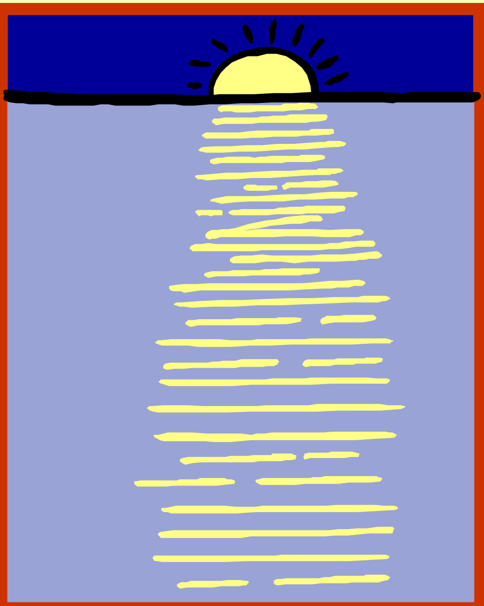
ConcepTest 23.1 Reflection

When watching the Moon over the ocean, you often see a long streak of light on the surface of the water. This occurs because:

1) the Moon is very large
2) atmospheric conditions are just right
3) the ocean is calm
4) the ocean is wavy
5) motion of the Moon



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4) the ocean is wavy
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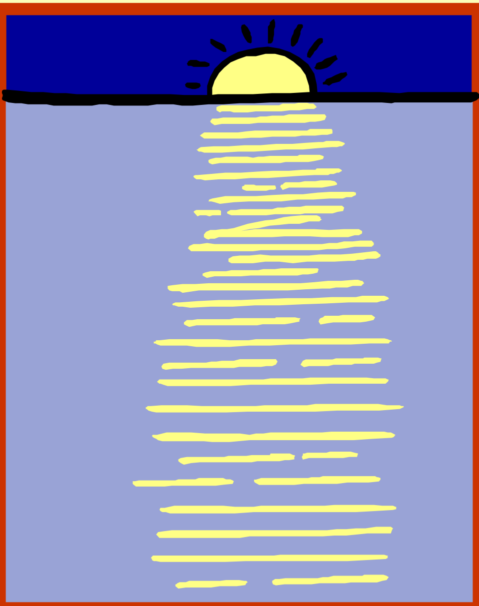
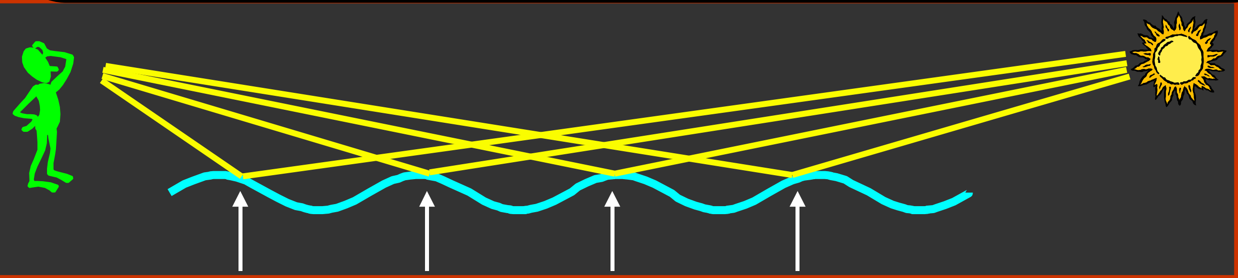
When the water surface changes, the angle of incidence also changes. Thus, different spots on the water can reflect the Moon into your eyes at different times.

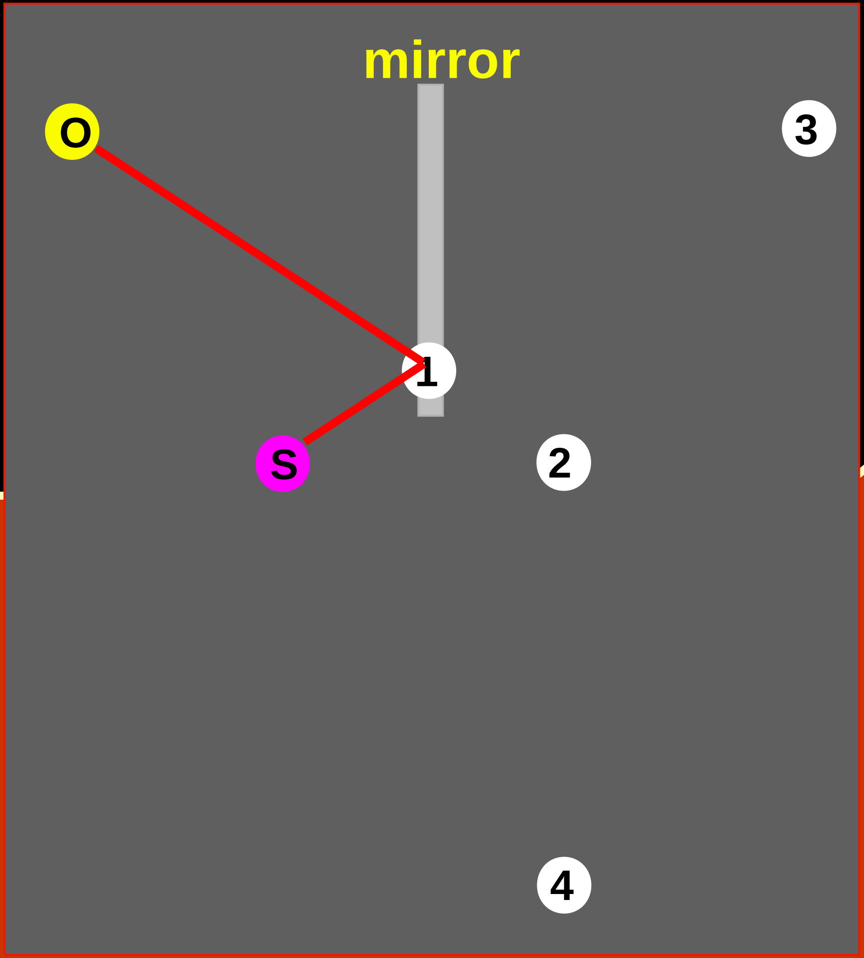




Follow-up: Where else does this occur?

