

A History of Science in Latin America (INTD290): Unit 0.1

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Course Introduction

1. Examination of the syllabus
2. ***What is science?*** Group activity in a moment.
3. Inaugural version of the course
4. Connections 2, Culture 3
5. Logistics made necessary by the pandemic
6. Creating quality writing with outlines, and Coggle.it
7. Introduce terminology

What is Science?

What is Science?

Have you ever been doing science or math homework, and someone asked you what you were doing? Have you ever attempted to explain to a family member your courses or major? ... *breakout rooms*

1. How did you answer?
2. What about your behavior indicated to someone that you were *performing* scientific activity?
3. If a person on a park bench left behind their backpack, and you had to examine its contents, how would you know this was a scientist or mathematician?

What is Science?

Components for **humans** to perform science

Move items from the lefthand list to the right. ... *breakout rooms.*

- Collections of data
- Specimens from nature
- Formulation of a hypothesis 1. ...
- A general paradigm 2. ...
- Instruments for making measurements 3. ...
- The five senses 4. ...
- A system of writing 5. ...
- A system of numbers
- A group of scientists

What is Science?

Determine the items at left at work in the following events:

... breakout rooms.

- Collections of data
- Specimens from nature
- Formulation of a hypothesis
- A general paradigm
- Instruments for making measurements
- The five senses
- A system of writing
- A system of numbers
- A group of scientists

Determine the items at left at work in the following events:

1. Galileo determining that objects fall at the same rate regardless of mass
2. Aztec doctors determining that chinaberry bark cures syphilis

What is Science?

Determine the items at left at work in the following events:
... *breakout rooms*.

- Collections of data
 - Specimens from nature
 - Formulation of a hypothesis
 - A general paradigm
 - Instruments for making measurements
 - The five senses
 - A system of writing
 - A system of numbers
 - A group of scientists
- 1. Incan accountants devising *quipu* knots to record taxation information in their Andean provinces^a
 - 2. Aztec doctors determining that chinaberry bark cures syphilis
-

^aIs this science? If not, what is it?

What is Science?

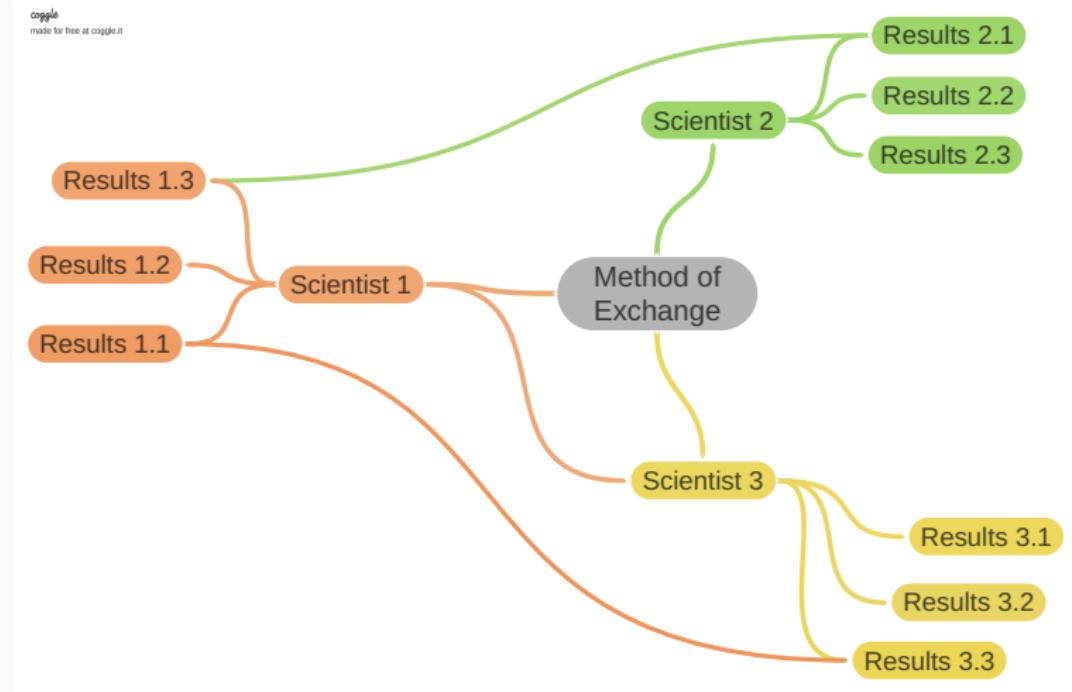


Figure 1: An imperfect method of exchange in a scientific community.

