Montgomery County Community College
GLG 125
The Science of Climate Change
4-3-3

COURSE DESCRIPTION:
The Science of Climate Change is an introductory survey of the causes and consequences of climate change at a variety of time and spatial scales throughout Earth's history. Natural and human-induced climate change will be studied as physical processes with varying dimensions of biophysical and societal impacts. This course should be considered by the following students: those needing to fulfill a lab science Core requirement, those preparing for a career in environmental science, and those considering a Geology or Atmospheric Sciences major seeking a geoscience elective. This course is subject to a course fee. Refer to http://mc3.edu/adm-fin-aid/paying/tuition/course-fees for current rates.

REQUISITES:
Previous Course Requirements
- ENG 010A - Basic Writing, ENG 011 Basic Writing II or ESL 011 ESL Basic Writing II
- MAT 011 Beginning Algebra or MAT 011B - Beginning Algebra with Review of Arithmetic
- REA 011 Fundamentals of College Reading or REA 017 - Vocabulary and Reading Comprehension Development II

Concurrent Course Requirements
None

LEARNING OUTCOMES Upon successful completion of this course, the student will be able to:	LEARNING ACTIVITIES	EVALUATION METHODS
1. Apply the scientific method of inquiry.	Lecture Small Group Discussion Collaborative Investigation Collaborative and/or Individual Presentations Laboratory Procedures Computer Simulation Computer-Aided Instruction Text and Outside Readings Written Examinations Research Paper Projects	Laboratory Reports Group and Individual Project Reports Examinations

LEARNING OUTCOMES	LEARNING ACTIVITIES	EVALUATION METHODS
2. Access online datasets as well as instrumental measurements, conduct quantitative analysis of these data, and apply them in problem-solving.	Collaborative and Individual Projects Computer Simulation	Laboratory Reports Group and Individual Project Reports
3. Relate the physical factors which determine global and regional climate.	Individual and Group Projects Lab and Computer Simulations Text and Outside Readings Lecture	Laboratory Reports Group and Individual Project Reports Examinations
4. Relate the processes responsible for former and current natural climate change.	Text and Outside Readings Lab and Computer Simulations Group and Individual Projects Lecture	Laboratory Reports Group and Individual Project Reports Presentations Examinations
5. Present the causes of anthropogenic climate change.	Text and Outside Readings Online Datasets Lab and Computer Simulations Lecture	Laboratory Reports Group and Individual Project Reports Examinations
6. Delineate consequences of future climate change upon biophysical and societal systems.	Text and Outside Readings Online Datasets Lab and Computer Simulations Lecture	Laboratory Reports Group and Individual Project Reports Examinations Common Assessment (Shared with Several Colleges)

At the conclusion of each semester/session, assessment of the learning outcomes will be completed by course faculty using the listed evaluation method(s). Aggregated results will be submitted to the Associate Vice President of Academic Affairs. The benchmark for each learning outcome is that *70% of students will meet or exceed outcome criteria*.

SEQUENCE OF TOPICS:

I. Introductory Material
   - A. The Nature of Scientific Inquiry
     1. methodology
     2. meaning of uncertainty
   - B. The Meaning of Language

C. Climate Fundamentals
    1. the 'spheres': lithosphere, hydrosphere, atmosphere, cryosphere and biosphere
    2. angle of incidence; inverse square law
    3. seasonality
    4. latitudinal zonation
    5. greenhouse mechanism

II. The Record of Natural Climate Change at Various Time Scales
A. Climate Change in Deep Geologic Time
    1. Precambrian glaciations; Snowball Earth
    2. Ordovician glaciation/faunal crisis
    3. Large Igneous Provinces/climate crises/faunal crises
    4. Cretaceous equable period
    5. Paleocene/Eocene Thermal Maximum
B. Climate Change in Last Million Years
    1. climate proxies: e.g. ^{18}O; lake sediments
    2. Milankovitch mechanism
    3. thermohaline circulation/Younger Dryas
C. Climate Change in Historical Time
    1. ice cores: mountain and Greenland/Antarctica
    2. pollen
    3. tree rings
D. Climate Change in Instrumental Time
E. Interannual/Interdecadal Cycles: ENSO,NAO, PDO

III. Anthropogenic Stresses
A. Greenhouse Gases: sources and sinks
B. Land Use
C. Positive/Negative Feedbacks

IV. Scenarios of the Recent Past and Near Future
A. Climate Modeling
B. IPCC
C. Inexorable Progressive Changes
    1. temperature
    2. precipitation
    3. soil moisture
    4. sea level rise
D. Crisis Events
    1. heat waves
    2. drought
    3. deluge
    4. storminess
    5. methane clathrates
E. Biophysical Consequences
    1. agriculture
    2. biodiversity/terrestrial & marine ecology
    3. disease
    4. economic systems
    5. climate refugees

V. Conclusion
   A. What Can Be Done?
   B. What Can You Do?

LAB ACTIVITIES
Lab investigations will center upon, but not be restricted to, the following content areas:

Heat Budget Parameters: inverse square law; angle of incidence
Climate Proxies: North African lake sediments
tree rings
Ice Cores: NCDC and EPICA datasets
Instrumental Record: trends in minimum/maximum temp. & precip.: NCDC
urban heat island: field data and NASA/GISS data
Climate Modeling: NASA/GISS EdGCM model runs & interpretation
Crisis Events: deluge: NCDC rainfall; USGS hydrographs; flood ranking
tropical cyclones: AVHRR imagery/SST; various datasets on Gulf hurricanes
Societal Impacts: sea level rise; agricultural productivity; infectious diseases; species migration; etc.: NASA/GISS TV/SEDAC spatial analyses

LEARNING MATERIALS:
Ruddiman, William. (2008). *Earth's Climate, Past and Future* (2nd ed.). W.H. Freeman.
Supplementary Handouts
Numerical Simulation & Spatial Analysis Software

Other learning materials may be required and made available directly to the student and/or via the College's Libraries and/or course management system.

COURSE APPROVAL:

Prepared by:	Robert Kuhlman	Date: 11/3/2010
Interim VPAA/Provost Compliance Verification:		
	Victoria L. Bastecki-Perez, Ed.D.	Date: 1/19/2011
Revised by:	Robert Kuhlman, Professor of Geology	Date: 6/2012
Revised by:	Robert Kuhlman, Professor of Geology	Date: 7/2013
VPAA/Provost or designee Compliance Verification:		
	Victoria L. Bastecki-Perez, Ed.D.	Date: 8/13/2013
Revised by:	Debbie Dalrymple	Date: 6/27/2016
VPAA/Provost or designee Compliance Verification:		
	Victoria L. Bastecki-Perez, Ed.D.	Date: 6/27/2016
Revised by:	Debbie Dalrymple and Evon Martins	Date: 1/11/2018
VPAA/Provost or designee Compliance Verification:		Date: 1/30/2018

This course is consistent with Montgomery County Community College's mission. It was developed, approved and will be delivered in full compliance with the policies and procedures established by the College.