ConcepTest 23.2a Mirror I

An observer at point O is facing a mirror and observes a light source S. Where does the observer perceive the mirror image of the source to be located?



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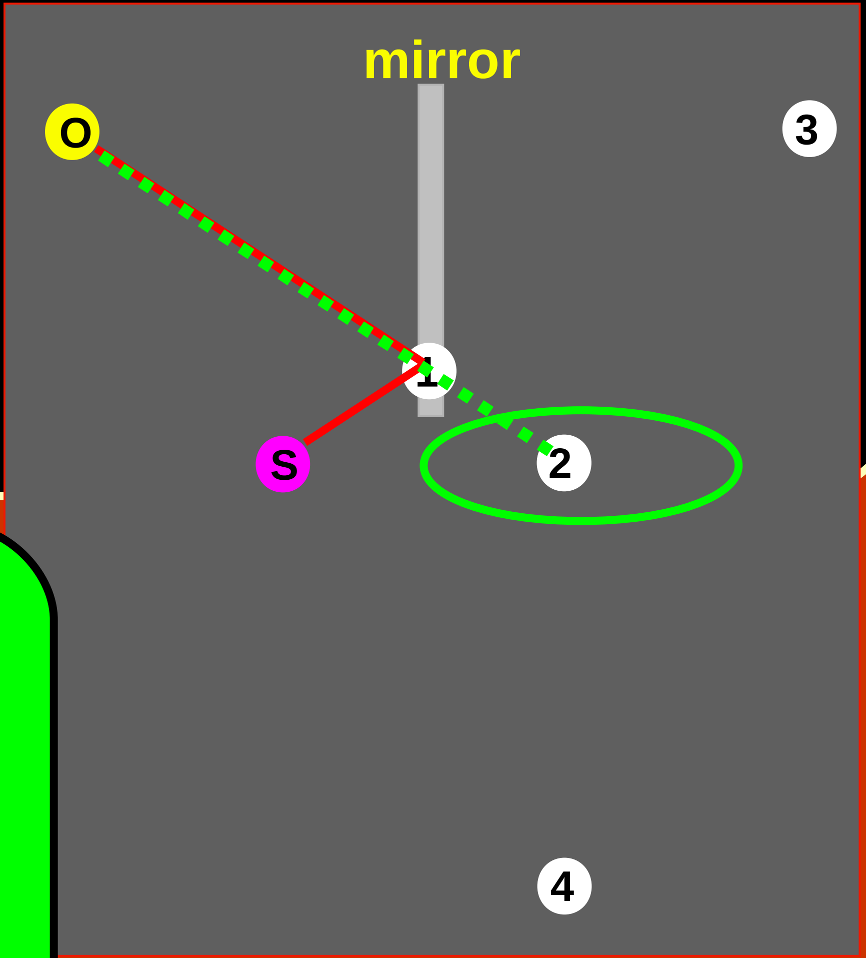


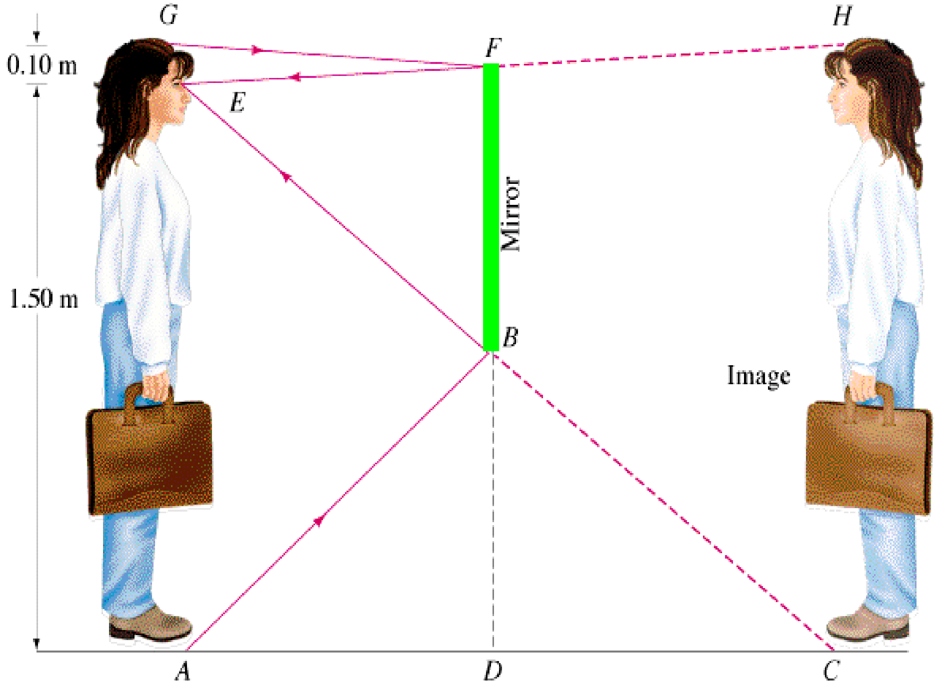
Trace the light rays from the object to the mirror to the eye. Since the brain assumes that light travels in a straight line, simply extend the rays back behind the mirror to locate the image.

