PATEF-UPDATE Mid-year National Convention 2017
"Approaches in Teaching and Assessment for the 21st Century Learning"

Demo-Lec with focus on Assessment (Secondary Level)

Von Anthony G. Torio
Science Educator

Understanding the Curriculum Guide: Physical Science: Earth and Space Science

Von Anthony G. Torio
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K to 12 BASIC EDUCATION CURRICULUM
SENIOR HIGH SCHOOL – CORE SUBJECT

Grade: Grade 11/12
Core Subject Title: Physical Science

No. of Hours/Quarter: 40 hours/quarter
Prerequisite (if needed): None

Core Subject Description: Evolution of our understanding of matter, motion, electricity, magnetism, light, and the universe from ancient times to the present; applications of physics and chemistry concepts in contexts such as atmospheric phenomena, cosmology, astronomy, vision, medical instrumentation, space technology, drugs, sources of energy, pollution and recycling, fitness and health, and cosmetics.

Grade level: 11/12
Subject: Physical Science
Number of hours per quarter: 40 hrs
Pre-requisites: none

K to 12 BASIC EDUCATION CURRICULUM
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Evolution of our understanding of matter, motion, electricity, magnetism, light and the universe from ancient times to present; applications of physics and chemistry concepts in contexts such as atmospheric phenomena, cosmology, astronomy, vision, medical instrumentation, space technology, drugs, sources of energy, pollution and recycling, fitness and health, and cosmetics.

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Competency coding of the Curriculum Guide

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Incomplete code legend for PS ...

Code Book Legend

Sample: S11/12PS-IIIa-1

LEGEND		SAMPLE	
First Entry	Learning Area and Strand/ Subject or Specialization	Science	**S11/12**
	Grade Level	Grade 11/12	
Uppercase Letter/s	Domain/Content/ Component/ Topic	Physical Science	**PS**
			-

LEGEND		SAMPLE	
First Entry	Learning Area and Strand/ Subject or Specialization	Science, Technology, Engineering and Mathematics General Physics	**STEM_GP12EM**
	Grade Level	Grade 12	
Uppercase Letter/s	Domain/Content/ Component/ Topic	Electricity and Magnetism	
			-
Roman Numeral **Zero if no specific quarter*	Quarter	Third Quarter	**III**
Lowercase Letter/s **Put a hyphen (-) in between letters to indicate more than a specific week*	Week	Week 1	**a**
			-
Arabic Number	Competency	Describe using a diagram charging by rubbing and charging by induction	**1**

DOMAIN/ COMPONENT	CODE
Electricity and Magnetism	EM
Optics	OPT
Modern Physics Concepts	MP

code legend from Physics

Sample code...

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SENIOR HIGH SCHOOL – CORE SUBJECT

