

Midterm - INTD262

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1 Unit 0

1. Offer some reasons why the Spaniards created the *virreinatos* of Nueva España and Perú in their respective locations, with Tenochtitlan and Lima as capital cities.
some reasons why the spaniards created the virreinatos of Nueva España and Perú in their respective locations with Tenochtitlan and Lima as capital cities is because of the people and natural resources already in the cities.
2. Was there a link between the introduction of capitalism and the growth of scientific activity in Latin America, or did the growth of modern science precede capitalism?
They thought the revolutionary effects of science were manifested in the economy and modern science was the result of establishing economy.
3. Given the definition of *peripheral* scientific activity in the Introduction, can you give an example of the creating and transmission of scientific results from the periphery to the center of science?
*Peripheral offered new, specific facets for historical study
An example of the creating and transmission of scientific results from the periphery to the center of science is religion and science.*
4. Give some examples of *pseudo-scientific* beliefs regarding mythical places the colonials sought in the New World.
Mythical places the colonials sought in the new world was fountain of youth, giant, monsters, Milk fountain, etc.
5. Multiple Choice - Nahua scientific activity, first period
 - (a) Which of the following were media through which inhabitants of the Mexica empire recorded scientific observations about the natural world?
 - A: Axolotl (codices) and *huitzitzilin* (paintings, stelae)
 - B: Amoxtl (codices) and *tlacuiloll* (paintings, stelae)
 - C: Tomatl (plume, writing tool) and *altepetl* (city-state)
 - D: Quetzal (plume, writing tool) and *huitzitzilin* (city-state)
 - (b) Using information from *Historia natural y moral de las Indias* (de Acosta), *Historia general y natural de las Indias* (Oviedo), *Décadas del Nuevo Mundo* (Anglería), *Historia de Nueva España* (Hernández), match the European story to the indigenous story or piece of knowledge.
 - (1): Ponce de León and the Fountain of Youth
 - (2): Griffins so large they capture people and calves as prey, with feathers as large as an arm.
 - (3): “A fountain running with hot water and as the water runs it turns to stone.”
 - (4): “fish that as they leave the water turn into butterflies.”
 - (5): “...a monstrous animal, with the face of a fox, a tail of a cercopithecus, ears of a bat, human hands, and feet of a monkey.” Carries young on the belly.

 - A: A flying fish **D**
 - B: A condor **B**
 - C: A mercury mine **C**
 - D: The belief about a certain river among the Lucayo and Carib indigenous **A**
 - E: The Mexican opossum **E**

6. Nahua scientific activity, second period

- (a) Father Bernardino de Sahagún translates from Nahuatl a description of a “tiger” that the indigenous say can do the following: (a) see small things even though there is fog or darkness (b) creates sounds “through the air” to intimidate hunters. What does this writing tell us about the Nahua understanding of physics?
what this tell us about the nahua understanding of phycis is optics, sound phycis to understand the biology of a tiger.

- (b) Why did the Spaniards and Aztec believe that hummingbirds were connected to immortality?

Spaniardr and Aztec believe that humming birds were connected to immortality because humming birds go into a deep hibernation and they look dead, but they comeback in spring, so it's like they reincarnate

7. Suppose the following statement is given: “If someone was born between 1945 and 1991, then they have Strontium-90 in their bones.” Which of the following statements is *deductively valid*?

- Adam was born in 1963. Therefore, Adam has Strontium-90 in his bones
- Eve has Strontium-90 in her bones. Therefore, Eve was born between 1945 and 1991. → **deductively valid**

8. Consider the following passage from Chapter 1 of *The Scientific Attitude*:

In 1981, the state of Arkansas passed Act 590, which required that public school teachers give “balanced treatment” to “creation science” and “evolution science” in the biology classroom. It is clear from the act that religious reasons were not to be offered as support for the truth of creation science, for this would violate federal law. Instead, the curriculum was expected to concentrate only on the “scientific evidence” for creation science. But was there any? And, how precisely was creation science different from creationism?

Explain the arguments used in court to thwart Act 590 the following year.

The argument used in the court to thwart Act 590 the following year was Popper's theory of falsifiability. They convinced the judge that creationism was not science so it had no bearing in the classroom.

9. Thomas Kuhn wrote a famous book entitled *The Structure of Scientific Revolutions* (1962). Rather than describing science as a global accumulation of progress, he argues that, sociologically, scientists move between periods of “puzzle-solving” within an accepted framework and revolution triggered by unavoidable experimental anomalies. (a) Give one example of a scientific revolution, and note the anomaly. (b) Do you think that the colonization of Nueva España triggered a scientific revolution?

a) scientific Revolution: Genetics, DNA

b) I do think the colonization of Nueva España triggered a scientific revolution because they found new observations, data, medicines.

