

<b>Course Title</b>	: The Process of Science
<b>Course Code</b>	: CCC8013 (starting 2019-20)/CLD9022 (for offering in 2017-18 and/or 2018-19 as a trial course, with the restriction that first-year students of 2018-19 be disallowed to take it as a cluster course)
<b>Recommended Study Year</b>	: Year 2 (as a common core course)/Nil as a cluster course
<b>No. of Credits/Term</b>	: 3
<b>Mode of Tuition</b>	: Lecture-tutorial mode
<b>Class Contact Hours</b>	: 1.5 hours lecture each week 1.5 hours lab/tutorial each week
<b>Category</b>	: Common Core Curriculum
<b>Discipline</b>	: Nil
<b>Prerequisite</b>	: Nil
<b>Co-requisite</b>	: Nil
<b>Exclusion</b>	: Nil
<b>Exemption Requirement</b>	: Nil

### **Brief Course Description:**

This course will introduce students to the process of science and the role that science plays in today's world. Students will meet twice per week in two 1.5 hour blocks, that will take two thrusts—lecture and tutorial/lab. The lecture portion will develop the students' understanding of how science works, the role of science in the world, and introduce some of the great challenges in science and technology facing the human population today. Instructional methods will include lectures, short videos, small group class activities, and individual reflection and writing. The lab portion will introduce students to the process of science and allow them to conduct their own independent research project. Where appropriate, this course will use technology to allow “flipped classrooms”.

### **Aims:**

The aims of this course are to introduce students to the process of science and give them an appreciation of the power, and limitations, of science as a way of learning about the world. In addition, this course will examine the role of science in helping to address many of the global challenges facing us today.

### **Learning Outcomes (LOs):**

Upon completion of this course, students will be able to:

1. Define science and compare/contrast it to other ways of learning about the world.
2. Successfully apply the “hypothesis testing protocol”.
3. Discuss when and why scientists use statistics to help test hypotheses and correctly apply the appropriate statistical analysis.
4. Design, conduct, analyze, and report on the results of an independent research project.
5. Discuss examples of how proper use or misuse of science can affect society.
6. Discuss the role of science in solving grand/global challenges.

**Indicative Content:**

Scientific methods

Experimental design/hypothesis testing

Basic statistical analyses

History of science

- E.g., Western, Asian, Middle Eastern, Mayan

Scientific revolutions

- E.g., Copernican, Darwinian, Plate tectonics, Molecular genetics

Pseudoscience and mistrust of science

- E.g., Anti-vaccination controversy

Big data

- Personalized medicine

Mathematical reasoning in science

Global climate change

Grand/global challenges in science and technology

**Teaching Method:**

Students will meet once each week for one and a half hours of lecture (large lecture hall) and once per week for one and a half hours in small (approx. 20 students) lab/tutorial sessions.

**Measurement of Learning Outcomes:**

Intended Learning Outcomes

Assessment Method	1	2	3	4	5	6
Midterm Exam (Lec)	X				X	X
Final Writing Assignment (Lec)	X				X	X
Quizzes (Lab and Lecture)		X	X		X	X
Lab Exam (Lab)		X	X			
Research Project (Lab)		X		X		
Research Report (Lab)		X		X		
Debates	X		X		X	X

**Course Assessment:**

Writing Assignments	15%
Debates	5%
Lecture Quizzes and Assignments (in class and online)	15%
Lecture Midterm Exam	10%
Lab Quizzes and Assignments (in class and online)	20%
Lab Exam	10%
Group Research Project (includes peer evaluation)	5%
Individual Research Report	20%

**Lab Research Projects**

Lab projects will attempt to (1) focus on topics familiar and interesting to students, (2) address topics that provide meaningful and interesting questions based on a basic understanding of relevant theory, (3) allows for low-tech data collection, or (4) allows students to work with large currently-existing data sets.

**Essential Readings:**

The Scientific Endeavor: A Primer on Scientific Principles and Practice. 2000. J. A. Lee.  
The Process of Science. 2004. M. A. McGinley.

**Supplementary Readings:**

Supplementary Readings from a variety of sources will be uploaded on moodle.

**“Students shall be aware of the University regulations about dishonest practice in course work and the possible consequences as stipulated in the Regulations Governing University Examinations.”**

## **Tentative Course Outline (lecture portion)**

Week 1. Introduction

Week 2. What is science? Difference between science and other ways of learning about the world.

Week 3. Evaluating scientific research.... Examples of good and poor studies.

Week 4. A brief History of Science. West, Americas, Middle East, China

Week 5. Scientific Revolutions

Week 6. Science gone wrong- pseudoscience

Week 7. Science gone wrong- antivax and superbugs

Week 8. Mathematical Reasoning in Science

- Climate Change models and Global Climate Change

Week 9. Big Data and Medicine

Week 10. Science and complex systems

Week 11. Artificial Intelligence

Week 12. Grand Challenges in Science and Technology

Week 13. Grand Challenges in Science and Technology

## **Tentative Course Outline (tutorial/lab portion)**

Week 1. Introduction and Fun Introductory exercise (divining for water, ESP, etc.)

Week 2. Introduction to Data and Hypothesis Testing Protocol

Week 3. Conduct small studies to focus on summarizing data and applying Hypothesis testing protocol

Week 4. Introduction to hypothesis testing- coin flipping exercise

Week 5. Introduction to statistics- t-test and regression

Week 6. Introduction to statistics- Chi square test- application of statistical tests

Week 7. Conduct Investigations- Guided Group Projects

Week 8. Conduct Independent Investigations

Week 9. Conduct Independent Investigations

Week 10. Conduct Independent Investigations: writing a scientific research paper

Week 11. Conduct Independent Investigations

Week 12. Research Presentations

Week 13. Research Presentations