. Students are aware of:
    a. The distribution and properties of water
    b. Groundwater, hot springs and geysers, wells, caverns and caves
    c. Streams and Rivers, stream flow, drainage basins
2. The world's oceans. Students are aware of:
    a. Seawater: Composition, sources of minerals
    b. The layered structure of the oceans
    c. Marine life zones
    d. Mapping the oceans
    e. Features of the seafloor: Deep ocean trenches, Abyssal plains, Seamounts, Mid-ocean ridges and Continental margins
3. From the sea to the sky. Students understand how water affects each of the five Earth Systems.
    a. Students understand the water cycle.
    b. Students understand the processes that drive the water cycle.
4. Dynamic oceans
    a. Surface currents: Ocean circulation patterns, Upwelling, Surface ocean currents and climatic patterns, El Niño and La Niña
    b. Deep ocean circulation

c. Tides: Causes of tides, Spring and Neap tides, Tidal patterns
d. Waves: Causes and characteristics of waves, Wave erosion and human efforts to counter it (Groins, Seawalls, Dunes and beach restoration)

5. Students design a remote sensing project
   a. Design and build a directly controlled ROV, or dipping buoys to perform an underwater investigation.
   b. The investigation could involve mapping the underwater topography, the thermocline profile or the currents present or any other approved mission.

Unit 5 – The Study of Our Atmosphere, Weather and Climate

1. The study of our atmosphere, weather and climate
   a. Students are aware of the composition and structure of the atmosphere
      i. Physical properties
      ii. Views on atmospheric layers
         (1) Homosphere and heterosphere
         (2) Troposphere, stratosphere, mesosphere, thermosphere, exosphere
   b. Students understand the Earth-Sun relationships
      i. Solstices, Equinoxes and Seasons
      ii. Solar radiation
      iii. Albedo and re-radiated energy
      iv. The greenhouse effect
   c. Students understand the movements of the atmosphere
      i. Convection currents and cells
2. How is the air up there?
   a. Students understand the atmosphere's composition
   b. Students understand the cycles that affect the atmosphere
3. Climate and climatic zones
   a. Climate definition
   b. Global climatic patterns
   c. Factors affecting climate
   d. The importance of vertical motion
   e. Global climatic zones
      i. Inter-tropical convergence zones
      ii. Horse latitudes
      iii. Polar storm track
      iv. Polar subsidence
   f. Climate patterns in the USA
   g. Climate changes
      i. Natural changes
      ii. Human impact on local and global climate
4. Moisture, pressure and wind
   a. Moisture
      i. Relative humidity
      ii. Dew point
      iii. Latent heat
   b. Clouds and fog
      i. Composition
      ii. Formation
      iii. Types of cloud
      iv. Atmospheric stability
   c. Precipitation
      i. How precipitation forms
      ii. Forms of precipitation
      iii. Measuring precipitation
   d. Air pressure
      i. Measuring air pressure
      ii. Lows and highs
   e. Winds
      i. Relationship between air pressure and wind
      ii. Factors affecting winds
5. Weather and weather systems
   a. Cyclones and anticyclones
      i. Air masses and their characteristics

ii. Fronts
b. Cyclogenesis
i. Formation of a mid-latitude storm system
ii. Development of a cyclone
iii. Precipitation patterns associated with a cyclone
iv. Dissipation of a cyclone
c. Other forms of severe weather
i. Thunderstorms and Lightning
ii. Tornadoes
iii. Tropical weather systems
(1) Tropical storms and hurricanes
(2) Storm surge

6. Students design carry out a mission with the focus of airborne pollution
a. Students use a sun photometer to analyze air quality
b. Students determine a system for evaluation of local air quality
i. Prepare a local map, showing areas of interest
ii. Design a detection grid for taking readings
iii. Collect data and report findings to the local community

Unit 6 – Renewable Energy

1. Students can identify the energy sources available from the Earth Systems
a. Solar, Wind, Wave, Biomass, Fossil fuels, Geothermal etc
2. Students understand how Science and Engineering give us access to the energy available from the Earth Systems
a. Conventional and alternative technologies (for example fuel cells, solar and wind generators)
3. Students understand the materials science relating to:
a. Solar/Photovoltaic cell technology
b. Battery technologies and related chemistry
c. Magnetism and electric generators
4. Students can design and construct simple alternate energy devices
a. They evaluate device/system power requirements
i. Stored energy capacity
ii. Power output
iii. Forces consideration in terms of system inputs and outputs
iv. They can select appropriate materials and technology
(1) Based in energy needs
(2) Based on working parameters
(3) Based on environment
b. Carry out calculations for power, and energy efficiencies of the device(s).
i. Drive train, Sensors, Communications load
ii. Active/rest cycles
c. Evaluate system and materials requirements
i. Task constraints
ii. Environmental constraints
5. Students should be able to review and comment constructively on the advantages and disadvantages of energy technologies
a. Non-renewable energy
b. Sustainable energy
c. Renewable energy