10. Fill in Tab. 1 below, using Fig. 1.

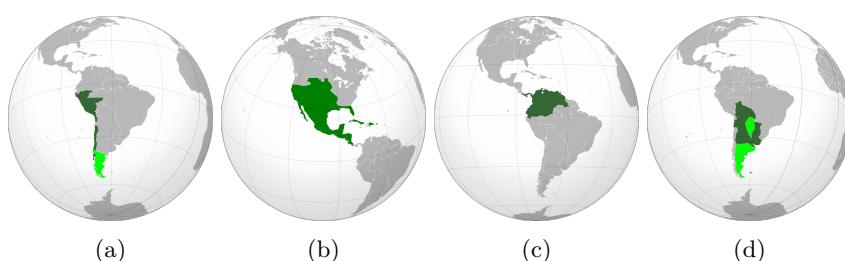


Figure 1: Maps depicting *virreinatos* in Latin America, 17th and 18th centuries.

Map in Fig. 1 (a-d)	Virreinato	Captial
B	Nueva España	Mexico city
C	Nueva Granada	Bogotá
D	Río de la Plata	Buenos Aires
A	Perú	Lima

Table 1: Fill in the missing information.

11. Consider the library of José Ignacio Bartolache. (a) What does the distribution of texts in this library tell us about the scientific attitude of Latin Americans in the 18th Century? (b) What other scientific items did Bartolache own, and what clues does this add to our picture of the scientific attitude in that time and place? (c) Considering these collections were built before 1760, draw a comparison to the state of science in the American colonies (later the United States).

- a) What the distribution of the texts in their library tells us about the scientific attitude of Latin America in the 18th century is that their texts cover various topics in math, medicine, physics, etc.
- b) Scientific items Bartolache owned were scales, microscopes, etc. Given this adds to our picture of the scientific attitude in that time and place in Bartolache's collection and observed work accurately because of the tools used.
- c) Comparing the state of science in the American colonies to 1760 in both terms of developing research necessary tools were used; however, American colonies probably had more developed resources than 1760.

2 Unit 1

1. In Chapter 2 of *The Scientific Attitude*, we encounter the following quote:

Samir Okasha recounts the example of John Couch Adams and Urbain Le Verrier ... they were working (independently) within the Newtonian paradigm and noticed a slight perturbation in the orbit of the planet Uranus.

Newton's Law of Gravity predicts perfectly elliptical orbits for the planets, with no perturbations. Was the law of gravity therefore falsified? What solved the problem in the end?

The law of gravity was somewhat falsified because to explain anomalous orbit not by the strong gravitational force of another planet, but instead by the non-Newtonian idea that the sun's gravitational force could warp the space around it.

2. Bode's Law was an attempted mathematical explanation of the planetary orbits. Bode's sequence was the pattern 0, 3, 6, 12, 24, ..., plus 4 to each, then divide the sequence by 10. The result is 0.4, 0.7, 1.0, 1.6, 2.8, 5.2, 10.0, 19.6, 38.8, 77.2, ... At the time (1772), the radii of the planets from the Sun were 0.387, 0.723, 1.0, 1.524, 5.203, 9.539. Nine years later, Uranus was discovered at 19.18. Twenty years later, the asteroid belt between Mars and Jupiter was discovered at 2.77. Did Bode's Law become a scientific fact because it fit the data?

Bode's law did not become a scientific fact because even though it successfully predicted two new planets it explained nothing and it had no scientific theory for its prediction to confirm.

3. In 1761, Judge Francisco Javier Gamboa created a set of legal and scientific studies that were meant to reform the mining industry, to make it more efficient. Recall some scientific results that he shared within his *Comentarios a las ordenanzas de minas*. What chemicometallurgical technique, important for ore extraction, did he share with The Crown? What institutions did he suggest creating?

The chemicometallurgical technique he shared with the crown was the patio process. Institutions he suggested creating was a school for the teaching of science for miners' children.

4. *El Real Seminario de Minería* was created by Joaquín Velázquez de León, Fausto de Elhúyar, and others. However, several factors might have driven it to bankruptcy. Describe the Mexican efforts to preserve it.

They were able to preserve it by translating texts, becoming professors, and supporting funds.

5. What are the two tenets of the scientific attitude, or ethos, according to the author of *The Scientific Attitude*?

1. We care about Empirical Evidence

2. We are willing to change our theories in light of new evidence.

6. Recall the story of Ignaz Semmelweis and antiseptic handwashing in maternity wards. Discuss how the scientific attitude was applied in this situation.

