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.

The Spaniards created the vierreinatos for many reasons, one of the reasons being they wanted to have more power. This allowed them to have small “governments” in the vierreinatos, which equaled more power. The location of these virreinatos were important as well because in Nueva Espana it became a key center for silver, and so was Peru with the most famous mountain, the silver mines of Potosi. In both locations of Tenochtitlan and Lima was important because the geographic advantages allowed better access to trade routes.

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?

There was a link between the introduction of capitalism and growth in scientific activity. As Silver mining increased many people in Latin America were trying to learn the best way to effectively and efficiently extract silver from the mines. This demand for technological advances in these areas can also be applied to agricultural science. In order to have good crops farmers had to know the science behind growing these crops so they could sell. This required a lot of knowledge about botany, soil science, and irrigation.

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?

An example would be how Mutis studies using quinine from the cinchona tree to treat malaria and sent his findings and specimens to the scientific institution in spain.

4. Give some examples of *pseudo-scientific* beliefs regarding mythical places the colonials sought in the New World.

Some pseudoscience beliefs would be the myth of el dorado, and the fountain of youth that was looked for by Juan Ponce de Leon.

5. **Multiple Choice - Nahua scientific activity, first period**

(a) Which of the following where 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 Españ*a (Hernández), match the European story to the indigenous story or piece of knowledge.

• (1): Ponce de León and the Fountain of Youth

D: The belief about a certain river among the Lucayo and Carib indigenous

• (2): Griffins so large they capture people and calves as prey, with feathers as large as an arm.
• B: A condor

• (3): "A fountain running with hot water and as the water runs it turns to stone." • C: A mercury mine

• (4): "fish that as they leave the water turn into butterflies." • A: A flying fish

• (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.
• E: The Mexican opposum

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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?

This tells us that they are using things that they know about and see in order to make scientific connections to physics. So they understood what was going on, maybe not knowing the actual scientific terms but they used their real life connections to process what was going on.

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

They believed that hummingbirds were connected to immortality because they thought that fallen soldiers would reincarnate as hummingbirds. This is because both the Spaniards and Aztecs admired the traits of the hummingbird, like speed, agility, and resilience. In the aztec culture they had a god named Huitzilopchtli, which literally translated to hummingbird of the south. This god was a god of sun representing the cycles of death and rebirth (sun rising and sun setting)

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. 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?

Creationism was different from creation science because creationism is based more on religious beliefs and creation science wanted to show they were not a religion.

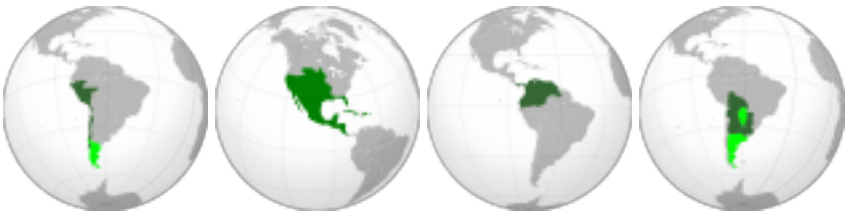
Explain the arguments used in court to thwart Act 590 the following year.

An argument that was used in court was that the curriculum that should be used should involve the scientific evidence for creation science. , and that they should give a “balanced treatment” to creation science and evolution science

9. Thomas Kuhn wrote a famous book entitled *The Structure of Scientific Revolutions* (1962). Rather than de scribing 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?

One of the well known examples of a scientific revolution is the copernican revolution. I would say that the colonization did not trigger a revolution but did trigger a series of scientific advances.

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



(a) (b) (c) (d)

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*	*Bogota*
a	*Río de la Plata*	*potosi*
d	*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).

The text in the library consisted of many different types of books, for example there were books written in latin,

greek, hebrew and other different languages. What this tells us about the scientific attitude is that people were very interested in science, and that there was a lot of influence from the enlightenment which is something that also influenced the American colonies. Bartolache owned different things as well, he owned scientific instruments such as a microscope, magnifying glass and a thermometer.

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 was not falsified because the theorists were working with predictions that were made by the Newton theory. The problem in the end was that force is not caused by another planet but instead it was the sun.

