

### 1. Identification Data:

Name of the course:	<b>Philosophy of Science</b>
Total guided time (theory and practice):	<b>40 hours</b>
Guided time per week:	<b>2 hours</b>
Self-study time:	<b>20 hours</b>
Modality:	<b>Non-scholarized</b>
Number and type of academic period:	<b>1° semesters</b>
Type of course	<b>Mandatory</b>
Cycle:	<b>First</b>
Curricular Area:	<b>Introductory to the profession initial training (ACFI-IP)</b>
Credits UANL:	<b>2</b>
Date created:	<b>05/03/2021</b>
Authors:	<b>M.C. Alejandra E. Arreola Triana Dra. Diana E. Caballero Hernández</b>
Date or most recent actualization:	<b>Does not apply</b>
Authors of actualization:	<b>Does not apply</b>

### 2. Presentation:

The Philosophy of Science Learning Unit is a set of knowledge, skills and argumentative and reflective practices through which the student learns to discern the concept, role and social utility of science. To achieve this, it will rely on epistemology as a way to reach true knowledge; This is so that the student himself supports an adequate organization for the development of a scientific work, using the appropriate method to contribute to subsequent field work and analysis of the information obtained in order to generate new knowledge.



Universidad Autónoma de Nuevo León  
College of Biological Sciences  
Biology; Chemistry, Bacteriology and  
Parasitology; Food Science; Genomic  
Biotechnology  
Analytic Program



In stage 1 "Epistemological foundations of science" the concepts of science, knowledge, induction and deduction, among others, are introduced, which will lay the foundations to identify the main philosophical currents of science. Philosophical problems pertinent to the biological sciences are also specifically discussed.

In stage 2 "The scientific method", the axioms of naturalism are presented, which are the foundation of the scientific method. The steps that make up the scientific method are also discussed, and a critical review of it is carried out, including the cognitive biases and methodological limitations that are present in scientific practice.

In stage 3 "Science and Pseudoscience", the demarcations of the different types of knowledge that are used in daily life are defined. Proto-sciences, pseudoscience, marginal and pathological sciences are discussed. The ways in which the adoption of beliefs in a context of structural epistemic injustices affects the social appropriation of scientific knowledge are examined.

The knowledge acquired in these three phases will lead the student to analyze and contrast the methods and tools of science and pseudoscience, and to explain how the cultural and educational background of society influences the appropriation or not of scientific knowledge.

### 3. Purpose:

The purpose of the learning unit (UA) is for the student to identify the philosophical and epistemological foundations of science and use the knowledge to evaluate and solve social problems with a more appropriate criterion. Philosophy of science is contextualized in the area of natural sciences and applies the steps of the scientific method to understand the interaction of living beings with the environment, this in order to intervene effectively in the face of the challenges of contemporary society in the local and global with a critical attitude and human, academic and professional commitment to contribute to consolidating the general well-being and sustainable development. The epistemological foundations of science applied to the natural sciences allow timely and pertinent decision making in the personal, academic and professional fields, which will help the student to understand, interpret and express ideas, feelings, theories and currents of thought .

This UA contributes to the UA of Comprehensive Biology Laboratory and Comprehensive Chemistry Laboratory, as it provides the student with the philosophical foundations to understand the scientific method used in natural and exact sciences and provides tools to reach conclusions based on empirical evidence. Likewise, it requires the knowledge seen in the UA Philosophy of the UANL baccalaureate since it provides the bases of philosophical reflection and its foundations.