What is Science?

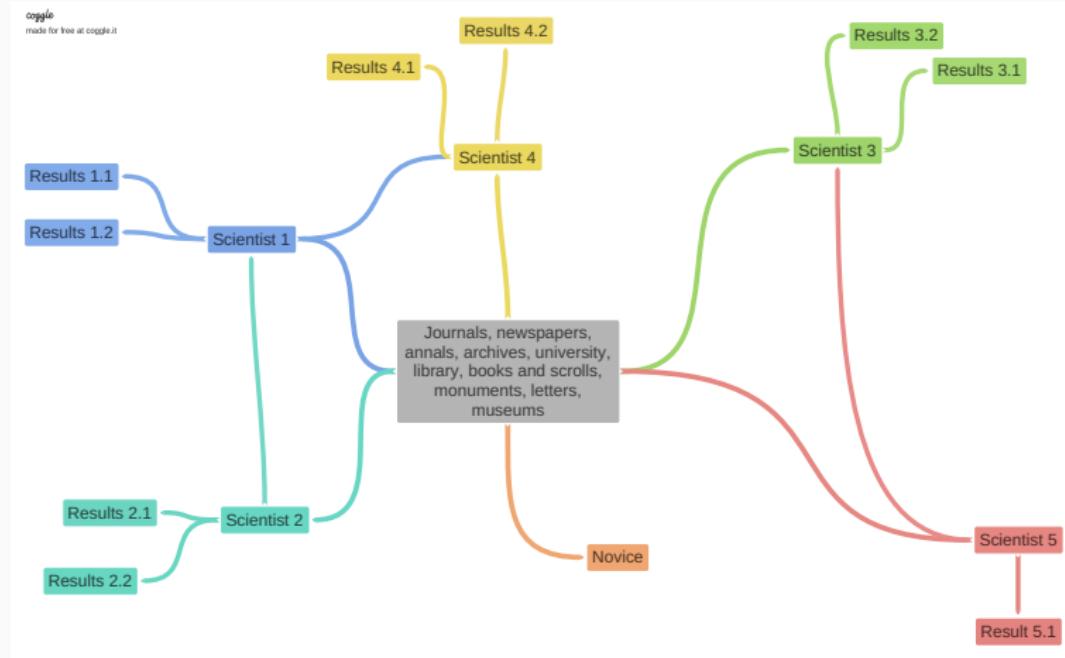


Figure 2: A (less) imperfect method of exchange in a scientific community.

What is Science?

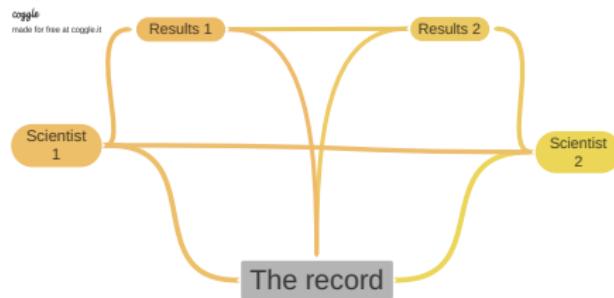


Figure 3: An ideal method of exchange in a scientific community.

Do we reach this in the modern era?

1. Traditions of physics in the United States, Russia, and China
2. The internet, computation and large data sets
3. Open-source technologies and strategies
4. Economic trends

Is Science True?

Is Science True?