Follow-up: What happens when the observer starts moving toward the mirror?

ConcepTest 23.2b Mirror II

You stand in front of a mirror. How tall does the mirror have to be so that you can see yourself entirely?

1) same as your height
2) less than your full height but more than half your height
3) half your height
4) less than half your height
5) any size will do



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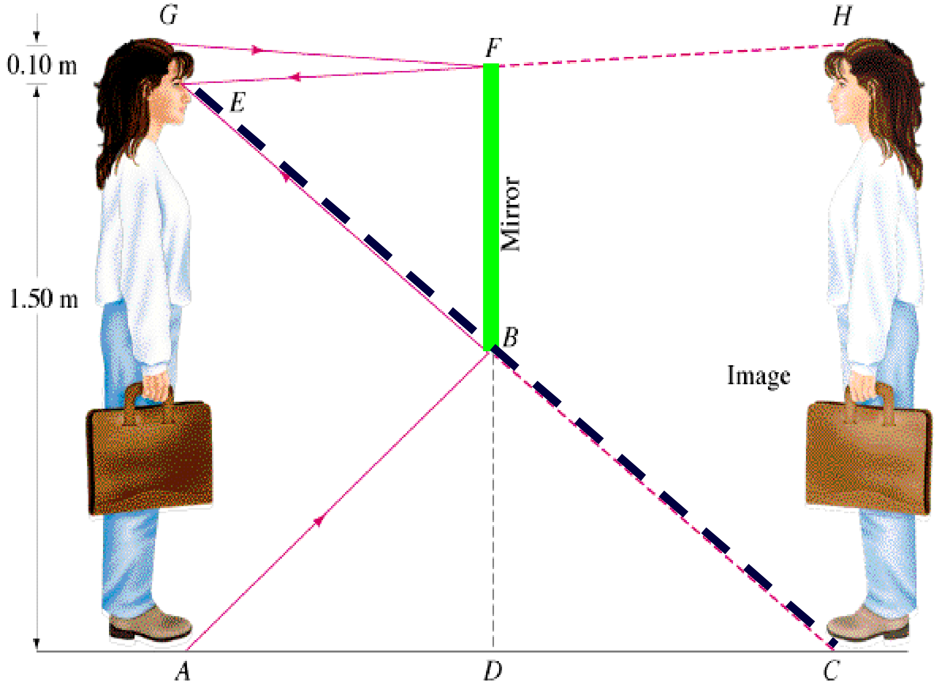
1) same as your height
2) less than your full height but more than half your height
3) half your height
4) less than half your height
5) any size will do

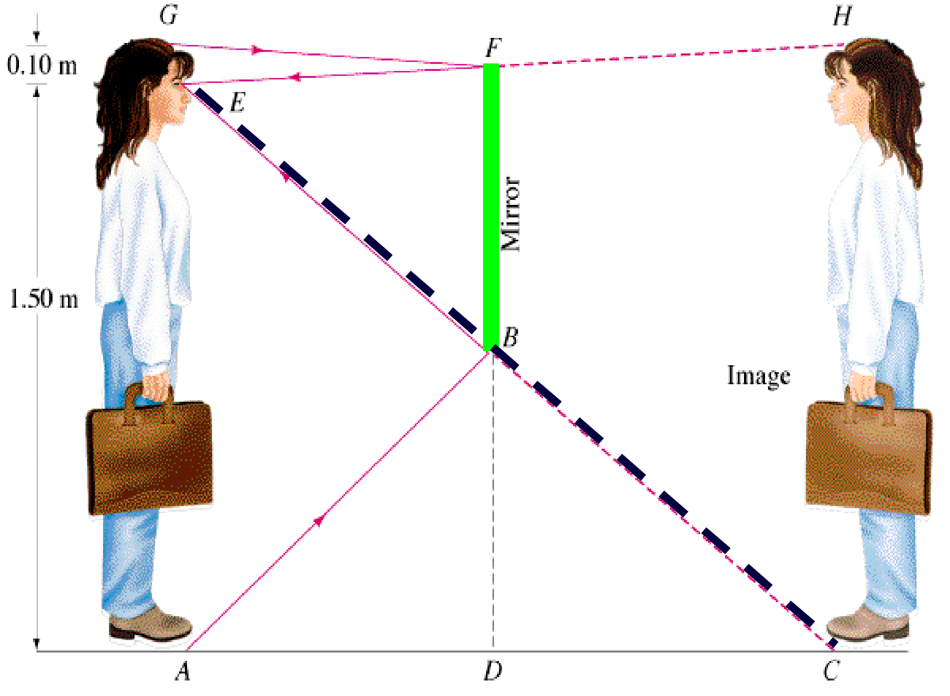
Trace the light rays from the image's foot to the mirror and then to the eye. Since we know that $\theta_i = \theta_r$, you need a **mirror only half your size**.



ConcepTest 23.2c Mirror III

Does this depend on your distance from the mirror?

1) No.
2) Yes.
3) Depends on the mirror.
4) Depends on the person.

