Okay SCATTER (Meteor that is)

Purpose: The objective of this activity is to allow the students to learn how radio waves can be detected beyond the normal line of sight between the transmitter and receiver by reflection off of tails created by meteorites penetrating the earth' s ionosphere.

Overview: During class discussion, the topics wave propagation and the modes of wave propagation should have been discussed. The basic concepts of sky wave, ground wave, and line of sight propagation were covered. In this activity those concepts are stretched beyond the limits by using a natural phenomena of ionized tails created as meteorites disintegrate as they plummet toward earth through the upper layers of the atmosphere. The study of this unique and specialized mode of wave propagation connects many of the concepts explored in the student' s study of earth science.

Time: Thirty minutes for demonstration setup, thirty minutes for the actual demonstration and following discussion.

Skills Required:

Observation

Materials and Tools:

- Chalkboard erasers with chalk dust
- or misting bottle with water,
- or aquarium filled with water that is slightly colored with milk.
- Laser pointer pen.

Preparation:

1. Review the concept of ionized gas; particularly review the mechanism of ionization at the atomic level.
2. Review what happens as a meteorite penetrates the outer atmosphere of earth.
3. Review the common modes of wave propagation, specifically reviewing sky wave propagation and the reflection of waves off of the ionized layer of the atmosphere.

Background:

ARRL Handbook page 21.14.

http://www.ykc.com/wa5ufh/Misc/bullets.htm

http://www.qsl.net/g3wzt/g3wzt_ms.html

What to do and how to do it:

Chalk and erasers:

1. Have dusty erasers ready to clap together during the activity. The room should be as dust free as possible before the activity begins. Darken the room as much as possible.
2. Shine the laser pen across the classroom and observe the amount of laser light scattered by the room atmosphere.
3. Clap the erasers together to create a chalk dust cloud. This simulated the ionized gas particles left behind a falling meteorite.
4. Shine the laser pen across the classroom and observe the amount of laser light scattered by the chalk dust. Continue to observe the scattered light intensity as the dusk dissipates.

Misting bottle:

1. Same procedure above except misting bottle with water is used to create the ionized tail.

Aquarium:

2. Fill the aquarium with water and let the water calm down so that the surface is still and the water is not turbulent.
3. Shine the laser pen light through the aquarium, from the side, at a 90^o angle. Observe the amount of light scattered by the clear water.
4. Blend in a small amount of milk to create a slightly opaque cloud in the aquarium. The cloud created by the milk particles simulates the ionized tail.
5. Allow the aquarium water to settle and shine the laser pin light through the aquarium as above. Observe the amount of light scattered by the cloudy water.

Data Analysis: The data collected will be anecdotal observations of the differences in the light scattered between the uncontaminated and contaminated media. The students should be inferring the connection between light scattered by dust particles in the air or clear water media to radio waves reflected off of the ionized particles left in the wake of a falling meteorite.

Activity questions:

1. Using meteor scatter to propagate waves, what are possible locations of the transmitter and receiver relative to each other and the meteorite tail?

2. How long do meteorite tails last and how will the life span affect the type of information transmitted, the method or mode, and the type of code used?

3. Do you anticipate that being scattered will modify the meteor scattered signals? If so, how are they modified? Would you need to consider how the waves are modified in choosing a mode of transmission, the type of information to be sent, and the probability that the information will be received correctly?

4. Will meteorite scatter communications be usable on other planets? Why or why not?

5. How is meteor scatter communications similar and dissimilar to other modes of wave propagation?

6. Does it matter where on earth or the time of day when using meteor scatter to propagate waves?

7. You have studied meteor scatter caused by natural phenomena. Would it be possible to propagate waves using this mode under conditions that are man made?

Adaptations for special needs:

The visually impaired student may have difficulty with this activity. Alternatives to reflecting light waves off of dust particles might be to reflect moving air off of window screen materials. Students should be able to sense the reflected air that bounces off the screen surface and also to feel the turbulence created by the screen downstream from the screen.