TSOKOS READING ACTIVITY
Section 4-4

1. Essential Idea: Waves interact with media and each other in a number of ways that can be unexpected and useful.

2. Nature Of Science: Competing theories: The conflicting work of Huygens and Newton on their theories of light and the related debate between Fresnel, Arago and Poisson are demonstrations of two theories that were valid yet flawed and incomplete. This is an historical example of the progress of science that led to the acceptance of the duality of the nature of light.

3. International-Mindedness: Characteristic wave behaviour has been used in many cultures throughout human history, often tying closely to myths and legends that formed the basis for early scientific studies.

4. Theory Of Knowledge:

    a. Huygens and Newton proposed two competing theories of the behaviour of light.

    b. How does the scientific community decide between competing theories?

5. Understandings:

    a. Reflection and refraction

    b. Snell's law, critical angle and total internal reflection

    c. Diffraction through a single-slit and around objects

    d. Interference patterns

    e. Double-slit interference

    f. Path difference

6. Applications And Skills:

    a. Sketching and interpreting incident, reflected and transmitted waves at boundaries between media

    b. Solving problems involving reflection at a plane interface

    c. Solving problems involving Snell's law, critical angle and total internal reflection

    d. Determining refractive index experimentally

    e. Qualitatively describing the diffraction pattern formed when plane waves are incident normally on a single-slit

    f. Quantitatively describing double-slit interference intensity patterns

7. Guidance:

    a. Quantitative descriptions of refractive index are limited to light rays passing between two or more transparent media. If more than two media, only parallel interfaces will be considered

    b. Students will not be expected to derive the double-slit equation

c. Students should have the opportunity to observe diffraction and interference patterns arising from more than one type of wave

8. Data Booklet Reference:

a. $\dfrac{n_1}{n_2} = \dfrac{\sin \theta_2}{\sin \theta_1} = \dfrac{v_2}{v_1}$

b. $s = \dfrac{\lambda D}{d}$

c. Constructive Interference: path difference = $n\lambda$

d. Destructive Interference: path difference = $\left(n + \dfrac{1}{2}\right)\lambda$

9. Utilization:

a. A satellite footprint on Earth is governed by the diffraction at the dish on the satellite

b. Applications of the refraction and reflection of light range from the simple plane mirror through the medical endoscope and beyond. Many of these applications have enabled us to improve and extend our sense of vision

c. The simple idea of the cancellation of two coherent light rays reflecting from two surfaces leads to data storage in compact discs and their successors

d. The physical explanation of the rainbow involves refraction and total internal reflection. The bright and dark bands inside the rainbow, supernumeraries, can be explained only by the wave nature of light and diffraction

10. Aims:

a. Aim 1: the historical aspects of this topic are still relevant science and provide valuable insight into the work of earlier scientists

b. Aim 6: experiments could include (but are not limited to): determination of refractive index and application of Snell's law; determining conditions under which total internal reflection may occur; examination of diffraction patterns through apertures and around obstacles; investigation of the double-slit experiment

c. Aim 8: the increasing use of digital data and its storage density has implications on individual privacy through the permanence of a digital footprint

11. Read section 4-4, pg. 172-181, in your textbook.

12. Watch the video *Star Trek vs. Star Wars* from the class website.

13. Describe how each of the following terms could be employed in the above video. Creativity and poetic license are both allowed and encouraged.

a. Reflection

b. Snell's Law

c. Refractive Index

d. Dispersion

e. Total Internal Reflection

f. Critical Angle

g. Diffraction

    h. Interference

    i. Path Difference

    j. Constructive Interference

    k. Destructive Interference

    l. Double-Slit Interference

14. This assignment may be typed or neatly printed. Drawings may be freehand, but try to make use of the 'Shapes' or 'Insert Clipart" functions of MS Word. If you submit this assignment electronically, the filename must be in the following format, "LastnameFirstinitialPerXReadActX-X". You ***do not*** need to include a copy of these instructions with the assignment you hand in.