

Activity 14

Degree of Avoidance to White Light

Rationale: It was determined that worms avoid bright white light in Activity 12. It is also important to know if the brightness has an effect on the worms. The students, with the aid of a light sensor, can determine if the worms react to differing intensities of light.

Objectives

- 1) Determine the effect of intensity of white light on worms' avoidance behavior.
- 2) Determine the effect of distance on white light intensity.
- 3) Set up an experiment to determine the effect of light intensity on worm avoidance behavior.

PDE Standards

Science and Technology

3.1.7. A,B,C

3.2.7. A,B,C,D,E,F.

3.4.7. B

3.6.7. A,B

3.7.7. A,B,C,D

Environment and Ecology

4.1.7. A,B,C

4.2.7. A,C

4.6.7. A,B,C

Math

2.1.8. A,B,D,G

2.2.8. A,B,F

2.3.8. A,B,D

2.4.8. A,B,D,F

2.5.8. A,B,C,D

2.6.8. A,B,C,E,F

2.7.8. B,C,D

2.8.8. F,G,H,I,J

2.11.8. A,B

Materials

CBL2

TI 83/84

Graphical Analysis

Computer

Ring stand (2)

Stopwatch

White LED

Camera light meter

Vernier light sensor

Ruler

Test tube clamp (2)

Introduction

To be able to accurately determine the effect of light intensity, students need to understand the inverse effect of intensity and distance. The actual effect is called the

inverse square law. If an intensity light reading is taken of a light bulb at a distance of 10.0 cm and then the sensor is moved to 20.0 cm, the intensity will decrease by a factor of 1/4 the original. If the sensor is then moved from the original 10.0 cm to 30.0 cm, the intensity of the light will decrease by a factor of 1/9 of the original. If the distance is changed to 40.0 cm, 4 times the original distance of 10.0 cm, the intensity will decrease to 1/16 of the original.

- 1) double (2x) the distance and the intensity will decrease by the inverse of 2 = $\frac{1}{2}$; $(\frac{1}{2})^2 = \frac{1}{4}$ as intense.
- 2) Triple the distance (3x) and the intensity will decrease by the inverse of 3 = $\frac{1}{3}$; $(\frac{1}{3})^2 = \frac{1}{9}$ as intense.
- 3) Quadruple the distance (4x) and the intensity will decrease by the inverse of 4 = $\frac{1}{4}$; $(\frac{1}{4})^2 = \frac{1}{16}$ as intense.

Strategies

The students should set up the light bulb in a darkened room and measure the light intensity at various distances and record the light intensity. If the distances and the intensities are measured by several groups and averaged, the results should approximate the inverse square law rather well. This will not work with a flashlight. That light is directed out through the lens from the mirror behind the bulb in a compacted stream and does not obey the inverse square law in the same way. If the diameter of the spot of light doubles, then the intensity obeys the inverse square law.

Procedure

Inverse square law

- 1) Darken the room or work in a very dark place.
- 2) Set up the light bulb on a ring stand.
- 3) Set up the light sensor on a ring stand.
- 4) The light bulb and sensor should be at the same height.
- 5) Measure (to the nearest tenth of a cm) the distance from the LED to the front of the sensor.
- 6) Press the APPS button and select the DataMate application. Select and setup the light sensor for "events with entry" or read the intensity in the upper right corner of the TI screen.
- 7) Record the distance and intensity in Data Table 1.

Optional

- 8) Enter the distances in List 1. Overwrite any values that are in List 1.
- 9) Perform a pwr (power) regression on the data. Power refers to the square (2^{nd} power) of the value.

Procedure

Light intensity

- 1) Use the original distance from the previous Data Table 1 and record the distance in Data Table 2.
- 2) Collect 4 mature worms.
- 3) Place a fluffed up sample of vermicompost on a white piece of paper.
- 4) Place the worms on the vermicompost and turn on the light at the same time.

For a dimly lit room take the intensity reading with the light sensor in the dimly lit room and subtract that reading from all subsequent intensity measurements and record the values in Data Table 1a (alternate).

1. What relationship is observed between the intensity and distance?

Data Table 2 **Time vs. Intensity**

Intensity (ave)				
Time (sec)	XXXX	XXXX	XXXX	XXXX
Group 1				
Group 2				
Group 3				
Group 4				
Group 5				
Averages				

1. What relationship is observed between the intensity and distance?
2. What relationship is observed between the intensity and burying time?