2. **Bode's Law** was an attempted mathematical explanation of the planetary orbits. Bode's sequence was the pat tern 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?

It did not become a scientific fact because it was considered to be more of a numerical coincidence, although some of the numbers are accurate, at a certain point the numbers were not accurate.

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?

A scientific result that he shared in the Comentarios a la ordenanzas de minas was the complete description of the patio process, and he expressed the intention to create a school (institution)for teaching science. The technique that was important was the amalgamation process. Which involved mercury to extract silver from the ore.

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.

In efforts to preserve the seminario de mineria there was a lot of support by the Mexican government, and there were wealthy mine owners who helped in order to keep the seminaro. The miners also tried to preserve it by offering to teach.

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

The first tenet is that someone should be willing to change beliefs based on evidence, and the second tenet is that there should be a prioritization of evidence especially when it comes to accepting or rejecting scientific claims.

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

The scientific attitude was applied in this situation because there was an experiment that took place and there was observation, a hypothesis, and experimentation and data collection. Semmelweis had a willingness to change his beliefs based on the evidence that was found

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.

The scientific attitude was not used in this situation because there was a lack of evidence, and there was no willingness to change beliefs. A piece of Latin American history that we can apply the scientific attitude to would be about herbal medicine. There can be experiments that can be performed in order to test a hypothesis, and keep an open mind while doing this.

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?

Santa fe de bogotá was located in nueva granada. Some scientific implications that this debate had was that it highlighted the role of colonial scholars, and contributed to the eventual spread of modern science in the region. Some of the goals and achievements of the expedition was medicinal plant research, and produced one of the most significant botanical collections of the flora de bogota.

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?

The city of caracas was in the viceroyalty of nueva granada, A implication for science was that there was a decline in scientific education since jesuit institutions were at the forefront of scientific education.

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

The scientific publication that was created by jose celestino mutis was the flora de bogotá o de nueva granada

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

I believe that there are scientific endeavors behind it, the anti vaccination campaigns do not believe in the science behind vaccines.

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.

Something that could be considered science but has not traditionally been considered scientific was astronomy.

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

> *La Universidad Gegoriana* in Quito alone had “seventy-one foreign professors teaching at the uni versity ... 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 Fransisco 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 was as integration of european of scientific knowledge. What we can infer about the ratio is that there would be more foreign professors, and less native professors. What

distinguished these is that some believed that the sun was at the center of the universe and others believed that the earth was at the center of the universe.

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

The main points of this publication was that there was a defense of the tychonic system, and mutis sought to reconcile scientific inquiry with contemporary religious beliefs.

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 d'Auteroche would work in San José del Cabo. What happened as a result?

Measurements that they made were astronomical observations and geographical measurements. This improved local knowledge because it made it easier to govern and develop the religion of nueva espana. Whar happened as a result is that there were scientific collaborations and there were successful astronomical observations.

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

What was notable about the explorations of jose sanchez was that he made significant contributions to the natural history and he was able to interact with indigenous populations.

4 Applications, Mayan and Incan Number Systems

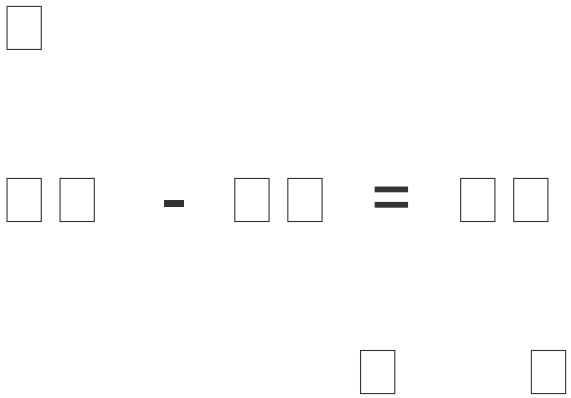
1. Work out the following exercises *using the Mayan system.*

