

Name: _____

Period: _____ Date: _____

TSOKOS READING ACTIVITY
Section 7-3

1. Essential Idea: It is believed that all the matter around us is made up of fundamental particles called quarks and leptons. It is known that matter has a hierarchical structure with quarks making up nucleons, nucleons making up nuclei, nuclei and electrons making up atoms and atoms making up molecules. In this hierarchical structure, the smallest scale is seen for quarks and leptons (10^{-18} m).
2. Nature Of Science:
 - a. Predictions: Our present understanding of matter is called the Standard Model, consisting of six quarks and six leptons. Quarks were postulated on a completely mathematical basis in order to explain patterns in properties of particles.
 - b. Collaboration: It was much later that large-scale collaborative experimentation led to the discovery of the predicted fundamental particles.
3. International-Mindedness: Research into particle physics requires ever-increasing funding, leading to debates in governments and international research organizations on the fair allocation of precious financial resources.
4. Theory Of Knowledge: Does the belief in the existence of fundamental particles mean that it is justifiable to see physics as being more important than other areas of knowledge?
5. Understandings:
 - a. Quarks, leptons and their antiparticles
 - b. Hadrons, baryons and mesons
 - c. The conservation laws of charge, baryon number, lepton number and strangeness
 - d. The nature and range of the strong nuclear force, weak nuclear force and electromagnetic force
 - e. Exchange particles
 - f. Feynman diagrams
 - g. Confinement
 - h. The Higgs boson
6. Applications And Skills:
 - a. Describing the Rutherford-Geiger-Marsden experiment that led to the discovery of the nucleus
 - b. Applying conservation laws in particle reactions
 - c. Describing protons and neutrons in terms of quarks
 - d. Comparing the interaction strengths of the fundamental forces, including gravity
 - e. Describing the mediation of the fundamental forces through exchange particles
 - f. Sketching and interpreting simple Feynman diagrams

- g. Describing why free quarks are not observed
7. Guidance: A qualitative description of the standard model is required.
8. Data Booklet Reference:

Charge	Quarks			Baryon number
$\frac{2}{3}e$	u	c	t	$\frac{1}{3}$
$-\frac{1}{3}e$	d	s	b	$\frac{1}{3}$
All quarks have a strangeness number of 0 except the strange quark that has a strangeness number of -1				

a.

Charge	Leptons		
-1	e	μ	τ
0	ν_e	ν_μ	ν_τ
All leptons have a lepton number of 1 and antileptons have a lepton number of -1			

b.

	Gravitational	Weak	Electromagnetic	Strong
Particles experiencing	All	Quarks, leptons	Charged	Quarks, gluons
Particles mediating	Graviton	W^+, W^-, Z^0	γ	Gluons

c.

9. Utilization: An understanding of particle physics is needed to determine the final fate of the universe (see Physics option sub-topics D.3 and D.4).

10. Aims:

- Aim 1: the research that deals with the fundamental structure of matter is international in nature and is a challenging and stimulating adventure for those who take part
- Aim 4: particle physics involves the analysis and evaluation of very large amounts of data
- Aim 6: students could investigate the scattering angle of alpha particles as a function of the aiming error, or the minimum distance of approach as a function of the initial kinetic energy of the alpha particle
- Aim 8: scientific and government organizations are asked if the funding for particle physics research could be spent on other research or social needs

11. Read section 7-3, pgs 295-307, in your textbook.

12. Use the Cornell Notes system to take notes on the lesson material. You have the following options:
 - a. You can print multiple copies of one of the forms on the following pages of this document and handwrite your notes.
 - b. You can use the MS Word form supplied below and type your notes.
 - i. You can then print your work and submit a hardcopy, or
 - ii. You can upload the assignment to Focus. If you choose this option, you must use a filename in the format, "LastnameFirstinitialPerXAsgnmtName". For example, "SmithKPerC34ReadActT9-3.doc"
 - c. You can take notes on notebook paper using the Cornell Notes format and submit the hardcopy.
13. When using this form, remember the **Five R's of Notetaking**:
 - a. **Record** – the most important or emphasized information
 - b. **Reduce** – and synthesize information wherever possible, making it as concise as you can
 - c. **Recite** – read your notes out loud
 - d. **Reflect** – and consider how this information is connected to your personal experiences and what you already know
 - e. **Review** – look over your notes more than once
14. As a minimum, you must include notes on the following topics:
 - a. the structure of matter
 - b. Thompson model
 - c. Rutherford scattering experiments and their consequences
 - d. Elementary particles
 - i. Quarks
 1. flavours
 2. anti-particles
 3. baryon
 4. baryon number
 5. meson
 - ii. Leptons
 1. family lepton number
 - iii. Exchange particles
 - e. Feynman diagrams
 - i. interaction vertex
 - f. Quark confinement
 - g. Higgs particle
 - h. Standard model

15. Answers may be typed or neatly printed. You do not need to include this page of instructions with your assignment.
16. **Note:** *The following computer skills should be practiced:*
- a. *Use Microsoft Equation to type any equations.*
 - b. *Drawings may be freehand, but try to make use of the ‘Shapes’, ‘Insert Picture’ or ‘Insert Clipart’ functions of MS Word.*
 - c. *A reading assignment may contain drawings that would be useful in your notes. If you have scanning capability, you should practice scanning pictures and inserting them into documents. As you prepare for college, you should consider investing in a desktop printer-scanner-copier.*
 - d. *Just remember that for formal reports you have to cite any images that you insert into your document. You don’t have to cite scanned images for this exercise unless you use a source other than the textbook.*

CORNELL NOTES and the 5 R's

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Name:
Date:
Topic:

Questions/Key Points	Notes
SUMMARY:	

Name _____

Date _____

CORNELL NOTES

Topic _____

Questions/key points

Notes

Summary

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