This UA contributes to the general competences of the UANL by giving the student the epistemological tools to use a broad, correct and pertinent language in the natural sciences (4.1.1) and the philosophical bases to accept and respect cultural and social diversity (9.1 .3). In addition, it allows you to assume leadership by promoting consensus among team members in the collaborating project



(13.1.3). It also pays for specific competencies, as it provides philosophical bases to propose strategies for the conservation, management and sustainable use of populations and ecosystems at the regional, state and national level based on biological processes at the different levels of organization, in accordance with social needs. and economic within the legal framework to increase economic benefits to human populations through the administration of natural resources (Esp. 3). **4. Competencias del perfil de egreso:**

Competencias generales a las que contribuye esta unidad de aprendizaje:

**Instrumental competencies:**

4. Mastering their mother tongue in oral and written form with correctness, relevance, timeliness and ethics, adapting their message to the situation or context, for the transmission of ideas and scientific findings.

**Personal and social interaction competencies:**

9. Maintain an attitude of commitment and respect towards the diversity of social and cultural practices that reaffirm the principle of integration in the local, national and international context in order to promote environments of peaceful coexistence.

**Integrative competencies:**

13. Assume leadership committed to social and professional needs to promote relevant social change.

**Specific contributes that the course contributes:**

3.- Proponer estrategias de conservación, manejo y uso sustentable de poblaciones y ecosistemas a nivel regional, estatal y nacional con base en los procesos biológicos a los distintos niveles de organización, de acuerdo con las necesidades sociales y económicas dentro del marco legal para incrementar beneficios económicos a las poblaciones del ser humano mediante administración de los recursos naturales.

**5. Phase structure:**

**Phase 1. Epistemological foundation of science.**

Competency: Define the epistemological foundations of science to examine the main philosophical currents

Evidences	Performance Criteria	Activities	Content	Resources
<p>1. Timeline of notable figures in the philosophy of science</p>	<ul style="list-style-type: none"> <li>● Identify the philosophical theories of science.</li> <li>● Identify the main representatives or exponents of the philosophy of science.</li> <li>● Include a picture of the exponents or representatives.</li> <li>● Describe as a biography the year of birth and death and main contribution of the exponent or representative.</li> <li>● Includes the following philosophers: Aristotle, Francis Bacon, Rene Descartes, Pierre Duhem, Carl Hempel, Karl Popper, Thomas Kuhn, Paul Feyerabend, Evelyn Fox Keller, Elliot Sober, and Nancy Cartwright</li> <li>● Create the timeline in Publisher, Canva, Genialy,</li> </ul>	<ul style="list-style-type: none"> <li>● ● The teacher introduces the UA by presenting the analytical program.</li> <li>● ● Students participate in a group discussion (2-4-all) where epistemological terms are defined. (Breakout rooms and Nearpod / Ideaboardz)</li> <li>● ● The student performs the weighted activity 1.1 Glossary of terms as a team</li> <li>● ● Students participate in a “world café” where concepts and examples of different philosophical currents are discussed (Nearpod)</li> <li>● ● Students in small groups, discuss the philosophical concepts involved in each area of biology (world café)</li> </ul>	<p>Epistemological foundations</p> <ul style="list-style-type: none"> <li>● Epistemology</li> <li>● Science</li> <li>● Empiricism</li> <li>● Deduction</li> <li>● Induction</li> <li>● Parsimony</li> <li>● Demarcation</li> <li>● Scientific Revolution</li> </ul> <p>Main philosophical currents of science</p> <ul style="list-style-type: none"> <li>● Empiricism</li> <li>● Logical positivism</li> <li>● Rationalism</li> <li>● Reductionism</li> </ul>	<ul style="list-style-type: none"> <li>● Presentations, Sway,</li> <li>● Explanatory videos.</li> <li>● Readings and presentations in PDF file</li> <li>● Virtual Teams classroom and small group classrooms (Breakout rooms)</li> <li>● Collaborative applications: Ideaboardz, Nearpod, Teams, Mentimeter, Mural, etc.</li> <li>● Assessment instruments and rubrics</li> </ul>

