WASC ASSESSMENT PLAN

General Education Requirement

Natural Sciences.

Division of Natural Sciences and Mathematics
Chaminade University of Honolulu

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A. Mission of the Natural Science Disciplines at Chaminade.

The Natural Sciences are organized into the disciplines of Biology, Chemistry, Physics and Forensic Sciences at Chaminade. Students in non-science majors may fulfill their General Education requirement of two natural science courses with laboratory, in either Biology, Chemistry, Physics or Environmental Studies. Overall, the mission of the General Education Science requirement at Chaminade may be stated as follows:

"To produce graduates who are scientifically literate, able to think scientifically and with appropriate skills to process and evaluate information arising in a technologically advanced world"

B. Core Learning Outcomes (CLO) for the GE Science Requirement.

Students who complete the natural science requirement of the General Education core at Chaminade will demonstrate:

1. An understanding of and the ability to recognize and use the Scientific Method;

2. The ability to recognize the dual nature of humans as being both from nature and a part of nature;

3. An understanding of impacts of human activities on nature and natural systems.

Note*: As part of the assessment process, the Natural Science disciplines at Chaminade are in the process of revising these outcomes. CLO#1 will remain unchanged. However, during AY2010-2011, it is proposed that CLO#2 and #3 be replaced. In general terms, these changes will reflect an emphasis on scientific literacy and the ability to differentiate valid and invalid information arising in our technologically advanced society. With this in mind, the goal of AY09-10 is to assess progress on CLO#1 only.*

C. Mechanisms for fulfilling the GE Natural Science requirement at Chaminade.

Students are required to take 8 semester hours of natural sciences, comprising either two courses with laboratory, or CLEP III and one course with laboratory.

C.1. Course Descriptions from Chaminade University Catalog.

The following courses are recommended for non-science majors in fulfillment of the GE Natural Science requirement at Chaminade.

** AEOP only*

*** undergoing revision or removal from catalog in AY09-10, therefore excluded from assessment*

**** Responsibility of the Division of Behavioral Sciences.*

BI 101-BI 102 General Biology (3-3)

Overview of basic biological principles, human concerns of overpopulation, environmental pollution, genetic engineering. Recommended for non-majors. BI 101 is not a prerequisite for BI 102. BI 101 and BI 102 offered annually. Concurrent registration in BI 101L and BI 102L necessary for lab science credit.

BI 101L-BI 102L General Biology Laboratory (1-1)

One three-hour laboratory period per week to accompany BI 101 and BI 102. Laboratory work and field trips related to lecture topics. BI 101L and BI 102L offered annually.

****BI 103 Botany (3)**

Distribution, identification, structure, and physiology of plants with special attention to identification, distribution, and uses of tropical plants of Hawai'i. Recommended for non-majors. Concurrent registration in BI 103L necessary for lab science credit.

****BI 103L Botany Laboratory (1)**

One three hour laboratory period per week to accompany BI 103. Laboratory work and field trips based on experiments, examinations of microscopic plant structure, and identification of Hawaiian specimens.

BI 110 People and Nature (3)

Addresses biological, ecological and public health questions which may have social, ethical, religious, or political implications. Recommended for non-majors. Offered annually. Concurrent registration in BI 110L required for lab science credit.

BI 110L People and Nature Laboratory (1)

One three-hour laboratory period per week to accompany BI 110. Laboratory work such as testing for water quality, field trips to aquaculture farms, estuaries, and the like. Offered annually.

BI 115 Introduction to Marine Biology (3)

Life in various marine habitats studied with regard to its relationship to the ocean and to man. Various zones in the ocean and its inhabitants, the impact of man on the marine environment, and food sources from the sea will be discussed. Recommended for non-majors. Offered annually. Concurrent registration in BI 115L necessary for lab science credit.

BI 115L Introduction to Marine Biology Laboratory (1)

One three-hour laboratory period per week to accompany BI 115. Classification, anatomy, and physiology of live and preserved marine animals. Field trips are included. Offered annually.

***BI 130 Ethnobotany (3)**

Common native and introduced flora of Hawai'i are investigated. Endangered and threatened species, identification, communities, and uses are stressed. Recommended for non- majors. Concurrent registration in BI 130L necessary for lab science credit.

***BI 130L Ethnobotany Lab (1)**

One three-hour laboratory per week to accompany BI 130. Field trips for identification purposes are made as well as ecology studies and nature walks.