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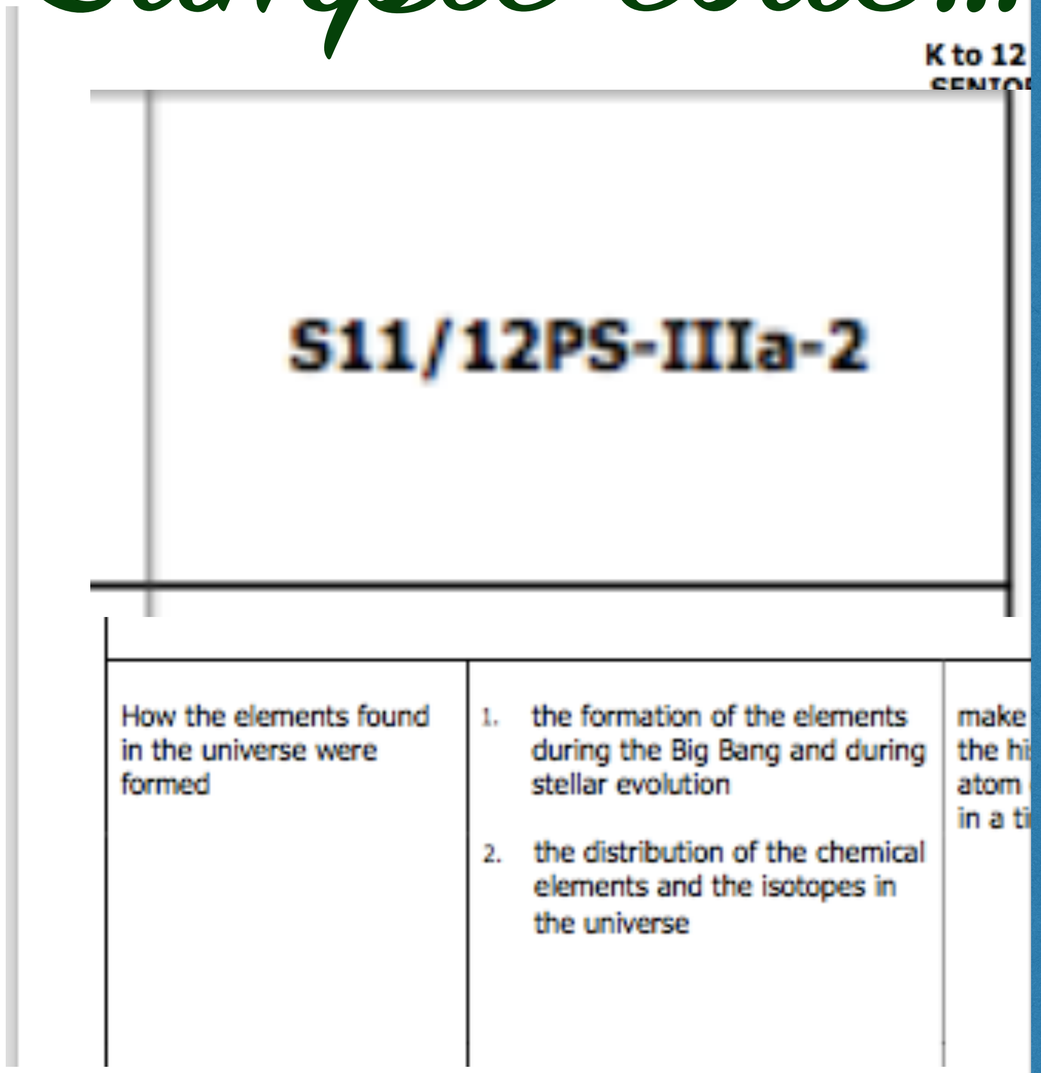
CONTENT	CONTENT STANDARD (The learners demonstrate an understanding of...)	PERFORMANCE STANDARD (The learners...)	LEARNING COMPETENCIES (The learners...)	CODE
QUARTER 3				
How the elements found in the universe were formed	1. the formation of the elements during the Big Bang and during stellar evolution 2. the distribution of the chemical elements and the isotopes in the universe	make a creative representation of the historical development of the atom or the the chemical element in a timeline	1. give evidence for and explain the formation of the light elements in the Big Bang theory (3 hours)	**S11/12PS-IIIa-1**
			2. give evidence for and describe the formation of heavier elements during star formation and evolution	**S11/12PS-IIIa-2**

Sample code...



K to 12

S11/12PS-IIIa-2

How the elements found in the universe were formed	1. the formation of the elements during the Big Bang and during stellar evolution 2. the distribution of the chemical elements and the isotopes in the universe	make the hi atom in a ti

Subject: S: Science

Grade level: 11/12

Quarter: III: 3rd

Week: a: 1

Competency #2

Content Outline: Physical Science: Earth and Space Science

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Content Outline: Physical Science: Earth and Space Science

Number of Content: 2

- **Content 1: How we come to realise that the earth is not the centre of the universe**
- **Content 4: How Physics helps us understand the cosmos**

Number of Competencies: 17 (#s 36-45, 69-75)

Number of weeks: 3

Performance Task: none

Content Outline: Physical Science: Earth and Space Science

Number of Content for Physical Science: 4

Number of weeks per quarter: 10

Number of hours per quarter: 40

Total number of competencies: 40 (for Physics and Earth and Space)

Content Outline: Physical Science: Earth and Space Science

Content 1: How we come to realise that the earth is not the centre of the universe?

Content Standards: *The learners demonstrate an understanding of…*

1) Greek views of matter, motion, and the universe.