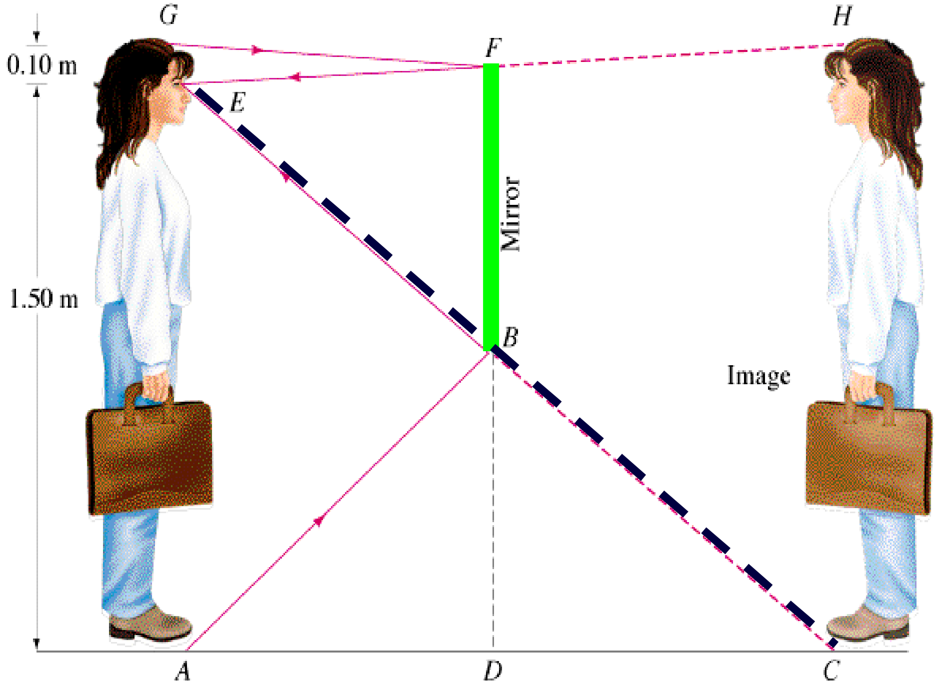


ConcepTest 23.2c Mirror III

Does this depend on your distance from the mirror?

1) No.
2) Yes.
3) Depends on the mirror.
4) Depends on the person.

The further you step back, the smaller the incident and reflected angles will be. But the rays will still be reflected at the same points, so the ray from the foot will still be reflected at mid-height.



ConcepTest 23.3 All Smoke and Mirrors

You hold a hand mirror 0.5 m in front of you and look at your reflection in a full-length mirror 1 m behind you. How far in back of the big mirror do you see the image of your face?

1) 0.5 m
2) 1.0 m
3) 1.5 m
4) 2.0 m
5) 2.5 m

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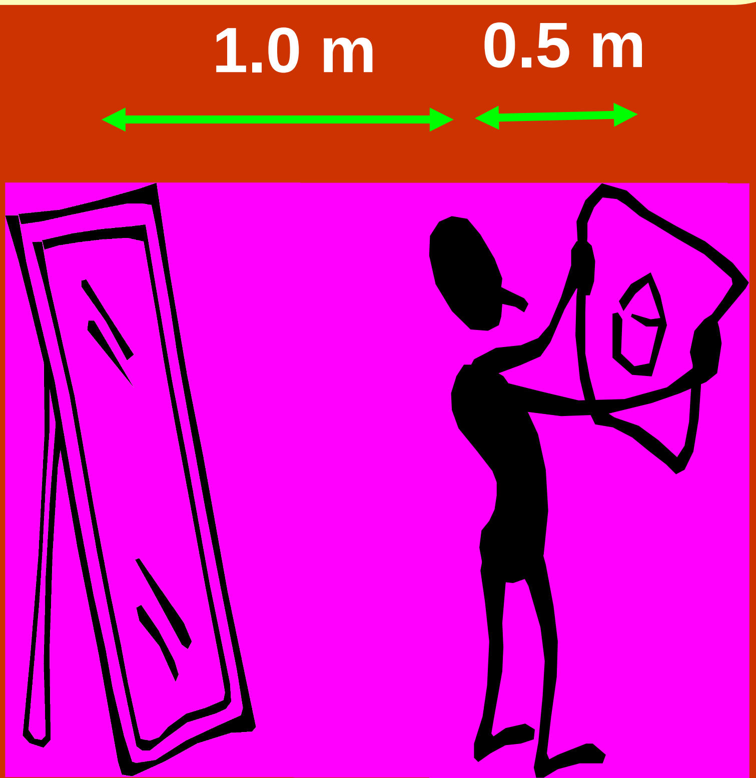
1) 0.5 m
2) 1.0 m
3) 1.5 m
4) 2.0 m
5) 2.5 m

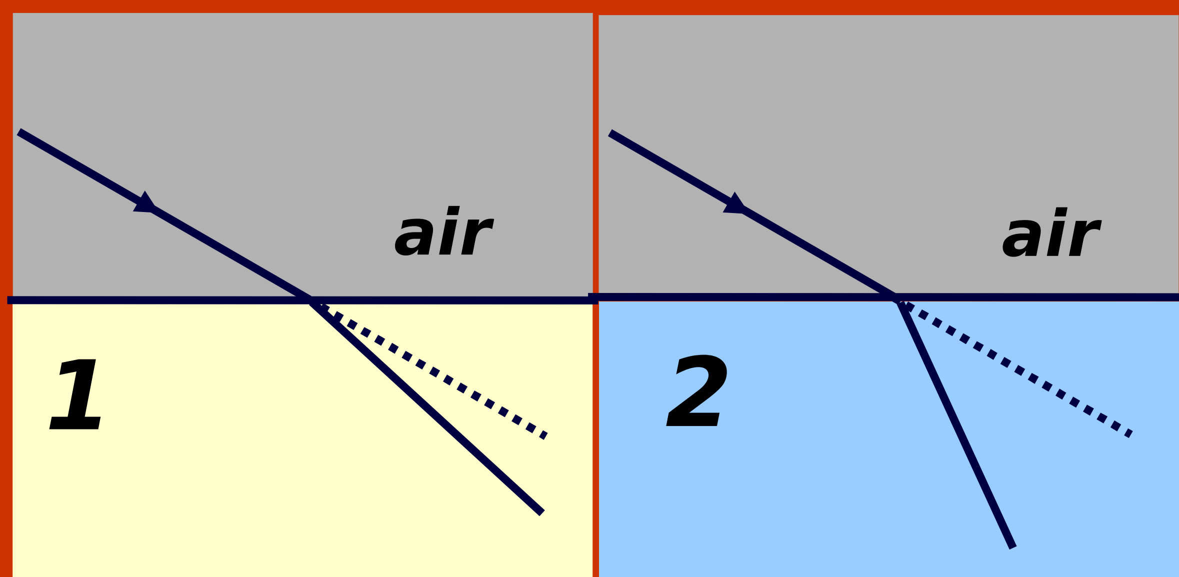
The image of the face reflected in the small mirror appears 0.5 m behind the small mirror. This image (which is the *object* for the big mirror) is 2.0 m away from the big mirror. The final image is 2.0 m behind the big mirror.