	<p>Inkscape, or another similar tool.</p> <ul style="list-style-type: none"> <li>• Delivery through the Teams platform.</li> </ul>	<p>(Breakout rooms and Nearpod)</p> <ul style="list-style-type: none"> <li>• The teacher facilitates and organizes the presentation or closing activities</li> <li>• The student individually presents the theoretical exam of phase 1 (Forms)</li> </ul>	<ul style="list-style-type: none"> <li>• Naturalism</li> </ul> <p>The philosophy of biology</p> <ul style="list-style-type: none"> <li>• Conceptual bases</li> <li>• Philosophy of evolutionary biology</li> <li>• Philosophy of systematic biology</li> <li>• Philosophy of molecular biology</li> <li>• Philosophy of developmental biology</li> <li>• Philosophy of Ecology and Conservation Biology</li> </ul>	
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## Phase 2. The Scientific Method

Competency: Interpret the axioms of naturalism and its relationship with the scientific method to identify the criticisms made of the method

Evidences	Performance Criteria	Activities	Content	Resources
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<p>2. Flow diagram of the scientific method</p>	<ul style="list-style-type: none"> <li>● Represents graphically the order of the steps of the scientific method.</li> <li>● Define and present an example of each step.</li> <li>● Indicates when biases or other errors may occur in the process, describes them, and presents alternative solutions.</li> <li>● Use tools such as Mindmeister, Ludichart, Creatly, Wireflow, Publisher, Powerpoint, or other design tools.</li> <li>● Includes information for all team members.</li> <li>● Delivery on Teams platform</li> </ul>	<ul style="list-style-type: none"> <li>● ● Students discuss the axioms of naturalism in small groups and challenge them using TRIZ mechanics or wicked questions. (Breakout rooms and Mural)</li> <li>● ● The teacher leads a group brainstorming to recap the steps of the scientific method</li> <li>● ● Students in groups (1-2-4-All), discuss criticism of science and the scientific method (Breakout rooms)</li> <li>● ● The teacher facilitates and organizes the presentation or closing activities</li> <li>● ● The student individually presents the theoretical exam of phase 2 (Forms)</li> </ul>	<p>The axioms of naturalism</p> <p>The scientific method</p> <ul style="list-style-type: none"> <li>● Question</li> <li>● Observation</li> <li>● Formulation of the hypothesis</li> <li>● Experimentation</li> <li>● Data analysis</li> <li>● Hypotheses, theories, and laws</li> </ul> <p>Criticisms of the scientific method and science:</p> <ul style="list-style-type: none"> <li>● Popper</li> <li>● Feyerabend</li> <li>● Meta-science</li> <li>● Objectivity</li> </ul>	<p>Presentations, Sway,</p> <ul style="list-style-type: none"> <li>● Explanatory videos.</li> <li>● Readings and presentations in PDF file</li> <li>● Virtual Teams classroom and small group classrooms (Breakout rooms)</li> <li>● Collaborative applications: Ideboardz, Nearpod, Teams, Mentimeter, Mural, etc.</li> <li>● Assessment instruments and rubrics</li> </ul>
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			<ul style="list-style-type: none"> <li>● Biases             <ul style="list-style-type: none"> <li>○ Cognitive</li> <li>○ of race</li> <li>○ Gender</li> <li>○ Publication</li> </ul> </li> <li>● Reproducibility crisis</li> <li>● Serendipity</li> </ul>	
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### Phase 3. Science and Pseudoscience

Competency: Distinguish scientific knowledge from other demarcations to contrast science and pseudoscience

Evidences	Performance Criteria	Activities	Contents	Resources
	<ul style="list-style-type: none"> <li>● Briefly describe each type of knowledge</li> <li>● Exemplify each one.</li> </ul>	<ul style="list-style-type: none"> <li>● ● Students brainstorm in small groups about the</li> </ul>	Types of knowledge <ul style="list-style-type: none"> <li>● Empirical</li> </ul>	Presentations, Sway,