Unit 7 – Mission To Planet Earth

1. Students choose a mission for their team to undertake.
a. The mission may be review/extension and Earth based, or based on another planetary body.
2. Students produce a mission proposal.
a. A mission title and a clear set of objectives, and the results that would be expected from the mission.
i. The mission proposal must be unique, and teacher approved.
b. A description of the scope of the mission.
i. Is the mission new, a test, a confirmation or an application?
ii. What is being investigated, or applied?
iii. Where is the mission targeted?
iv. What is the duration of the mission?
v. What are the criteria for success?

vi. What are the requirements, considerations and obstacles that will be met?
vii. NO SCIENCE FICTION, ONLY SCIENCE FACT!

c. A description of the complete mission system.
i. What is the mission platform?
ii. What are the sub-systems? What makes up the system, and what is each part's function? How will they operate?
iii. What data will be collected and how will it be collected?
iv. Describe the systems operation. What will it do, and how does it work?
v. How will it be known that the mission systems function correctly?
vi. What capability for system and sub-system maintenance will there be?

3. A working mission system model
   a. Produce scale drawings. Front, side and top views on graph paper.
   b. Produce an isometric drawing of the system. Use Isometric "dot paper."
   c. A working model, from a budget for materials of $150 per team.
4. A mission proposal presentation
   a. The presentation should cover the same content as the mission systems report.
   b. It should be time limited to 30 minutes per team.
   c. It must include a "sales pitch."
      i. Why should your team's proposal be the one to choose?
         (1) Use science and engineering for justification, not emotions.
         (2) Provide supporting evidence for your mission proposal's importance.
   d. It must include a design report covering: Problem Analysis, Concept Generation, Design Synthesis, Manufacture, Testing and Review

19. Texts & Supplemental Instructional Materials

Text:
Earth Science 11/e (Prentice Hall, Tarbuck and Lutgens), OR
Earth Science: Geology, the Environment, and the Universe (Glencoe, Hess)

Supplemental Materials:
Science 101: Cosmology, Oceans, Weather, Geology (Harper Collins, Smithsonian)
The Blue Planet: An Introduction to Earth System Science (Wiley, Skinner, Porter, Botkin)
Earth Science the Easy Way (Barrons)
DVD Sets
- Blue Planet set
- Planet Earth and the Universe set
- Faces of Earth set
- Miracle Planet set

The Unofficial LEGO MINDSTORMS NXT Inventor's Guide
The LEGO MINDSTORMS NXT Idea Book: Design, Invent, and Build

NASA (http://www.nasa.gov)
National Oceanic and Atmospheric Administration (http://www.noaa.gov/)
The GLOBE program (http://www.globe.gov)
Kids Only Earth Enterprise (http://kids.earth.nasa.gov/)
Earth Science, Virtual Library (http://vlib.org/EarthScience)
USGS Education (http://education.usgs.gov/)
Earth Science World (http://www.earthscienceworld.org/)
Ocean Motion and Surface Currents (http://oceanmotion.org/)
Physical Oceanography (http://www.es.flinders.edu.au/~mattom/IntroOc/newstart.html)
Ocean in Motion (http://www.onr.navy.mil/focus/ocean/motion/default.htm)
Renewable Energy (http://www.fsec.ucf.edu/en/education/k-12/curricula/index.htm)
US Dept of Energy – Energy Efficiency and Renewable Energy (http://www1.eere.energy.gov/education/)

20. Key Assignments

Unit 1 - Earth Systems Science
Lab 1 – Making and calibrating a Barometer
Lab 2 – Making and calibrating a Thermometer
Lab 3 – Making and calibrating a Hair Hygrometer
Lab 4 – Making and calibrating a Fan Psychrometer

Lab 5 – Making a Seismograph
Vocabulary Assignments 1 and 2 – Grouping and defining terms, Earth Systems research
Assignments 1 and 2 – Unit Conversions and Scientific notation
Quiz 1 – Unit Conversions and Scientific notation