BI 131 Human Nutrition (3)

An introduction to basic concepts and current research in nutrition. The nature and roles of nutrients, nutrient requirements throughout the human life cycle, diseases resulting from over and under nutrition, food safety, and food sources. Recommended for non-majors. Offered annually. Concurrent registration in BI 131L necessary for lab science credit.

BI 131L Human Nutrition Laboratory (1)

One three-hour laboratory period per week to accompany BI 131. Survey of methodology and instrumentation involved in the analysis and evaluation of foods, their nutritional value, and diets. Offered annually.

CH 102 Chemistry for the Concerned World Citizen (3)

This is an introductory course presenting many different branches of chemistry. In contrast to other courses in the discipline, there is a significant qualitative component, where impact to environment, and how chemical

knowledge can contribute to one's overall awareness are among the topics discussed. The quantitative part of the course is especially designed to be non-intimidating when covering concepts such as atomic theory, formulas, equations, thermochemistry, gases, and stoichiometry. Non-science majors, who wish to relate general principles of chemistry to socioeconomic and environmental issues, as well as science majors, who feel the need for a refresher course, are encouraged to enroll. Offered annually. *Prerequisites: High school algebra recommended.*

CH 102L Chemistry for the Concerned World Citizen Laboratory (1)

The general theme for this lab course is to demonstrate that chemistry is everywhere. A great majority of the experiments will be carried out using household supplies and equipment. During the last few weeks a transition to using conventional lab equipment is aimed to help students understand the logic of experimental design. One three-hour laboratory period per week to accompany CH 102. Offered annually.

***, **CH 107 Marine Sciences: Chemical Perspectives (3)**

This course acquaints the non-specialist with the multi-faceted marine environment. The topics covered range from wave action and reef eco-systems to marine invertebrates and drugs from the sea. Many unique features of the marine environment around the Hawaiian Islands are also covered. Offered annually. *Prerequisites: Concurrent registration in CH 107L and consent of instructor required.*

***,**CH 107L Marine Sciences: Chemical Perspectives Laboratory (1)**

Hands-on experience in data-collection and processing, observations of marine eco-systems, sample collecting, and isolation techniques are introduced through field trips and laboratory experiments. One three-hour laboratory period per week to accompany CH 107. Offered annually.

CH 103 College Chemistry (3)

A one semester introduction to chemistry for students who wish to strengthen their understanding of basic concepts in chemistry before beginning the general chemistry sequence or for students working towards associate degrees. Emphasis will be placed on problem solving. Topics covered will include: chemical measurements, properties of atoms and molecules, chemical reactions, chemical calculations, acids and bases, properties of gases and thermochemistry. Offered annually. (Concurrent registration in CH 103L required).

CH 103L College Chemistry Laboratory (1)

Laboratory experiments designed to reflect the topics presented in CH 103. Offered annually. *Concurrent registration in CH 103 required*.

PHY 111 Environmental Physics (3)

Introduction to physical principles as they relate to societal impact on the environment. Offered according to demand. . Concurrent registration in PHY 111L is required. Cross listed as ENV 202.

PHY 111L Environmental Physics Lab (1)

One three-hour laboratory period per week to accompany PHY 111. Offered according to demand. Concurrent registration in PHY 111 required. Cross listed as ENV 202L.

****PHY 121 Physics of Photography (3)**

Knowledge of the science and technology that underlie photography intended to help those interested in photography to become knowledgeable and skilled photographers. This course presents the history of photography, as well as a detailed presentation of how it "works" from the point of view of the simple physics relating to light, color, lenses, image formation and storage, etc. Both film based and digital imaging are covered. Offered annually. Concurrent registration in PHY121L.

****PHY 121L Physics of Photography Lab (1)**

One three-hour laboratory period per week to accompany PHY 121. Offered annually. Concurrent registration in PHY 121 required.

PHY 140 Introduction to Astronomy (3)

Historical overview: the Earth-Moon system; the solar system; stellar evolution; white dwarfs, pulsars, and black holes; galaxies; the Big Bang, cosmology and structure of the Universe. Offered according to demand. Concurrent registration in PHY 140L required.

PHY 140L Intro to Astronomy Lab (1)

One three-hour laboratory period per week to accompany PHY 140. Includes field trips to planetariums and star gazing sessions. Offered annually. Concurrent registration in PHY 140 required.