Determine which of the following questions can be answered scientifically, and add them to the list at right ... *breakout rooms.*

- What is the nature of time?
- What colors are present in sunlight?
- Given market demand, at what price should we sell our milk? 1. ...
- What is the speed of sound in a particular substance? 2. ...
- Are these two individuals related? 3. ...
- Are these two individuals in love? 4. ...
- What is the arrangement of the Earth, stars, and planets?

Is Science True?

For each question we claim is answerable with the scientific method, think about how we rely on our senses.

What colors are present in sunlight? Using a prism, we can tease apart the different frequencies of light wave in regular sunlight.

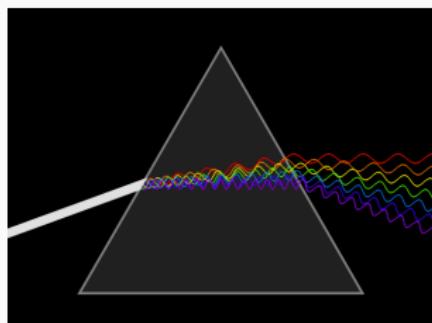


Figure 4: A prism has an index of refraction that depends on the frequency of the light.

Is Science True?

For each question we claim is answerable with the scientific method, think about how we rely on our senses.

What colors are present in sunlight?

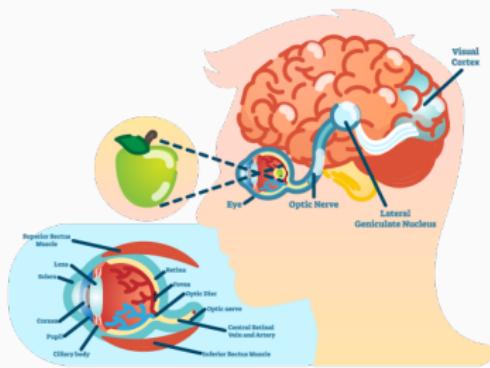


Figure 5: However, the light is still something you perceive with your eyes. The eyes are merely producing electrical signals after focusing the light.

Is Science True?

For each question we claim is answerable with the scientific method, think about how we rely on our senses.

What colors are present in sunlight?



Figure 6: And if your eyes are optical devices that produce electrical signals, how do you know that the actual universe appears the way you think it does? Is it possible that the signals that serve as input to your perception are from somewhere else? The matrix ...

Is Science True?

For each question we claim is answerable with the scientific method, think about how we rely on our senses.

What colors are present in sunlight?



Figure 7: In this film, the matrix is a complex system delivering electrical signals to the brains and nervous systems of captive human beings. They have to realize that reality is actually a simulation.

Is Science True?

For each question we claim is answerable with the scientific method, think about how we rely on our senses.

What colors are present in sunlight?



Figure 8: A portrait of René Descartes, French philosopher, mathematician, and scientist, 1596-1650. You will read about the *Cartesians*, or those that follow his philosophical treatises.

Is Science True?

1. *Discourse on the Method*¹

- “I think, therefore I am.” The method of starting with doubt and finding one concrete thing in which to place belief, before moving forward.
- Offers three proofs of the existence of God

2. An appendix to The Discourse was entitled *Geometry*, which unified algebra and geometry. This method of translating geometric areas and volumes into algebraic equations was unique and new at the time. From this moment we get the notion of a coordinate system: Cartesian coordinates
3. Also discussed cosmology, optics, and the psychology of emotions

¹Discours de la Méthode Pour bien conduire sa raison, et chercher la vérité dans les sciences, 1637

Is Science True?

For each question we claim is answerable with the scientific method, think about how we rely on our senses.

Some vocabulary:

1. Epistemology: the theory of the origin of knowledge, distinguishing justified belief from opinion
2. Rationalism: the theory that reason rather than experience is the foundation of certainty in knowledge
3. Empiricism: the theory that all knowledge is derived from sensory experience, stimulated by the rise of experimental science
4. Theology: the study of the nature of God and religious belief, systematically developed

Is Science True?

For each question we claim is answerable with the scientific method, think about how we rely on our senses.