ConcepTest 23.4a Refraction I

Parallel light rays cross interfaces from air into two different media, 1 and 2, as shown in the figures below. In which of the media is the light traveling faster?

1) medium 1
2) medium 2
3) both the same

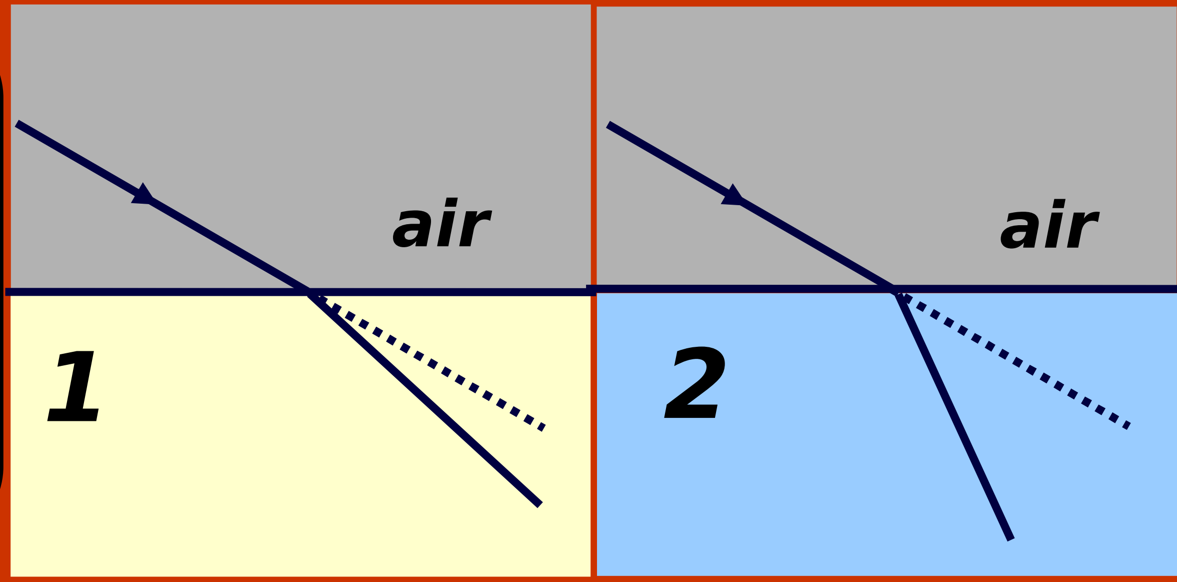


ConcepTest 23.4a Refraction I

Parallel light rays cross interfaces from air into two different media, 1 and 2, as shown in the figures below. In which of the media is the light traveling faster?

1) medium 1
2) medium 2
3) both the same

The greater the difference in the speed of light between the two media, the greater the bending of the light rays.



Follow-up: How does the speed in air compare to that in 1 or 2?

ConcepTest 23.4b Refraction II

Parallel light rays cross interfaces from medium 1 into medium 2 and then into medium 3. What can we say about the relative sizes of the index of refraction of these media?