*****ENV 115 Marine Environmental Science (3)**

This course introduces students to the scientific causes and consequences of the current major marine environmental issues. Topics include: effects of global warming on ocean ecosystems, marine pollution, marine debris, oil spills, fisheries exploitation, fisheries by-catch, marine alien species and coral reef degradation. The course focuses on making students aware of the material causes and consequences of each issue as well as the role of science in devising solutions to each issue.

*****ENV 115 L Marine Environmental Science Lab (1)**

This course introduces students to the scientific methodologies used to determining and studying the current major marine environmental issues. Issues studied include: global warming, marine pollution, marine debris, oil spills, fisheries exploitation, fisheries by-catch, marine alien species and coral reef degradation. Laboratory exercises are conducted in the field and on the Chaminade campus. Students taking this course will be engaged in field science activities.

*****ENV 201 Conservation Biology & Ecology (3)**

An introduction to conservation biology issues and goals and the principles of ecology. The course includes consideration of the impacts of human activity on ecosystems and our efforts to ameliorate destructive impacts. Major topics include the effects of industrialization, agriculture, pollution, species introduction and human population growth and development on the health and future sustainability of ecosystems and humans alike. Particular emphasis is placed on island ecosystems.

*****ENV 201L Conservation Biology & Ecology Laboratory (1)**

Students perform laboratory and field research techniques used in conducting conservation biology and ecological research and restoration. Analyses are conducted in the laboratory and in the field. Course must be taken concurrently with ENV 201 D.

D. Assessment Plan.

D.1. Summary of Assessment Strategy for GE Natural Science Requirement

Assessment Strategy	Delivery of an assessment instrument designed to test appropriate skills related to CLO as a pre- and post-test administered to a cohort of non-science major students each semester.
Evidence Type (Rubric)	Performance data on assessment instrument (Rubric A)
Location of Evidence	Office of the Dean of Natural Sciences and Mathematics

D.2. Assessment Timeline

Spring 2009	Faculty consultation on methodology of assessment for GE Natural Science requirement.
Spring 2009	Selection of assessment methodology for GE Natural Science requirement.
Summer 2009	Design of draft assessment instrument and rubric for GE Natural Science requirement.
Fall 2009	Pilot delivery of assessment instruments for GE Natural Science requirement to a selected cohort of classes.
Winter 2009 and ongoing.	Analyze and reflect on pilot data, refine and develop instrument. Deliver instrument and analyze data each semester.
AY2010-2011	Revise CLO#2 and #3, develop instruments to test new CLO, implement instruments.

D.3. Instrument.

The GE assessment instrument for natural sciences is divided into two sections:

- **Section I. The Scientific Method**
  - Assesses CLO#1, understanding of components and correct application of the scientific method;
  - 8 questions, multiple choice format.

- **Section II. Critical thinking and data analysis**
  - Assesses CLO#1, problem solving skills necessary to engage in the correct use of the scientific method, ability to correctly interpret experimental information, ability to solve problems across disciplinary boundaries;
  - 13 questions offered of which students must answer 10, multiple choice format.

SECTION I. The Scientific Method (Core Learning Outcome #1)

ANSWER ALL OF QUESTIONS 1 to 8.

1. The first step of the scientific method involves:

A. forming a hypothesis.

B. making observations.

C. performing an experiment.

D. predicting the result of an experiment

2. A pattern or relationship that has been established based on a large amount of experimental data is a:

A. theory

B. hypothesis

C. law

3. Which of the following is most correct:

A. You can accept or reject a hypothesis, but never prove it to be true.

B. You can prove a hypothesis to be true.

C. You can prove a hypothesis to be false.

D. Accepting or rejecting a hypothesis is the same as proving whether or not the hypothesis is true.

4. Which of the following is true:

A. Data and Results are two names for the same thing.

B. Data are the facts you collect from your experiment, while Results are your interpretation of what the data means.

C. All data are numerical.

5. If a hypothesis is shown to be true within a high statistical probability, can it still be wrong?

A. Yes, the hypothesis could still be incorrect.

B. No, a high degree of statistical probability basically proves a hypothesis.

6. If you have a control group for your experiment, which of the following is true:

A. There can be more than one difference between the control group and test groups, but not several differences or else the experiment is invalid.

B. The control group and the test groups may have several differences between them.

C. The control group is identical to each test group except for one variable.

7. Which of these is NOT a component of the scientific method?

A. writing a lab notebook

B. performing an experiment

C. dismiss a hypothesis

D. revise a hypothesis

8. Which of these is NOT a form of scientific misconduct?

A. plagiarism

B. falsification of data

C. reporting negative data

SECTION II. Critical Thinking Skills and Data Analysis (Core Learning Outcome #1).