(a) 365 + 365 = □ + □

□ □ = □

□□

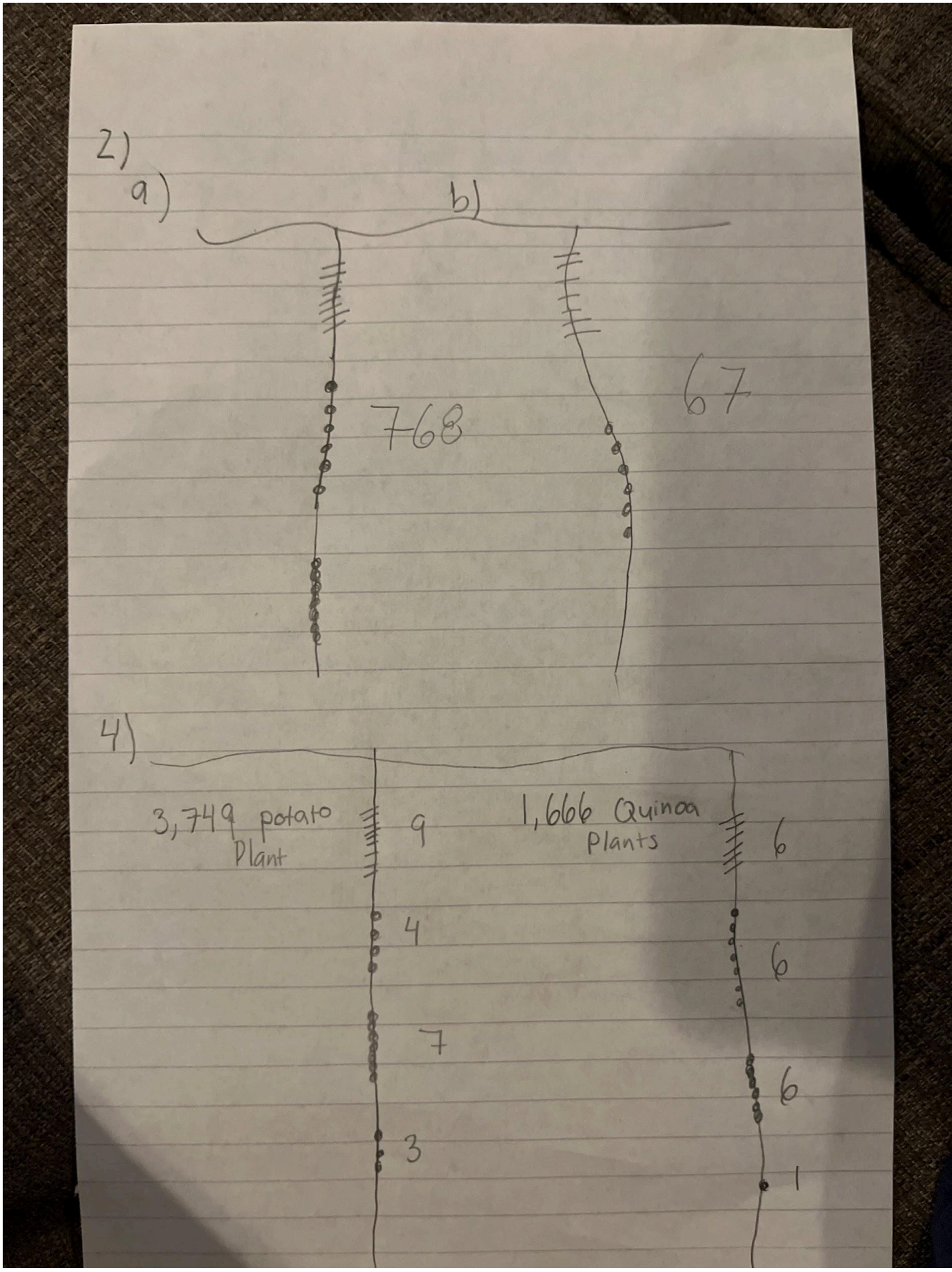
(b) 1024 − 512 =



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

(a) 512 + 256 = 768

(b) 365 − 67 = 67



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 that 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.

5 Modern Science in Lati0000n 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 discoveries that HAWC found was the existence of gamma rays, and the very high energy gamma rays.

There was searches that also could indicate the presence of dark matter.

6 Modern Science in Latin America - Cosmic Ray Physics 1.

What is the purpose of the Pierre Auger Observatory?

The purpose of the PAO is to detect and measure cosmic rays, it measures the energy, composition and arrival direction of the particles so that researchers can see where the origin is.

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