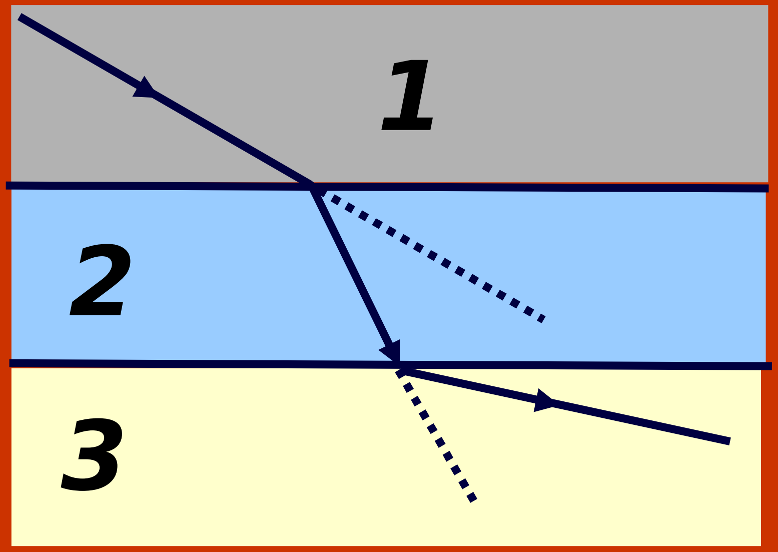
1) $n_1 > n_2 > n_3$

2) $n_3 > n_2 > n_1$

3) $n_2 > n_3 > n_1$

4) $n_1 > n_3 > n_2$

5) none of the above



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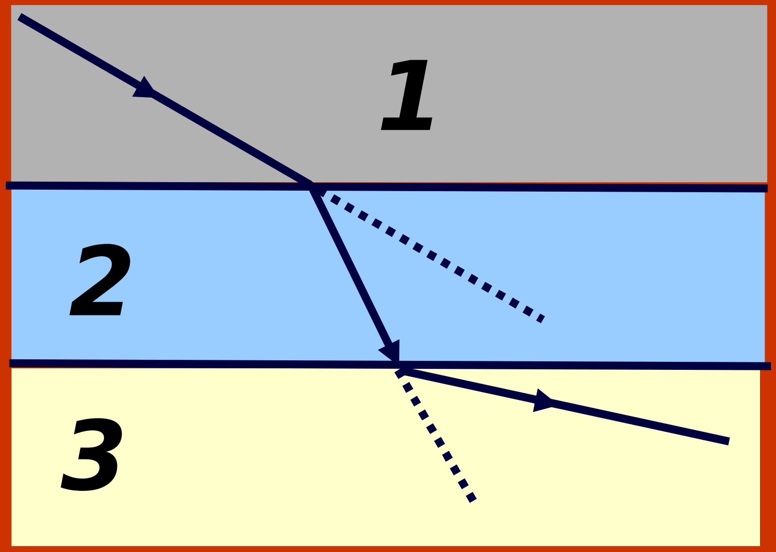
2) $n_3 > n_2 > n_1$

3) $n_2 > n_3 > n_1$

4) $n_1 > n_3 > n_2$

5) none of the above

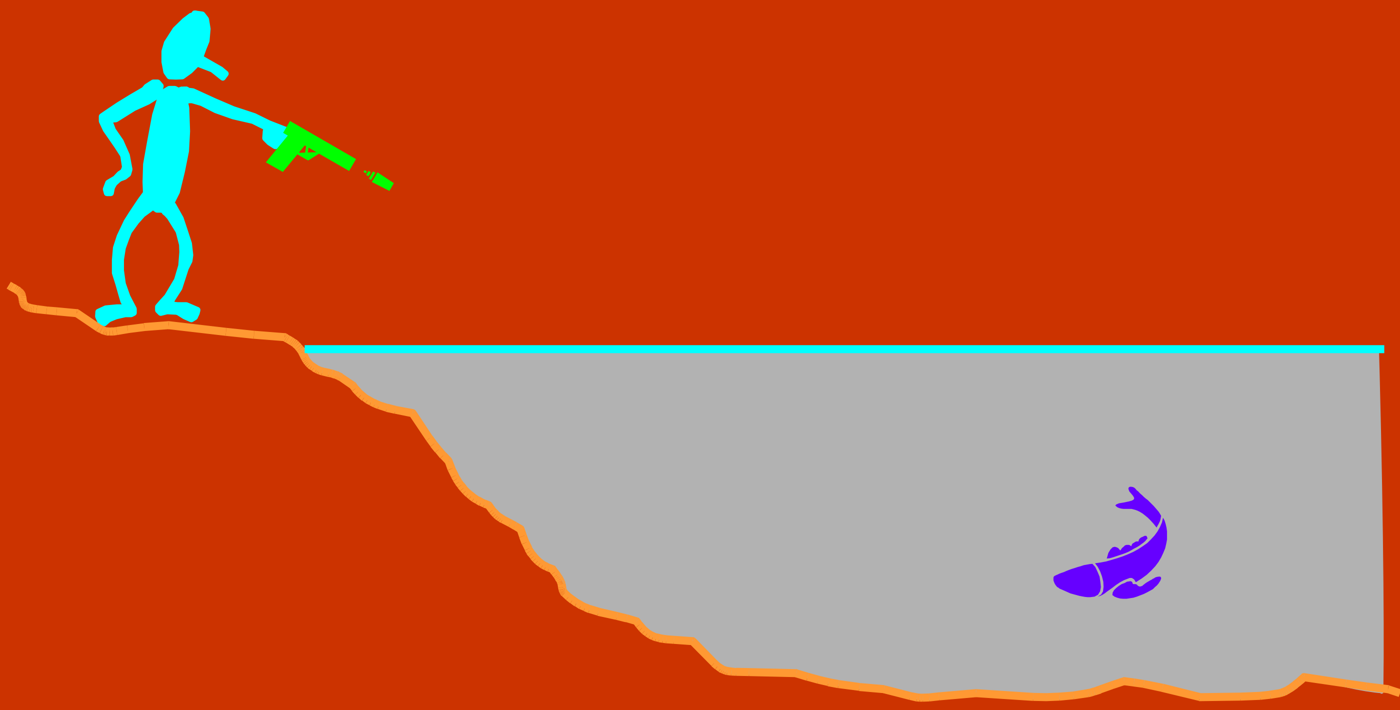
The rays are bent toward the normal when crossing into #2, so $n_2 > n_1$. But rays are bent away from the normal when going into #3, so $n_3 < n_2$. How to find the relationship between #1 and #3? Ignore medium #2! So the rays are bent away from the normal if they would pass from #1 directly into #3. Thus, we have: $n_2 > n_1 > n_3$.



ConcepTest 23.5a Gone Fishin' I

To shoot a fish with a gun, should you aim directly at the image, slightly above, or slightly below?

