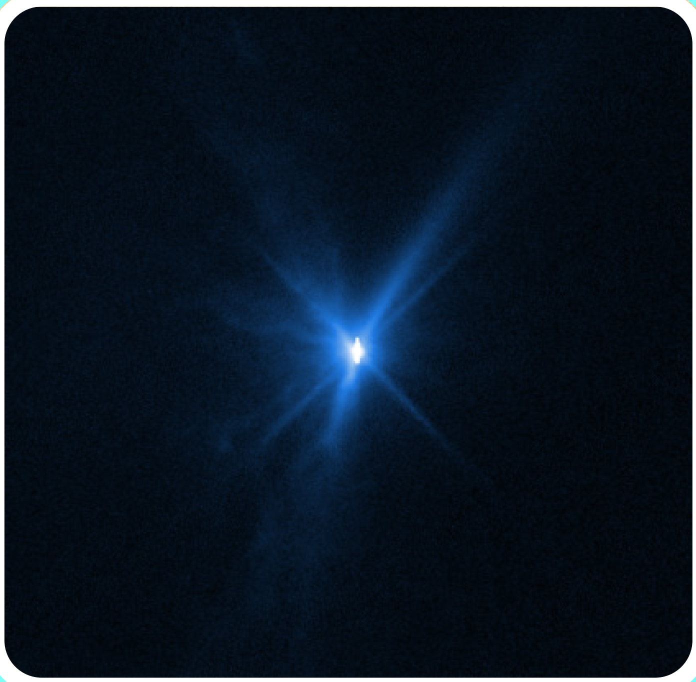
STEM Sims™

Star Bright



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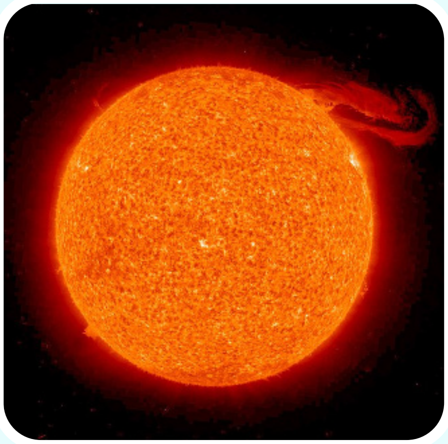
Do you need an idea for a scientific study?
Try out one of our ideas or make one of your own.

Astronomers can't reach stars to investigate their properties. Instead, they examine the light from stars to learn about them. Take the following brief quiz to see how much you already know about stars and light. See the bottom of page 4 to check your answers.

1. Stars with the highest temperatures are what color?
   a. red
   b. yellow
   c. white
   d. blue

2. What color are the oldest stars?
   a. red
   b. yellow
   c. white
   d. blue

3. The inverse square law is valid for all the following *except*:
   a. light.
   b. gravity.
   c. contact forces.
   d. sound.



4. About how many stars can a person see using only the naked eye in the typical night sky on Earth?
   a. 2,000
   b. 200,000
   c. 2,000,000
   d. 2,000,000,000

5. People using only the naked eye *cannot* see any green colored stars in the night sky.
   a. true
   b. false

Inverse Square Law

<u>Materials Required</u>

1- Maglite flashlight 1- 30-cm ruler
1- pencil 1- small piece of paper masking tape

Procedure

1. Make sure to have permission before conducting this investigation.
2. Loosely tape the flashlight to the ruler so the front of the flashlight is positioned on the 5-centimeter mark of the ruler. The flashlight should be facing the 0-mark on the ruler.
3. Place the piece of paper on a flat surface.
4. Darken the room where you are conducting your investigation.
5. Hold the ruler/flashlight vertically on the paper with the flashlight pointing downward.
6. Turn on the flashlight. Use the pencil to mark two opposite edges of the flashlight beam on the paper.
7. Turn off and untape the flashlight. Move the flashlight to the 10-cm mark on the ruler and retape.
8. Repeat steps 5-6.
9. Remove the taped flashlight from the ruler and use the ruler to measure the distance between the two marks on the paper for the 5-cm and 10-cm flashlight heights. Record these values in Table 1 below.

Table 1. Light Data

Light Height Above Paper (cm)	Distance Between Two Opposite Marks (cm)	Radius (r) of Light Circle (cm)	Area (A) of Light Circle (cm^2)	Observations
5				
10				

10. The "Distance Between Two Opposite Marks" is the diameter of the light circle. Divide this value by two to find the "Radius of the Light Circle." Record this new value in Table 1.
11. The area of a circle is found using the following formula: A = (3.14)r2. Calculate the area of the light circle and record this value in Table 1.

<u>**Questions**</u>

1. How did the area of the two light circles change when the distance from the light to the paper was doubled?

2 Describe what happened to the light's brightness on the paper changed with the changing heights of the light above the paper.

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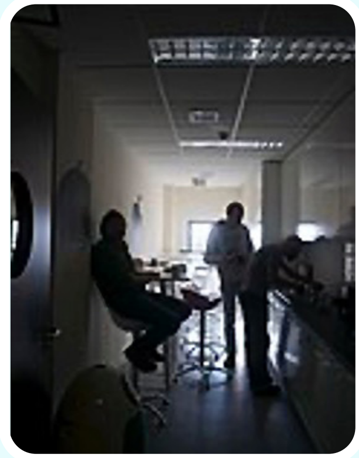
Flash and the Inverse Square Law

Have you ever tried to take a large group photograph using a flash and noticed how the people in the middle of the image are clear, but the quality of the image decreases for the people at the edges of the group? This is a classic example of the inverse square law at work. Placing the camera's flash at the correct distance away from the group will ensure a "perfect" image every time. But what is the correct distance to place the flash?



Let's say the group of people form a line 30 feet across. If the flashed is placed at a distance of 10 feet from the center of the group, will this fully illuminate the entire group? The people in the middle of the group will receive 100% of the light from the flash since they are 10 feet away from the flash. However, the inverse law predicts that since the people at the edge of the group are almost 20 feet away from the flash, they will only receive about 25% of the flash's intensity. This results in poorly lit subjects at the fringes of the group.

If the flash is moved to a distance of 30 feet away from the middle of the group, the quality of the image changes dramatically. Using trigonometry, the people at the fringes of the group are now about 33 feet away from the flash, which compares much more closely to the 30-foot distance from the people in the middle of the group. This means the people on the edges of the group now receive about 83% of the light from the flash compared to the middle of the group's 100%. A much better image awaits those who use a correct flash placement.

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Answers: **Page 2 Answers:** 1) d, 2) a, 3) c, 4) a, 5) a. **Page 3 Answers:** Inverse Square Law. 1) The 10-cm distance area is about four times as large. 2) The brightness of the spot on the paper is less at 10-cm since the light is more spread out.