Semmelweis did not already know the answer to the question of what causes child bed fever; he examined the similarities and differences between the two wards, then learned what he could through observations + controlled experiments. Also when he found the answer he later broadened it and changed his ideas based on the new data.

7. Recall the story of the false discovery of cold fusion. (a) Discuss how the scientific attitude was not applied in this situation. (b) Now select a piece of science from Latin American history that we have encountered thus far, and apply the criteria of the scientific attitude to it.

a) scientific attitude was not applied in this situation because they failed to accept the evidence and instead kept changing the experiment until it proved their theories right.

b) herbal treatments quinine used to treat malaria... chemical compound that belonged to cinchona alkaloids

Good Doctors were knowledgeable of the properties of this herb and experienced with cures.

3 Unit 2

1. (a) In what viceroyalty (Fig. 1) was the city of Santa Fe de Bogotá? (b) Discuss the scientific implications of the “half century-long polemic on Copernican theories, which started in 1773 between José Celestino Mutis and the Dominican Congregation of Santa Fe de Bogotá. (c) In 1783, the Expedición Botánica began in Santa Fe. What were some of its goals and achievements?

a) Santa Fe de Bogotá (Columbia) → Nueva Granada

b) The scientific implication of the half century-long polemic on copernican theories, was astronomy and the solar system (explaining the universe)

c) Some of the goals and achievements were herbal medicine in Bogotá & Borders.

2. (a) In what viceroyalty (Fig. 1) was the city of Caracas? (b) In 1767, the Jesuit order was expelled from the Spanish colonies. The Dominican order recovered authority over some colleges and universities. What was the implication for science?

a) Quito - Peru and Nueva Granada

b) Their goals were to gather and compile information from travelers
in order to stimulate interest in the natural sciences and explore the Colombian coast and understand the borders.

3. What scientific publication was created by José Celestino Mutis?

Reflexiones sobre el sistema tycónico

4. Evaluate the logical truth of this claim: “anti-vaccination campaigns do not have the scientific attitude, therefore these are not scientific endeavors.”

This claim is saying that if something does not have a hypothesis, testing, results, observation, etc. then it is not scientific.

5. Discuss one example we have encountered from our scientific history that should count as science, even though it has not traditionally been considered scientific.

An example is the humming bird specific classification and their physical characteristics and names based on their environmental and evolution factors.

6. In Chapter 3 of *Science in Latin America*, we encounter the following quote:

La Universidad Gregoriana in Quito alone had “seventy-one foreign professors teaching at the university ... Native professors were twenty-one, of whom five were from Loja, four from Quito, three from Guayas, three from Cuenca, three from Riobamba, two from Ibarra, and one from Ambato.” ... As a consequence, it is not strange that in a center of cultural ferment such as Quito, intellectual Jesuits were most closely linked to the Franco-Spanish geodetic mission directed by La Condamine and Jorge Juan.

- (a) What scientific transition began to take place as a result of the interaction between foreign and Ecuadorian professors? (b) What can we infer about the ratio of the native professors at the university? (c) Consider Father Francisco Javier Aguilar, who taught physics and mathematics at Universidad Gregoriana. He taught no less than five world systems, and focused on three: Ptolemaic, Copernican, and Tychonic. What distinguished these?

a) scientific transition that began to take place as a result of the interactions between Foreign and Ecuadorian professors or was they started to include different ways the world was structured (geocentric to heliocentric model of the universe.)

b) what we can infer about the ratio of the native professors at the university is that they had their own thoughts and opinions of how the world is structured.

c) what distinguished these was these systems were formed by scientific spirit.

7. In 1767, Mutis published *Reflexiones sobre el sistema tycónico*. (a) What were the main points of this publication?

(b) Was it considered controversial?

a) He defended Copernican ideas that the earth moved like other planets and how the sun spins.

b) It was considered controversial especially for the Dominicans.

8. When Joaquín Velázquez de León and José de Gálvez arrived in Baja California, they remained there for three years. (a) What types of measurements did they make? (b) How did this improve local knowledge of Nueva España? (c) Velázquez de León communicated with Chappe d'Auteroche that he would help with the Venus transit measurements, and d'Auteroche suggested that Velázquez de León remain in Real de Santa Ana, while

a) the measurement they made was a geographical measurement (distance from the earth and the sun), as well as an astronomical measurement.

b) This improved local knowledge of Nueva España by knowing the borders and boundaries of Mexico (accurate, modern map to build roads, schools, etc.)

c) What happened as a result they were able to conduct their own research on vendor's transit measurements from where in different place which made their results more accurate.

9. What was notable about the explorations of José Sanchez Labrador?

What was notable about the explorations of José Sánchez Labrador was he reopened direct communication between Paragay and Potari.