Empiricism: epistemology based on sensory experience.

1. Clearly has implications for experimental science
2. Modern science (physics) is divided into two poles: *theoretical* and *experimental*
3. Mathematics can be grouped into various categories as well (some didn't exist at the time).

Is Science True?

Why does a spring oscillate? Can we predict the motion?

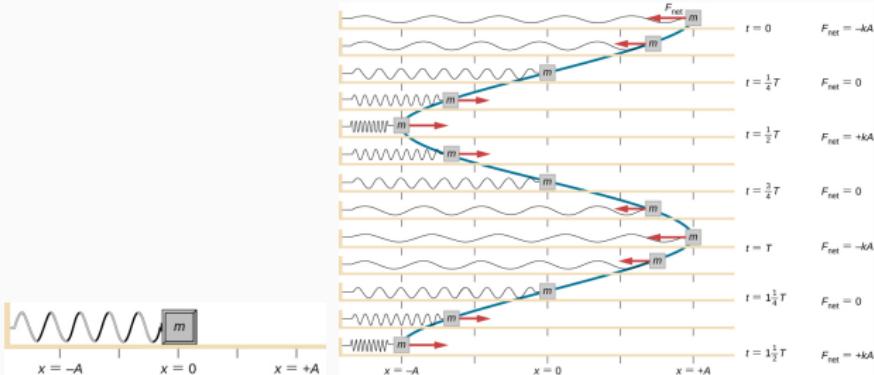


Figure 9: Springs are subject to Hooke's law, which states that the force is linearly proportional to the change in length of a system.

$$F = m\ddot{x} \quad (1)$$

$$x(t) = A \cos(\omega t) \quad (2)$$

Is Science True?

Is this like seeing the future? - topic of *determinism*.

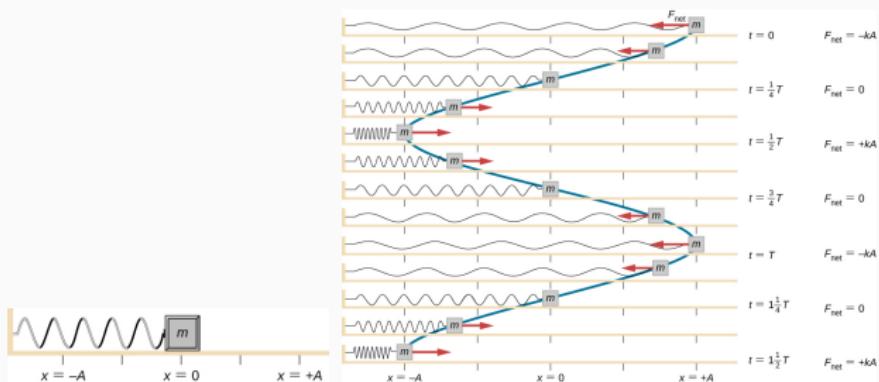


Figure 10: Springs are subject to Hooke's law, which states that the force is linearly proportional to the change in length of a system.