2) competing models of the universe by Euxodus, Aristotle, Aristarchus, Ptolemy, Brahe, and Kepler

3) evidence that the earth is not the center of the universe.

Content Outline: Physical Science: Earth and Space Science

Content 1: How we come to realise that the earth is not the centre of the universe?

Competencies: *The learners …*

1. explain what the Greeks considered to be the three types of terrestrial motion.
2. explain what is meant by diurnal motion, annual motion, precession of the equinoxes
3. explain how the Greeks knew that the Earth is spherical

Content Outline: Physical Science: Earth and Space Science

Content 1: How we come to realise that the earth is not the centre of the universe?

Competencies: *The learners …*

4. explain how Plato's problem of "Saving the Appearances" constrained Greek models of the Universe.
5. compare and contrast the models/descriptions of the universe by Euxodus, Aristotle, Aristarchus, Ptolemy, and Copernicus
6. cite examples of astronomical phenomena known to astronomers before the advent of telescopes.

Content Outline: Physical Science: Earth and Space Science

Content 1: How we come to realise that the earth is not the centre of the universe?

Competencies: *The learners …*

7 compare and contrast explanations and models of astronomical phenomena (Copernican, Ptolemaic, and Tychonic).

8 explain how Galileo's astronomical discoveries and observations (lunar craters, phases of Venus, moons of Jupiter, sun spots, supernovas, the apparent identical size of stars as seen through the naked eye, and telescope observations) helped weaken the support for Ptolemaic model.

Content Outline: Physical Science: Earth and Space Science

Content 1: How we come to realise that the earth is not the centre of the universe?

Competencies: *The learners …*

9	explain how Brahe's innovations and extensive collection of data in observational astronomy paved the way for Kepler's discovery of his laws of planetary motion
10	apply Kepler's 3rd law of planetary motion to objects in the solar system.

Content Outline: Physical Science: Physics

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Content Outline: Physical Science: Earth and Space Science

Content 2: Why we believe that the laws of Physics are universal?

Content Standards: *The learners demonstrate an understanding of…*

1) Aristotelean vs Galilean views of motion

2) how Galileo used his discoveries in mechanics (and astronomy) to address scientific objections to the Copernican model

3) Newton's laws of Motion

4) Newton's law of Universal Gravitation

5) mass, momentum, and energy conservation

Content Outline: Physical Science: Earth and Space Science

Content 2: Why we believe that the laws of Physics are universal?

Competencies: *The learners …*

1. compare and contrast the Aristotlian and Galilean conceptions of vertical motion, horizontal motion, and projectile motion.
2. explain how Galileo inferred that objects in vacuum fall with uniform acceleration, and that force is not necessary to sustain horizontal motion.
3. explain how the position vs time, velocity vs time graphs of constant velocity motion are different from those of constant acceleration motion.

Content Outline: Physical Science: Earth and Space Science

Content 2: Why we believe that the laws of Physics are universal?

Competencies: *The learners …*

4 recognize that the everyday usage and the physics usage of the term "acceleration" differ: In physics an object that is slowing down, speeding up, or changing direction is said to be accelerating

5 explain each of Newton's three laws of motion

6 explain the subtle distinction between Newton's 1st law of motion (or law of inertia) and Galileo's assertion that force is not necessary to sustain horizontal motion.

Content Outline: Physical Science: Earth and Space Science

Content 2: Why we believe that the laws of Physics are universal?

Competencies: *The learners …*

7 Use algebra, Newton's 2nd law of motion, and Newton's law of universal gravitation to show that, in the absence of are resistance, objects close to the surface of the Earth fall with identical accelerations independent of their mass.

8 explain the statement "Newton's laws of motion are axioms while Kepler's laws of planetary motion are empirical laws."

Content Outline: Physical Science: Earth and Space Science

Content 2: Why we believe that the laws of Physics are universal?

Competencies: *The learners …*

9 explain the contributions of scientists to our understanding of mass, momentum, and energy conservation.

10 use the law of conservation of momentum to solve one-dimensional collision problems.

Content Outline: Physical Science: Earth and Space Science

Content 3: How light acts as a wave and a particle?