<p>3. Infographic about types of knowledge</p>	<ul style="list-style-type: none"> <li>• Includes a representative image of each type of knowledge.</li> <li>• Use tools like Genially, Canva, Publisher, etc.</li> <li>• Includes identification data of team members</li> <li>• Reference the bibliography used in APA 7th edition format.</li> <li>• Delivery through Teams.</li> </ul>	<p>distinctive characteristics of different types of knowledge, presenting examples of each. (Breakout rooms and Ideboardz)</p> <ul style="list-style-type: none"> <li>• Students in small groups (1-2-4-All) discuss why pseudoscience is believed and analyze the role of epistemic justice in these beliefs. (Breakout rooms and Mural)</li> <li>• Students, through the dynamics of wicked questions, analyze how to combine different types of knowledge and demarcations to achieve a social appropriation of knowledge (Breakout rooms and Mural / Nearpod)</li> <li>• The teacher facilitates and organizes the presentation or closing activities</li> </ul>	<ul style="list-style-type: none"> <li>• Scientific</li> <li>• Philosophical</li> <li>• Theological</li> </ul> <p>Pseudoscience Pathological science Fringe science Proto-science</p> <p>Why do we believe in pseudoscience?</p> <p>Epistemic justice and injustice</p> <p>Social appropriation of knowledge</p>	<ul style="list-style-type: none"> <li>• Explanatory videos.</li> <li>• Readings and presentations in PDF file</li> <li>• Virtual Teams classroom and small group classrooms (Breakout rooms)</li> <li>• Collaborative applications: Ideboardz, Nearpod, Teams, Mentimeter, Mural, etc.</li> <li>• Assessment instruments and rubrics</li> </ul>
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		<ul style="list-style-type: none"> <li>The student individually presents the theoretical exam of phase 3 (Forms)</li> </ul>		
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**6. Evaluación de los aprendizajes:**

PHASE I		Ponderación
<b>EVIDENCE</b>	Evidence 1. Timeline	4%
<b>GRADED ACTIVITY</b>	Glossary	4%
<b>EXAM</b>	Theoric exam	18%
<b>SUBTOTAL</b>		26%
PHASE II		
<b>EVIDENCE</b>	Evidence 2. Flow Chart of the scientific method	7%
<b>EXAM</b>	Theoric exam	18%
<b>SUBTOTAL</b>		25%
PHASE III		

<b>EVIDENCE</b>	Evidence 3. Infographic about types of knowledge	<b>10%</b>
<b>EXAM</b>	Theoric exam	<b>19%</b>
<b>SUBTOTAL</b>		<b>29%</b>
Integrative Product (PIA)		<b>20%</b>
<b>TOTAL</b>		<b>100%</b>

### 7. Integrative Product (PIA):

Comparison between a science and a pseudoscience, identifying why pseudoscience are identified as such.

### 8. Bibliography:

- Bunge, Mario. (2018.) *La ciencia: su método y su filosofía*. Vol. 1. Laetoli,
- Stanford Encyclopedia of Philosophy. (2021). Stanford Encyclopedia of Philosophy. Recuperado de <https://plato.stanford.edu/index.html>
- Science and Pseudo-science. Stanford Encyclopedia of Philosophy. *Science and Pseudo-Science*. (2017, April 11). Stanford Encyclopedia of Philosophy. <https://plato.stanford.edu/entries/pseudo-science/>
- Jiménez Lozano, Blanca (1994). Epistemología y métodos de las ciencias. *Perfiles Educativos*, (63), Disponible en: <https://www.redalyc.org/articulo.oa?id=132/13206307>
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- Popper, Karl. (2011). *La lógica de la investigación científica*. <https://www.redalyc.org/pdf/844/84421585014.pdf>
- Quine, W. V. O. (2001) *Palabra y objeto*. Ed. Herder.
- Rivadulla, Andrés. *La filosofía de la ciencia hoy. Problemas y posiciones*. <https://www.ucm.es/data/cont/docs/481-2013-10-14-filocien.pdf>



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- Sagan, Carl, and Dolores Udina. (1997). *El mundo y sus demonios*. Barcelona: Planeta.

*Note. The readings and topics may be subject to change*