Catholic Terminology

Catholic Terminology

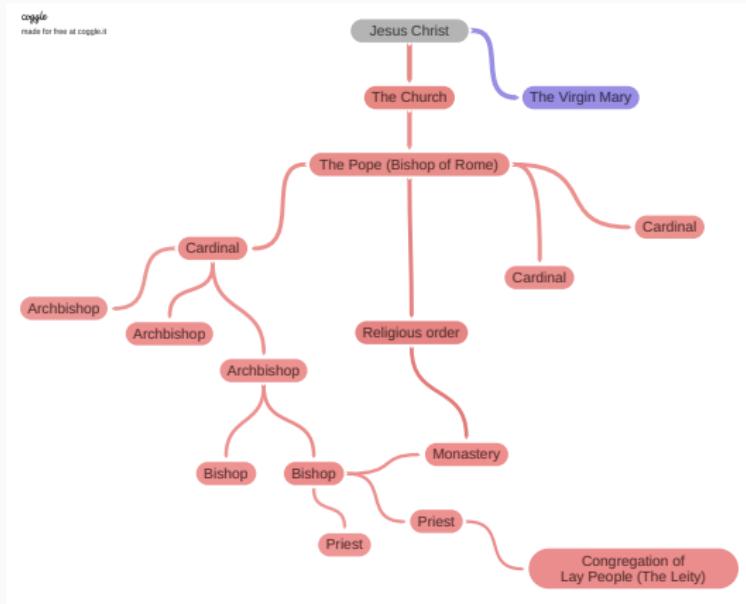


Figure 11: A rough outline of the Catholic Church hierarchy, including *Religious Orders*.

Catholic Terminology

Other Catholic terminology:

1. Diocese: A district under the pastoral care of a bishop. A diocese may have several churches or a cathedral, in which people worship.
2. Monastery: A place where those who have taken religious vows (think monks and nuns) live and work.
3. The Society of Jesus (Jesuits): A religious order that played a significant international role in education
4. The Dominican Order: A religious order primarily known for scholastic tradition and preaching the gospel, dealing with heresy
5. Heresy: When a person spreads an idea counter to the teaching of Christ. For example, the Arian heresy took place in first few centuries in Church history. The Emperor Constantine attempted to settle the question at the Council of Nicea, from which we get the Nicene Creed.

Geographic Terminology

Geographic Terminology



Figure 12: The largest extent of the (northern) Spanish colonies in America, up to 1803.

Geographic Terminology

The four major Spanish *viceroyalties*:

- Virreinato de Nueva España, comprised of former Aztec capital and territory
 1. Capital: Ciudad de México, Tenotchitlan, modern Mexico City
- Virreinato del Perú, comprised of former Incan capital and territory
 1. Capital: Lima, Perú. The original capital of the Incans was Cusco. *Note: Incan empire was the largest in the world at the time.*
- Virreinato de Nueva Granada (from Perú)
 1. Capital: Santa Fe de Bogotá, modern Bogotá, Colombia
 2. Caracas and Quito are also within this province
- Virreinato del Río De la Plata (from Perú)
 1. Capital: Buenos Aires
 2. Modern Argentina, Chile, Bolivia, Paraguay and Uruguay

Geographic Terminology



Figure 13: Virreinato de Nueva España

Geographic Terminology



Figure 14: Virreinato del Perú

Geographic Terminology



Figure 15: Virreinato de Nueva Granada

Geographic Terminology



Figure 16: Virreinato del Río De la Plata

Vocabulary: Nahuatl and Español

Vocabulary

Nahuatl vocabulary. Think Nahuatl is a language of the past? Consider these 8 words:

1. Chocolate (cocoa)
2. Coyote
3. Avocado
4. Tomato
5. Chili
6. Ocelot
7. Axolotl
8. Chipotle



Vocabulary

Nahuatl vocabulary. Think Nahuatl is a language of the past? Consider these 8 words:

1. Chocolate ... chocolate (Esp.) ... chocolātl
2. Cocoa ... cacao (Esp.) ... cacahuatl ... chocolate bean, or peanut?
3. Coyote ... coyote (Esp.) ... coyōtl
4. Avocado ... aguacate (Esp.) ... āhuacatl²
5. Tomato ... tomate (Esp.) ... tomatl
6. Chili ... chile (Esp.) ... chīlli
7. Ocelot ... ocelot (Fr.) ... ōcēlōtl
8. Axolotl (a salamander) ... axolotl
9. Chipotle ... chipotle (Esp.) ... chīlli + pōctli = chīlpōctli. Smoked jalapeño, chile from Xalapa.

²This is also the word for testicle.

Vocabulary

Nahuatl vocabulary³:

1. **Nahua**: main ethnic group indigenous to Mexico. The Aztecs were of Nahua ethnicity. Around 500 BC, settled in the basin in central Mexico.
2. **Nahautl**: a language group of the Nahua
3. **altepetl**: a Nahua city-state within which most individuals were of the same tribe and ethnicity. Sub-unit: **calpolli**.
4. **amoxtli**: a codex or book written in Nahuatl
5. **tlacuilooll**: a painting or stelae
6. **tlacuilo**: one who paints or records, a notary or scribe

³The letter x makes a sound much like the English “h,” as in *México* or *Oaxaca*.