Content Standards: *The learners demonstrate an understanding of…*

none!

Content Outline: Physical Science: Earth and Space Science

Content 3: How light acts as a wave and a particle?

Competencies: *The learners …*

1. describe what happens when light is reflected, refracted, transmitted, and absorbed.
2. explain how Newton and Descartes described the emergence of light in various colors through prisms.
3. cite examples of waves (e.g., water, stadium, sound, string, and light waves)

Content Outline: Physical Science: Earth and Space Science

Content 3: How light acts as a wave and a particle?

Competencies: *The learners …*

4 describe how the propagation of light, reflection, and refraction are explained by the wave model and the particle model of light.

5 explain how the photon theory of light accounts for atomic spectra.

6 explain how the photon concept and the fact that the energy of a photon is directly proportional to its frequency can be used to explain why red light is used in photographic dark rooms, why we get easily sunburned in UV but not in Visible light, and how we see colors.

Content Outline: Physical Science: Earth and Space Science

Content 3: How light acts as a wave and a particle?

Competencies: *The learners …*

7 apply the wavelength-speed-frequency relation

8 describe how Galileo and Roemer contributed to the eventual acceptance of the view that the speed of light is finite.

9 cite experimental evidence showing that electrons can behave like waves.

Content Outline: Physical Science: Earth and Space Science

Content 3: How light acts as a wave and a particle?

Competencies: *The learners …*

10	differentiate dispersion, scattering, interference, and diffraction
11	explain various light phenomena such as: a) your reflection on the concave and convex sides of a spoon looks different. b) mirages. c) light from a red laser passes more easily through red cellophane than green cellophane; d) clothing of certain colors appear different in artificial light and in sunlight; e) haloes, sundaes, primary rainbows, secondary rainbows, and supernumerary bows; f) why clouds are usually white and rainclouds dark; g) why the sky is blue and sunsets are reddish

Content Outline: Physical Science: Earth and Space Science

Content 3: How light acts as a wave and a particle?

Competencies: *The learners …*

12 explain the contributions of Franklin, Coulomb, Oersted, Ampere, Biot-Savart, Faraday, and Maxwell to our understanding of electricity and magnetism.

13 describe how Hertz produced radio pulses.

Content Outline: Physical Science: Earth and Space Science

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Content Outline: Physical Science: Earth and Space Science

Content 4: How Physics helps us understand the cosmos

Content Standards: *The learners demonstrate an understanding of…*

1) Relativity and big bang

2) planets beyond the solar system

Content Outline: Physical Science: Earth and Space Science

Content 4: How Physics helps us understand the cosmos

Content Standards: *The learners demonstrate an understanding of…*

1. explain how special relativity resolved the conflict between Newtonian mechanics and Maxwell's electromagnetic theory
2. explain the consequences of the postulates of special relativity (e.g., relativity of simultaneity, time dilation, length contraction, mass-energy equivalence, and cosmic speed limit)
3. explain the consequences of the postulates of general relativity (e.g., correct predictions of shifts in the orbit of mercury, gravitational bending of light, and black holes)

Content Outline: Physical Science: Earth and Space Science

Content 4: How Physics helps us understand the cosmos

Content Standards: *The learners demonstrate an understanding of…*

4 explain how the speeds and distances of far-off objects are estimated (e.g., Doppler effect and cosmic distance ladder)

5 explain how we know that we live in an expanding universe, which used to be hot and is approximately 14 billion years old.

6 explain how Doppler shifts and transits can be used to detect extra solar planets

Content Outline: Physical Science: Earth and Space Science

Content 4: How Physics helps us understand the cosmos

Content Standards: *The learners demonstrate an understanding of…*

7 explain why pluto was once thought to be a planet but is no longer considered one

