Miami Dade College

Course Competencies Template - Form 112

GENERAL INFORMATION	
Name: Dr. Curtis McKinney	Phone #: 7-1689
Course Prefix/Number: ISC4535C	Course Title: Research in the Sciences
Number of Credits: 3	
Degree Type	☐ B.A. ☒ B.S. ☐ B.A.S ☒ A.A. ☐ A.S. ☐ A.A.S. ☐ C.C.C. ☐ A.T.C. ☐ V.C.C
Date Submitted/Revised: 06/2/08	Effective Year/Term: Fall 2008-1
☒ New Course Competency ☐ Revised Course Competency	
Course to be designated as a General Education course (part of the 36 hours of A.A. Gen. Ed. coursework): ☐ Yes ☒ No	
The above course links to the following Learning Outcomes: ☐ Communication ☒ Numbers / Data ☒ Critical thinking ☐ Information Literacy ☐ Cultural / Global Perspective ☐ Social Responsibility ☐ Ethical Issues ☒ Computer / Technology Usage ☐ Aesthetic / Creative Activities ☒ Natural Systems/Environmental Responsibility	
Course Description (limit to 50 words or less, **must correspond with course description on Form 102**): This course provides students with a hands-on experience in developing a rich understanding of the processes of science through the development of a scientific research project in life, physical, and/or earth/space sciences. Student will generate hypothesis, develop an experimental design, collect data, and present an analysis of their findings.	
Prerequisite(s):	Corequisite(s):

Course Competencies: (for further instruction/guidelines go to:

http://www.mdc.edu/asa/curriculum.asp)

Competency 1:	The student will identify the characteristics and components of scientific inquiry by:

a) Recognizing the elements of a well-designed scientific investigation.
b) Identifying the various ways scientists do their work and differ greatly in the phenomena they study.
c) Identifying and analyzing the relationship between experimental observations and underlying assumptions, hypotheses, conclusions, laws, or theories.
d) Explaining the scientific method, including the concepts of hypothesis and experimental controls, and why objectivity is essential.
e) Explaining that scientific investigations are conducted for different reasons (e.g. to explore new phenomena, to check on previous results, to test how well a theory predicts, and to compare theories).
f) Describing that scientific investigations usually involve the collection of relevant data, the use of logical reasoning, and the application of imagination in devising hypotheses and explanations to make sense of the collected data.
g) Distinguishing between accuracy, precision, systematic error, and random error.

Revision Date: _____

Approved By Academic Dean Date: _____ Reviewed By Director of Academic Programs Date: _____

h) Differentiating between qualitative and quantitative data in experimental, observational, and modeling methods of research.
i) Identifying variables (dependent, independent, and control) in a given experimental design.
j) Relating experimental evidence to models and analyzing natural events for evidence of patterns.
k) Describing how scientific knowledge and reasoning provide an empirically-based perspective to inform society's decision making.
l) Identifying that bias is attributable to the investigator, the sample, the method, or the instrument and may not be completely avoidable in every instance, but scientists want to know the possible sources of bias and how bias is likely to influence evidence.
m) Utilizing and correctly interpreting relational terms such as *if… then…*, *and*, *or*, *sufficient*, *necessary*, *some*, *every*, *not*, *correlates with*, and *causes*.
n)

Competency 2: The student will demonstrate appropriate procedures and conceptual understanding of scientific investigations by:

a) Identifying proper field techniques (e.g., site selection, field procedures, sampling, capture/recapture, transects, collecting techniques, environmental quality assessment).
b) Engaging appropriate inquiries that require them to develop concepts and relationships from their observations, data, and inferences in a scientific manner.
c) Investigating the applications of life, physical, and Earth and space sciences in environmental quality and to personal and community health.
d) Integrating and applying information and experiences from mathematics and science courses to an original scientific investigation.
e) Identifying prior expectations as an impediment to objectivity and taking steps to avoid it when designing investigations and examining data.
f) Identifying questions about the natural world that will guide an original scientific investigation.
g) Utilizing the science processes of observing, inferring, communicating, classifying, predicting, measuring, and graphing in an original scientific investigation.
h) Formulating a testable hypothesis and demonstrating the logical connections between the scientific concepts guiding the design of an original scientific investigation.
i) Designing and performing an original scientific investigation (e.g., forming hypotheses, controlling variables, defining operationally, interpreting data).
j) Selecting appropriate equipment to conduct an original scientific investigation.
k) Characterizing variables and the affected outcomes for appropriate experimental designs with minimum bias.
l) Evaluating, interpreting, and predicting from empirical data sets, including graphical data.
m) Formulating models based upon physical, conceptual, and mathematical concepts.
n) Utilizing evidence and logic in the construction of an argument for their proposed explanations.
o) Analyzing arguments for flawed assumptions, flawed reasoning, or both; and be critical of the claims if any flaws in the argument are found.

Competency 3: The student will demonstrate appropriate use of technologies and mathematics to conduct a scientific investigation and improve the communication of findings by

a. Utilizing measurement in posing questions, formulas in developing explanations, significant figures in data representation, and charts and graphs in communicating results appropriately
b. Utilizing a variety of technologies (e.g. hand tools, measuring instruments, computers, and calculators, etc.) to collect and analyze data from an original scientific investigation.
c. Utilizing computer spreadsheet, graphing, and database programs to assist in quantitative analysis of real-world objects and events.
d. Identifying the applications of basic statistics and statistical interpretation to the analysis of data.
e. Selecting appropriate summary statistics to describe group differences, always indicating the spread of the data as well as the data's central tendencies.
f. Identifying that trends can be described mathematically and can be used to estimate how long a process has been going on.
g. Identifying and critiquing claims based on the faulty, incomplete, or misleading use of numbers (e.g. average results are reported but not the amount of variation around the average, a percentage or fraction is given but not the total sample size, absolute and proportional quantities are mixed, and/or results are reported with overstated precision).
h. Evaluating graphs to see that they do not misrepresent results by using inappropriate scales or by failing to specify the axes clearly.

Competency 4: The student will be able to communicate and defend a scientific argument by:

a. Participating in group discussions on scientific topics by restating or summarizing accurately what others have said, asking for clarification or elaboration, and expressing alternative positions.
b. Maintaining an up-to-date laboratory notebook (that includes proper documentation of outside resources, procedures, reviewing information, data, diagrams and charts, and statistical analysis) which is of sufficient detail that others could repeat the original scientific investigation if necessary
c. Presenting and writing up results from an original scientific investigation in a clear and concise manner and utilizing appropriate style and depth in a report.
d. Accessing relevant information from the library and other information resources to review what is known in light of empirical evidence and enhance scientific explanation of the original scientific investigation.
e. Interpreting and reporting data effectively.
f. Utilizing formulas, tables, charts, and graphs in making arguments and claims in oral, written, and visual presentations.
g. Constructing a reasoned argument and responding appropriately to critical comments.
h. Relating an original scientific investigation to the bigger picture while applying scientific principles to real world situations and recognizing when seemingly minor oversights can have serious consequences.
i. Showcasing an original scientific investigation that meets all of the requirements of the International Science and Engineering Fair (ISEF) standards.

Competency 5: The student will be able to organize safe laboratory and/or field environment when performing a scientific investigation by:

a. Identifying and adhering to precautions on laboratory safety and recognizing hazardous situations so that they can act appropriately.
b. Identifying emergency procedures and the proper use of safety equipment.
c. Identifying and adhering to the legal and ethical responsibilities in the proper treatment of animals and the maintenance/disposal of materials.
d. Practicing safe and proper techniques for the preparation, storage, dispensing, supervision, and disposal of all materials.
e. Treating all living organisms used in the classroom or found in the field in a safe, humane, and ethical manner and respect legal restrictions on their collection, keeping, and use.

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