4 Applications, Mayan and Incan Number Systems

1. Work out the following exercises *using the Mayan system.*

$$\begin{array}{r}
 \text{(a) } 365 + 365 = \\
 \begin{array}{r}
 \bullet = 20 \\
 \overline{-} = 5
 \end{array}
 \quad
 \begin{array}{r}
 18 \times 20^{\circ} = 360 \\
 5 \times 20^{\circ} = 5
 \end{array}
 \quad
 \begin{array}{r}
 365 + 365 = 730 \\
 \hline
 360 + 5 = 365
 \end{array}
 \end{array}$$

$$(b) \quad 1024 - 512 =$$

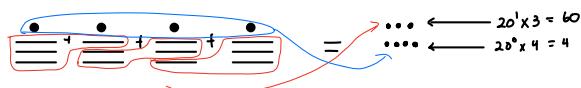
$20^2 = 400 \times 2 = 800$ $20^2 = 400 \times 1 = 400$ \therefore $-$
 $20^0 \times 11 = 220$ $20^0 \times 5 = 100$ \equiv $=$
 $20^0 \times 4 = 4$ $20^0 \times 2 = 12$ \cdots \equiv
 \therefore

2. Work out the following exercises *using the Incan quipu*:

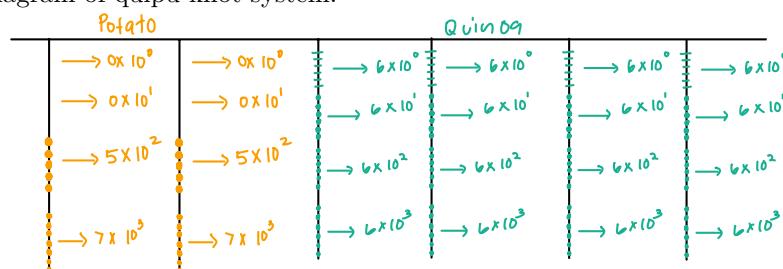
(a) $512 + 256 =$ _____

A logarithmic scale diagram showing values from 512 to 768. The scale is labeled with powers of 10 and scientific notation. A vertical dashed line at 256 is labeled with an arrow pointing right as 6×10^0 .

3. Suppose we are looking for a set of trees tall enough to supply sixteen four-meter beams. Using the Mayan system, create a calculation showing that the total number of beams is sixty-four.



4. Suppose you have six terrace plots in the Andean mountains to use to survive. You and your cohort of fellow Incans decide to grow potatoes and quinoa. Quinoa actually do better at higher altitudes than potatoes. So the plan is to use the two lowest terraces for potatoes, and the upper four for quinoa. Each terrace is 30 meters by 5 meters. A potato plant requires a 0.2 meter by 0.2 meter patch, and a quinoa plant requires a 0.3 meter by 0.3 meter patch. How many potato plants and how many quinoa plants can you plant? Store the results in a diagram of quipu knot system.



$$30 \times 5 = 150 \times 2 = 300 \text{ m} \leftarrow \text{For Potato}$$

$$150 \times 4 = 600 \text{ m} \leftarrow \text{For Quinoa}$$

Potato = $0.2 \times 0.2 = 0.04$ $300 / 0.04 = 7,500$

Quinoa = $0.3 \times 0.3 = 0.09$ $600 / 0.09 = 6,666\frac{2}{3}$

5 Modern Science in Latin America - Gamma Ray Astrophysics

1. What is a gamma-ray?

- A: A charged particle with mass
 - B: A neutral particle with mass
 - C: A quantum of light
 - D: A radio wave

2. What was the purpose of the Milagro experiment?

- A: To observe the direction of incoming gamma-rays
- B: To observe the energy of incoming gamma-rays
- C: To observe the direction and energy of incoming gamma-rays
- D: To observe the charge of incoming gamma-rays

3. What upgrades to the Milagro concept were made that produced the HAWC design?

- A: Using oil instead of water as the detection medium
- B: Increasing the amount of water tanks to improve the sensitivity
- C: Moving the tanks to a higher altitude
- D: Both B and C

4. List some of the discoveries of HAWC and/or Milagro in the field of gamma-ray astrophysics.

some of the discoveries in the field of gamma-ray astrophysics were supernova, pulsars, black holes, etc. and Cherenkov effect in water (water-based detectors and PMTs)

6 Modern Science in Latin America - Cosmic Ray Physics

1. What is the purpose of the Pierre Auger Observatory?

The purpose of the Pierre Auger Observatory is to conduct experiments, observation, etc.

2. What is the typical energy of a cosmic-ray observed at Auger?

- A: 10^{12} eV
- B: 10^{14} eV
- C: 10^{16} eV
- D: 10^{18} eV