Sound Pedagogical Inputs

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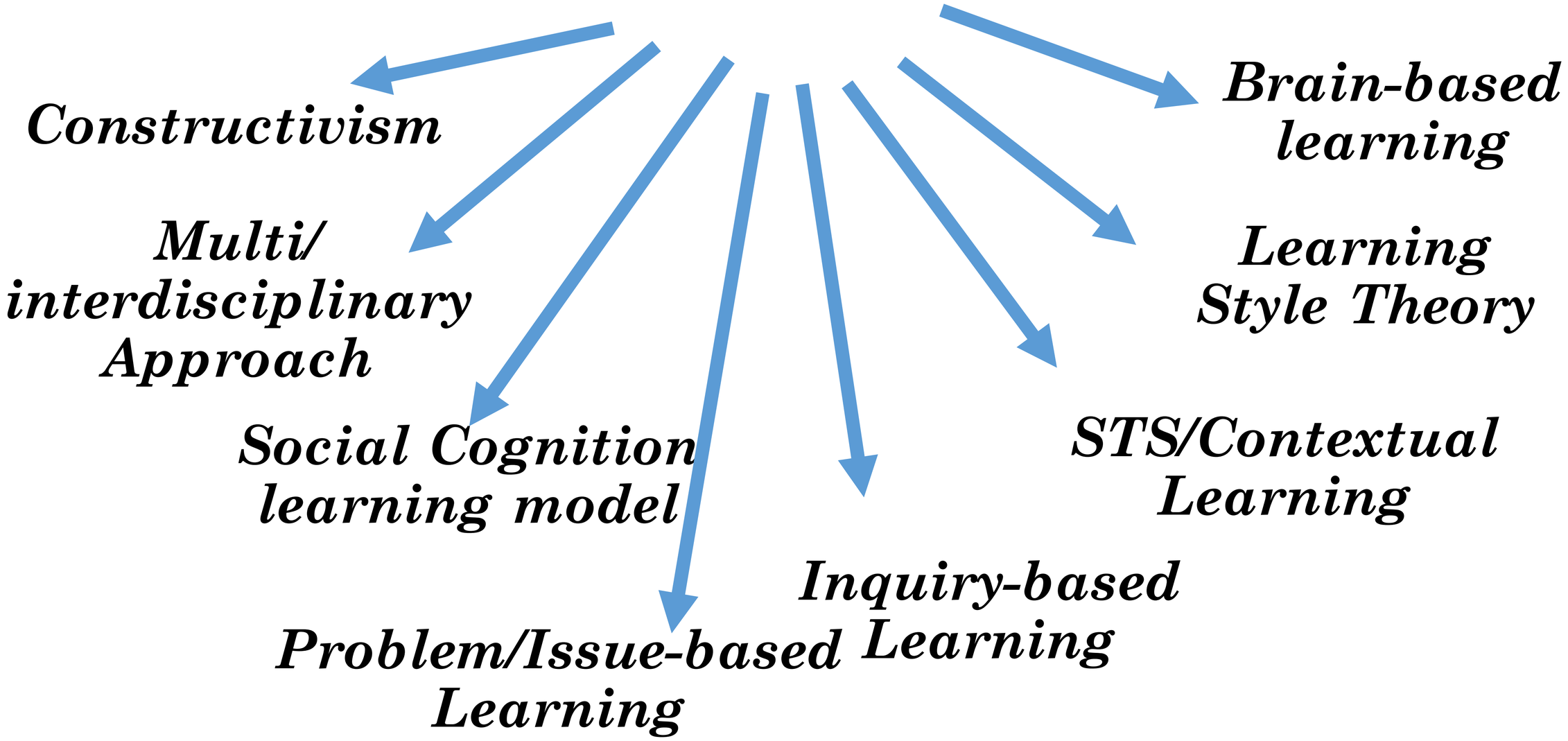
K12 Science Curriculum

Conceptual Framework of Science Curriculum

Educational Pedagogy



Inquiry-based Approach

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Inquiry-based (A quick review of some basics)

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Five Kinds of Questions for IBL

1) Inference Questions
2) Interpretation Questions
3) Transfer Questions
4) Questions about hypothesis
5) Reflective Questions

Four Levels of Inquiry

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Four Levels of Inquiry

Provided to the students:

Levels of Inquiry	Question	Procedure	Solution
Level 1. Confirmation Inquiry			
Level 2. Structured Inquiry			
Level 3. Guided Inquiry			
Level 4. Open Inquiry			