ANSWER ANY 10 of the QUESTIONS BELOW:

9. Souring of milk is caused by bacteria that utilize sugars to generate acids (note that acids are sour). It is a common observation that milk kept in a refrigerator does not sour as rapidly as milk left on a kitchen table. What is the reason?

(a) The cold temperatures kill the bacteria.
(b) Chemical reactions caused by bacteria occur more slowly at colder temperatures.
(c) It is not possible to form acids via chemical reactions at colder temperatures.
(d) Milk gets thicker at lower temperatures and stops the bacteria from being mobile.

10. The LD_{50} value of a drug is a measure of toxicity and indicates the dose required to kill 50% of test animals. Suppose you are comparing the LD_{50} values of two drugs that are tested on mice. Drug A has an LD_{50} of 1 milligram (mg) and Drug B has an LD_{50} of 20 mg. Which drug is more toxic to mice?

(a) Drug A is more toxic than Drug B
(b) Drug B is more toxic than Drug A
(c) The two drugs are equally toxic
(d) It's not possible to tell using these LD_{50} values

11. All pharmaceuticals are tested by clinical trials on patients. Suppose that a new painkiller drug – called *Cureall* - is being tested to see if it is more effective in reducing pain than an older medication like *Aspirin*. How would you set up a clinical trial to answer this question? (Note that in these trials "a placebo" is a pill which does not have any painkiller properties)

(a) Give *Cureall* to one patient group and a placebo to another patient group
(b) Give *Aspirin* to one patient group and a placebo to another patient group
(c) Give *Aspirin* to one patient group and *Cureall* to another patient group
(d) Give *Cureall* to all patients.

12. Consider a chemical reaction that takes 1 second to complete under normal conditions. Suppose that you are able to increase the rate (speed) of the reaction by a factor of 1 million. How many times could the chemical reaction be completed during one minute?

(a) 60
(b) 60 thousand
(c) 60 million
(d) 60 billion

13. A "mahalole" is a unit originated by the residents of a remote Pacific island to express a large quantity of small fish. As years went by, and as fishing was no longer the only activity on the island, 1 mahalole ended up to mean a quantity of 200 of anything. If one of the island residents wanted to order 40 french fries in the newly opened fast-food restaurant, how many mahaloles of french fries would he/she ask for?

(a) 40
(b) 0.2
(c) 0.4
(d) A mahalole unit can only be used for small fish, not french fries

14. A research project is initiated on a remote Pacific island to monitor the emission of carbon dioxide, which is known to be a major factor causing the "the green-house effect." The researchers are aware that carbon dioxide is formed when fossil fuels such as gasoline, diesel, etc. are used to power engines. Which of the following is the least likely cause of the green house effect and therefore not necessary for the researchers to consider for the purposes of their project?

(a) Number of cars on the island
(b) Number of fishing boats
(c) Ozone depletion
(d) All of the above are necessary factors to be considered

15. The results of a ten-year study, during which skin cancer cases in population samples residing in San Francisco and in Honolulu are monitored, demonstrate that a significant cause of skin cancer is exposure to sun. Which of the following is a main reason why population samples are chosen in those specific locations?

(a) Most people who reside in San Francisco travel to Honolulu
(b) It would take more than ten years to complete the study, if the distance between the locations was further than that between San Francisco and Honolulu
(c) The medical facilities in both locations have a high success rate in treating skin cancer
(d) The number of sunny days per year in Honolulu is on the average five times as many as those in San Francisco

16. Olbers' paradox assumes that the universe:

A. is completely filled with light
B. has always been the way it is now
C. is infinitely old and infinitely large
D. is finite in at least one aspect

17. Under which of the following conditions do we see lit up one fourth of the moon's total surface?

A. when the sun and moon are on opposite sides of the Earth.

B. when the sun and moon are on the same side of the Earth.

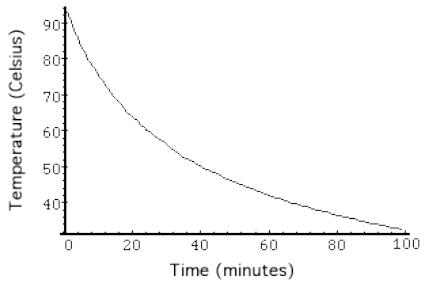
C. when the moon is partly turned away from the Earth.