Vocabulary

Nahuatl vocabulary⁴:

1. **Nahuatl list of animals:**

http://www.native-languages.org/nahuatl_animals.htm.

Nota bene: la historia del tecolote y mi suegra. Búho o tecolote?

2. **Abuizotl:** river otter. Cases like these are interesting because the European colonials had likely never encountered such a species. Another example is the Andean condor, a bird of prey called *Vultur gryphus*, an amalgamation of indigenous and latin words. It's not a vulture, but like one, and condor comes from *quechua*.

⁴The letter x makes a sound much like the English “h,” as in *México* or *Oaxaca*.

Vocabulary

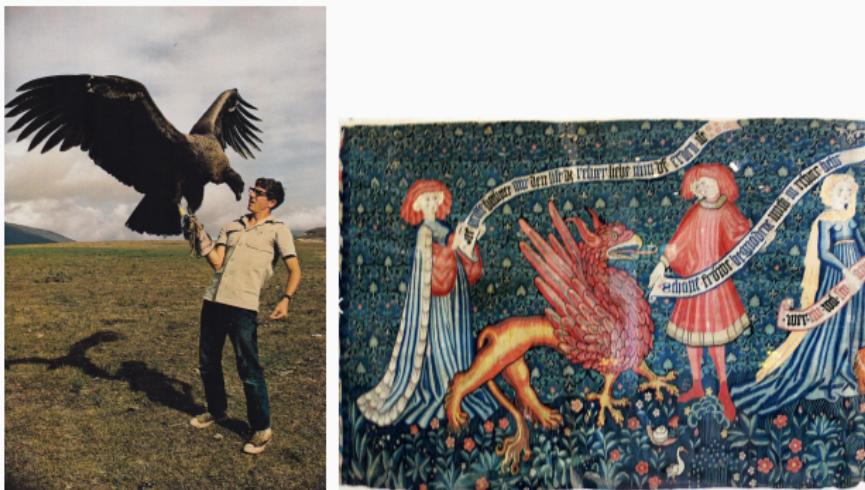


Figure 17: (Left) A California condor to scale with a man. (Right) Colonials compared this creature to a classical griffin.

Language is Bull*t**

Vocabulary

1. **Huitzilin:** hummingbird. A discussion of Linnaean classification and indigenous language will be necessary (see Ch. 1). This species is completely restricted to the New World, so it would have been totally unknown to colonials.

- quetzal huitzilin (a quetzal is not a hummingbird)
- xi huitzilin ... turquoise hummingbird
- chalchi huitzilin ... light green hummingbird
- yiauhlic huitzilin ... purple hummingbird
- tlapal huitzilin ... mixed black hummingbird
- aiopal huitzilin ... light purple hummingbird
- tle huitzilin ... hot coal colored hummingbird
- quapa huitzilin ... tawny yellow hummingbird

The story of hummingbird “resurrection,” that leads to the Nahua belief that hummingbirds are symbols of the warrior and immortality.

Vocabulary



Figure 18: This is a *quetzal*, which is not a hummingbird. Compare to the case of the andean “condor:” *vultur gryphus*.

Vocabulary

1. **Xilo, xiloxochitl:** balsam, balsam tree. A general term for residue extracted from tree matter that has medicinal properties. The word balsam comes from The Balm of Gilead, in the Hebrew Bible (Genesis) for a region currently in Jordan. Why did the Spanish colonials refer to *xilo* as balsam?
2. **tzipipatli:** an herb native to Nueva España used to treat diarrhea. Compare to how the Europeans treated diarrhea. What is to be learned from the different treatments?

Science is not Bull*t**

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Asynchronous activity: number systems, how numbers are represented with a language, number systems of pre-Columbian people