Five Kinds of Questions for IBL

1) Inference Questions
2) Interpretation Questions
3) Transfer Questions
4) Questions about hypothesis
5) Reflective Questions

Roger Bybee's 5Es of Learning

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Roger Bybee's 5Es of Learning

5E STAGE	TEACHERS SHOULD AVOID…	INSTEAD, TEACHERS SHOULD…
ENGAGE	Starting the lesson by explaining the topic.	Hook student interest in the topic or arouse their curiosity with a problem question.
EXPLORE	Allowing students to do whatever they want.	Put direction in the inquiry and set parameters. Have hands-on work .
EXPLAIN	Doing all the talking.	Ask students to present their findings and reasons. Then give feedback on their answers and other need inputs.
ELABORATE	Giving a test at once after discussion.	Extend student learning to new situations and to new challenges.
EVALUATE	Assessing only with a written objective type test.	Use also open-ended and application types of assessments.

Sample Inquiry-based Lesson

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Chosen competency:

explain why pluto was once though to be a planet but is no longer considered one

Content Outline: Physical Science: Earth and Space Science

Content 4: How Physics helps us understand the cosmos

Content Standards: *The learners demonstrate an understanding of…*

7 explain why pluto was once though to be a planet but is no longer considered one

Content Outline: Physical Science: Earth and Space Science

Content 4: How Physics helps us understand the cosmos

How physics helps us understand the Cosmos	1. Relativity and the Big Bang 2. Planets in and beyond the Solar System		1. explain how special relativity resolved the conflict between Newtonian mechanics and Maxwell's electromagnetic theory (3 hours)	**S11/12PS-IVi-j-69**

CONTENT	**CONTENT STANDARD** (The learners demonstrate an understanding of...)	**PERFORMANCE STANDARD** (The learners...)	**LEARNING COMPETENCIES** (The learners...)	**CODE**
			2. explain the consequences of the postulates of Special Relativity (e.g., relativity of simultaneity, time dilation, length contraction, mass-energy equivalence, and cosmic speed limit)	**S11/12PS-IVi-j-70**
			3. explain the consequences of the postulates of General Relativity (e.g., correct predictions of shifts in the orbit of Mercury, gravitational bending of light, and black holes)	**S11/12PS-IVi-j-71**
			4. explain how the speeds and distances of far-off objects are estimated (e.g., Doppler effect and cosmic distance ladder) (2 hours)	**S11/12PS-IVj-72**
			5. explain how we know that we live in an expanding universe, which used to be hot and is approximately 14billion years old	**S11/12PS-IVj-73**
			6. explain how Doppler shifts and transits can be used to detect extra solar planets	**S11/12PS-IVj-74**
			7. explain why Pluto was once thought to be a planet but is no longer considered one	**S11/12PS-IVj-75**

How physics helps us understand the Cosmos	1. Relativity and the Big Bang 2. Planets in and beyond the Solar System		1. explain how special relativity resolved the conflict between Newtonian mechanics and Maxwell's electromagnetic theory (3 hours)	**S11/12PS-IVi-j-69**
CONTENT	**CONTENT STANDARD** (The learners demonstrate an understanding of...)	**PERFORMANCE STANDARD** (The learners...)	**LEARNING COMPETENCIES** (The learners...)	**CODE**
			2. explain the consequences of the postulates of Special Relativity (e.g., relativity of simultaneity, time dilation, length contraction, mass-energy equivalence, and cosmic speed limit)	**S11/12PS-IVi-j-70**
			3. explain the consequences of the postulates of General Relativity (e.g., correct predictions of shifts in the orbit of Mercury, gravitational bending of light, and black holes)	**S11/12PS-IVi-j-71**
			4. explain how the speeds and distances of far-off objects are estimated (e.g., Doppler effect and cosmic distance ladder) (2 hours)	**S11/12PS-IVj-72**
			5. explain how we know that we live in an expanding universe, which used to be hot and is approximately 14billion years old	**S11/12PS-IVj-73**
			6. explain how Doppler shifts and transits can be used to detect extra solar planets	**S11/12PS-IVj-74**
			7. explain why Pluto was once thought to be a planet but is no longer considered one	**S11/12PS-IVj-75**