D. when the light rays from the sun to the moon and from the moon to the Earth form a right angle.

E. any of the above, depending upon our location on Earth.

18. The graph below shows the cooling behavior of water. Water in a container is heated to just below the boiling temperature. Subsequently the heating source is removed and the temperature of the cooling water is recorded at certain time intervals.

Which of the statements below is the correct information obtained from the results of this experiment?



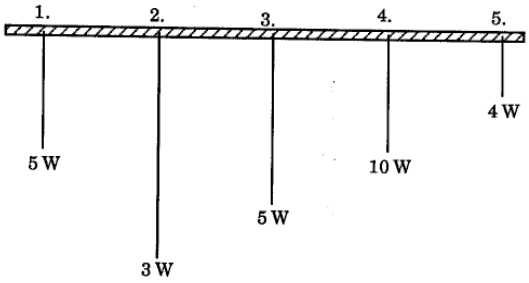
(a) The rate of cooling is constant

(b) The rate of cooling increases as the temperature approaches room temperature

(c) The rate of cooling decreases as the temperature approaches room temperature

(d) No information about the rate of cooling can be obtained from the graph above

19. The picture below shows a series of pendulums of carrying lengths, each with a number of steel washers (W) hanging from them.



Suppose you wanted to do an experiment to find out if changing the length of a pendulum changed the amount of time it takes to swing back and forth.

Which pendulums, in the above figure, would you use for the experiment?

a) 1 and 4

b) 2 and 4

c) 1 and 3

d) 2 and 5

e) all

20. What is the reason for your answer to question 19?

a) The longest pendulum should be tested against the shortest pendulum.

b) All pendulums need to be tested against one another.

c) As the length is increased the number of washers should be decreased.

d) The pendulums should be the same length but the number of washers should be different.

e) The pendulums should be different lengths but the number of washers should be the same.

21. Suppose you wanted to do an experiment to find out if changing the weight on the end of the string changed the amount of the time the pendulum takes to swing back and forth. Which pendulums, in the above figure, would you use for the experiment?

a) 1 and 4

b) 2 and 4

c) 1 and 3

d) 2 and 5

e) all

22. What was the reason for your answer to question 21?

a) The heaviest weight should be compared to the lightest weight.

b) All pendulums need to be tested against one another.

c) As the number of washers is increased the pendulum should be shortened.

d) The number of washers should be different but the pendulums should be the same length.

e) The number of washers should be the same but the pendulums should be different lengths.

D.4. Rubric.

Instrument Component	CLO assessed	Exemplary	Very Good	Proficient	Incomplete	Inadequate
Understanding of the scientific method (SM)	**1**	Correctly articulates components and order of steps in the SM; Understands key concepts in application of SM, including controls and treatment of hypotheses; Is equipped with sufficient knowledge of SM to correctly design and interpret experiments.	Has overall understanding of SM, with some very minor flaws in conceptual understanding of components or utilization of SM.	Has a competent understanding of components and application of SM, with some gaps in understanding.	Lacks factual understanding of more than 1-2 components of the SM, leading to flawed in application of SM.	Is unable to recall or apply major conceptual components of the SM.
Benchmark for achievement on assessment instrument		*>65% on questions 1-8 (Section I)*	*>55% on questions 1-8 (Section I)*	*>45% on question 1-8 (Section I)*	*>35% on questions 1-8 (Section I)*	*<35% on questions 1-8 (Section I)*
Critical thinking and data analysis	**1**	All steps in the process are correctly performed. Demonstrates ability to integrate theory and application. Demonstrates ability to apply scientific inquiry and synthesize knowledge. Demonstrates ability to interpret results inside and outside the context of a discipline	Consistently demonstrates desired skills, with some minor inconsistencies in problem solving or conceptual grasp of material.	Solves scientific problems and integrates knowledge, but some flaws are evident in conceptual knowledge or application of critical thinking methodology.	Solves scientific problems and integrates knowledge, but is inconsistent and major flaws are evident in conceptual knowledge or application of critical thinking methodology.	Is manifestly unable to solve scientific problems or think critically.
Benchmark for achievement on assessment instrument		*>65% on 10 answers in Section II*	*>55% on 10 answers in Section II*	*>45% on 10 answers in Section II*	*>35% on 10 answers in Section II*	*<35% on 10 answers in Section II*