1) aim directly at the image
2) aim slightly above
3) aim slightly below



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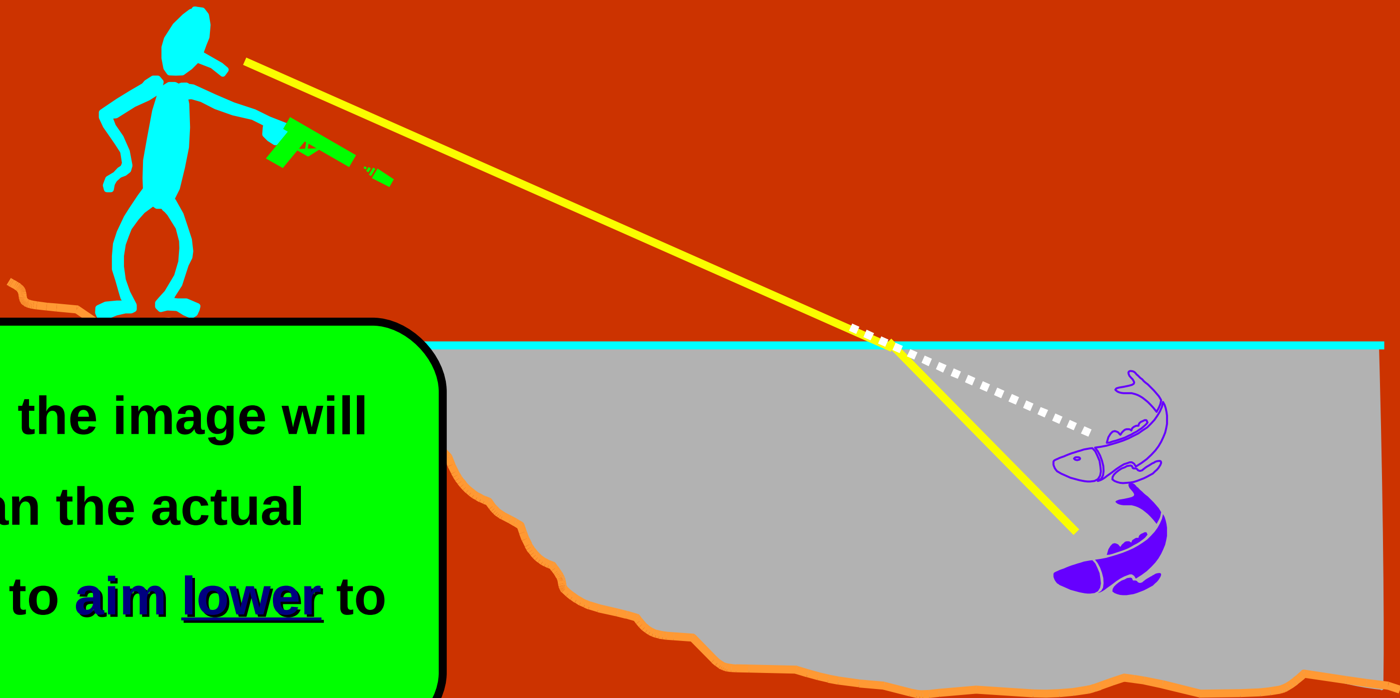
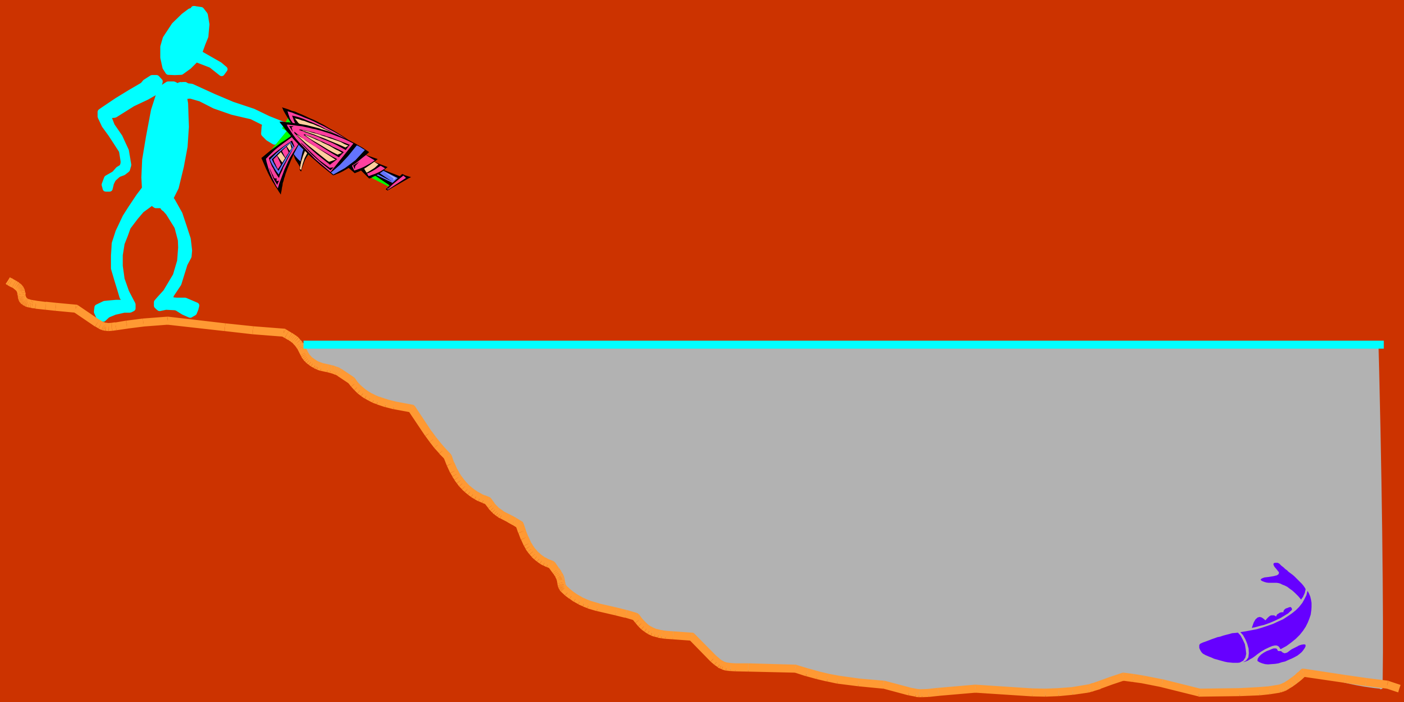


Due to refraction, the image will appear higher than the actual fish, so you have to aim lower to compensate.