Insights:

7 competencies to be taught in more than 1 week with 4 hours per week

How physics helps us understand the Cosmos	1. Relativity and the Big Bang 2. Planets in and beyond the Solar System		1. explain how special relativity resolved the conflict between Newtonian mechanics and Maxwell's electromagnetic theory (3 hours)	**S11/12PS-IVi-j-69**
CONTENT	**CONTENT STANDARD** (The learners demonstrate an understanding of...)	**PERFORMANCE STANDARD** (The learners...)	**LEARNING COMPETENCIES** (The learners...)	**CODE**
			2. explain the consequences of the postulates of Special Relativity (e.g., relativity of simultaneity, time dilation, length contraction, mass-energy equivalence, and cosmic speed limit)	**S11/12PS-IVi-j-70**
			3. explain the consequences of the postulates of General Relativity (e.g., correct predictions of shifts in the orbit of Mercury, gravitational bending of light, and black holes)	**S11/12PS-IVi-j-71**
			4. explain how the speeds and distances of far-off objects are estimated (e.g., Doppler effect and cosmic distance ladder) (2 hours)	**S11/12PS-IVj-72**
			5. explain how we know that we live in an expanding universe, which used to be hot and is approximately 14billion years old	**S11/12PS-IVj-73**
			6. explain how Doppler shifts and transits can be used to detect extra solar planets	**S11/12PS-IVj-74**
			7. explain why Pluto was once thought to be a planet but is no longer considered one	**S11/12PS-IVj-75**

Insights:

The chosen competency can be taught for a week

Content Outline: Physical Science: Earth and Space Science

Content 4: How Physics helps us understand the cosmos

Content Standards: *The learners demonstrate an understanding of…*

7 explain why pluto was once thought to be a planet but is no longer considered one

Lesson Objectives

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Lesson Objectives

1) **Identify the characteristics of a planet.**
2) **Explain why pluto is not considered as a planet.**
3) **Come up with generalization about identifying planets.**

Engage Activity

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Engagement Activity

Problem Question:

How can we tell if a thing is part of a group or not?

Engagement Activity

Modified four pics 1 word activity

Engagement Activity

Instructions:

1) You will be shown four pics, your task is to guess a mystery word.
2) The catch: One of the pics is not related. Can you identify it?

Explore Activity

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Explore Activity

Reading Article

You will be given an article entitled,

What's a Planet and Why is Pluto Not in the Planet Club Anymore?

by Andrew Fraknoi
(Foothill College & ASP)

Explore Activity

Your Task:

Answer the following guide Questions:

1) **What are the characteristics of a planet?**
2) **What made pluto disqualified as a planet?**
3) **How can we officially tell if a thing is part of a group or not?**

Explain Activity

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Explain Activity

Prepare your presentation as a group:

1) **What are the characteristics of a planet?**
2) **What made pluto disqualified as a planet?**
3) **How can we officially tell if a thing is part of a group or not?**

Elaborate Activity

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Elaborate Activity

Consider the brief history given at the end of the article. Can you tell what made scientists change their minds in identifying planets?

A Brief History of the Number of Planets Being Taught

Time Period	Number of Planets	Explanation
Most of human history	7	Sun, Moon, Mercury, Venus, Mars, Jupiter, Saturn
After the work of Copernicus, Kepler & Galileo	6	Mercury, Venus, Earth, Mars, Jupiter, Saturn
1781-1801	7	Uranus added
1801-1802	8	Ceres added
1802-1804	9	Pallas added
1804-1807	10	Juno added
1807-1846	11	Vesta added
1846-1850's	12+	Neptune added (other asteroids discovered)
1850's-1930	8	All asteroids become minor planets
1930-2004	9	Pluto added
2004-2006	10?	Eris announced and its category debated
2006 on	8	Pluto and Eris become dwarf planets

A Brief History of the Number of Planets Being Taught

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2004-2006	10?	Eris announced and its category debated
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Evaluate Activity

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Evaluate

Answer the following questions:

1) What are the characteristics of a planet?
2) What made pluto disqualified as a planet?
3) How can we officially tell if a thing is part of a group or not?

Thank you very much!

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