Unit 2 - The Universe and Earth's Place In It
Lab 6 – Building a refracting telescope
Lab 7 – Building a simple spectrometer
Lab 8 – The Herschel experiment (infrared radiation)
Lab 9 – The Ritter experiment (ultraviolet radiation)
Lab 10 – How far is it to the moon?
Vocabulary Assignments 3 and 4 – Reading/Reaction papers
Assignment 3 – Star Trekkin' (a tour of the solar system and beyond)
Quiz 2 – The Universe and Earth's Place in it
Mission 1 – Design a space-based Earth Systems Science mission (prepare a mission system model)

Unit 3 – A Study of Earth's Surface and its Interior
Lab 11 – Making sandstone and conglomerate
Lab 12 – Liquefaction
Lab 13 – Measurement in the field
Lab 14 – Rock and mineral properties
Vocabulary Assignments 5 and 6 – Reading/Reaction papers
Quiz 3 – Rocks and Minerals
Assignment 4 – Weather and Erosion
Assignment 5 – Mass wasting
Mission 2 – Topographical Mapping

Unit 4 – Oceanography and Water on Earth
Lab 15 – Streams and tables
Lab 16 – The tools of Oceanography
Lab 17 – Count Marsili's solution
Lab 18 – Beach erosion
Lab 19 – Erosion control
Lab 20 – The physical properties of sea, salt and fresh water
Lab 21 – Ocean buoys, tides and waves
Lab 22 – Wave/current energy
Vocabulary Assignment 7 – Writing Assignment (The future of oceanography)
Assignment 6 – The water cycle
Quiz 4 – The water cycle
Mission 3 – Design/equip an ROV, or dipping buoys to perform an underwater investigation.

Unit 5 – The Study of Our Atmosphere, Weather and Climate
Lab 22 – Greenhouse heat
Lab 23 – Aerosol counts in the local community
Lab 24 – Measuring the oxygen content of air
Lab 25 – Ozone content of local air
Lab 26 – Atmospheric conditions and local weather
Lab 27 – Wind energy, turbine design
Vocabulary Assignment 8 – Writing assignment (The early atmosphere)
Vocabulary Assignment 9 – Writing assignment (Global climate change)
Assignment 7 – Solar radiation and the Earth
Assignment 8 – Earth's climate systems
Assignment 9 – Global climate change
Assignment 10 – Atmospheric Systems
Mission 5 – A study of local air quality using a sun photometer

Unit 6 – Renewable Energy
Lab 28 – Solar Power generation
Lab 29 – Wind Power generation
Lab 30 – Wave Power generation
Lab 31 – Electric motors and generators
Vocabulary Assignment 9 – Renewable Energy and Earth Systems Cycles Reading/Reaction paper

Assignment 11 – Energy resources and mission systems
Assignment 12 – Generator efficiency
Quiz 5 – Basic Electronics
Mission 6 – Renewable Energy and Mission Systems

Unit 7 – Mission to Planet Earth Systems
Vocabulary Assignment 9 – Mission System vocabulary/bibliography
Assignment 13 – Mission System proposal
Assignment 14 – Mission System report
Assignment 15 – Mission System design/building
Assignment 16 – Mission System testing/evaluation
Assignment 17 – Mission System presentation/PowerPoint

21. Instructional Methods and/or Strategies

- Lecture
- Laboratory work
- Lab equipment building and calibrating
- Mission systems proposals and development
- Slide shows
- Outside Activities (fieldtrips)
- Instructor made videos
- Internet and Library research
- DVDs
    - Blue Planet set
    - Planet Earth and the Universe set
    - Faces of Earth set
    - Miracle Planet set
- Library and internet research
- Student projects
- Student PowerPoint presentations

22. Assessment Methods and/or Tools

Unit Work 60%

- Vocabulary (Reading/Writing/Reaction papers)
- Quizzes
- Assignments
- Laboratories
- Mission Systems
    - Proposal
    - Mission System
    - Report
    - Presentation

Semester Finals 20%
Mission to Planet Earth Systems 20%

- Proposal
- Mission System
- Report
- Presentation

C. HONORS COURSES ONLY

Please refer to instructions

D. OPTIONAL BACKGROUND INFORMATION

Please refer to instructions

Funding provided by Department of Labor, Employment & Training Administration: WIRED Initiative