ConcepTest 23.5b Gone Fishin' II

To shoot a fish with a *laser gun*, should you aim directly at the image, slightly above, or slightly below?

1) aim directly at the image
2) aim slightly above
3) aim slightly below



ConcepTest 23.5b Gone Fishin' II

To shoot a fish with a *laser gun*, should you aim directly at the image, slightly above, or slightly below?

1) aim directly at the image
2) aim slightly above
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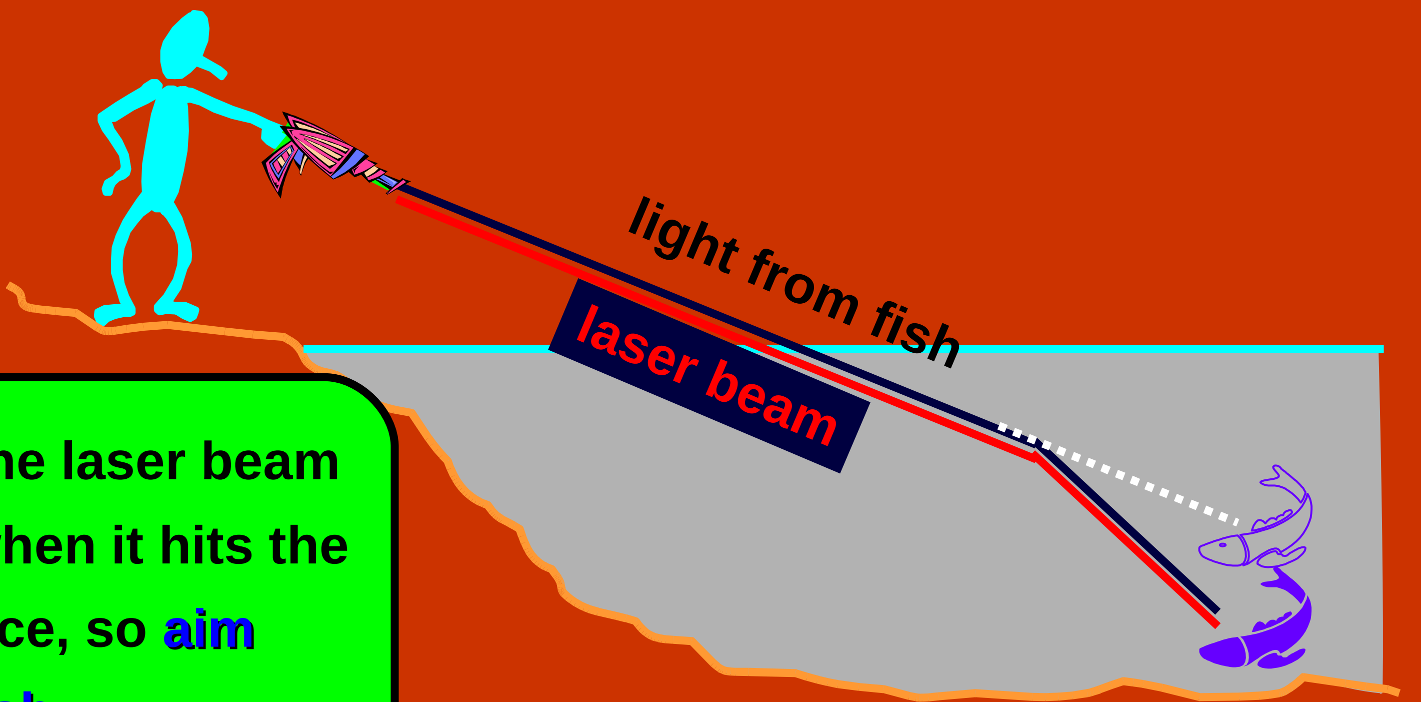
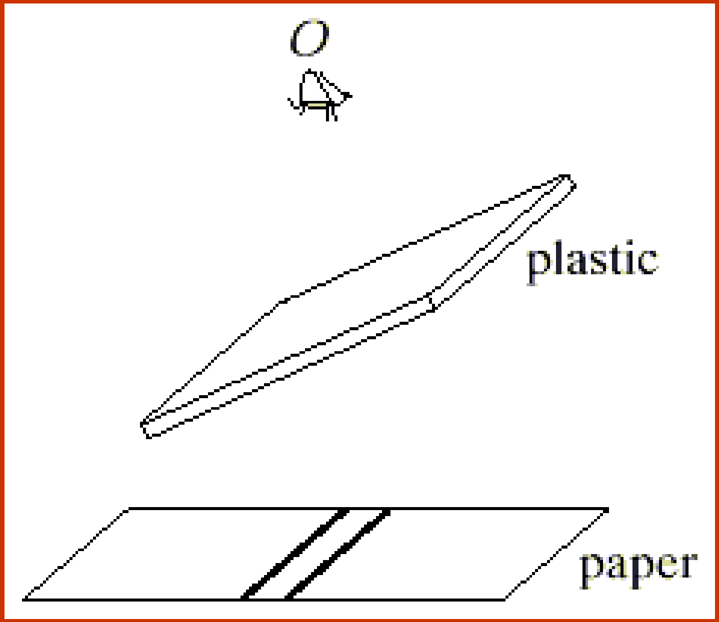


The **light** from the laser beam will also **bend** when it hits the air-water interface, so **aim directly at the fish**.

ConcepTest 23.6 Parallel Lines

An observer views two closely spaced lines through an angled piece of glass. To the observer, the lines appear:

1) shifted to the right
2) shifted to the left
3) spaced farther apart
4) spaced closer together
5) no change – same as before



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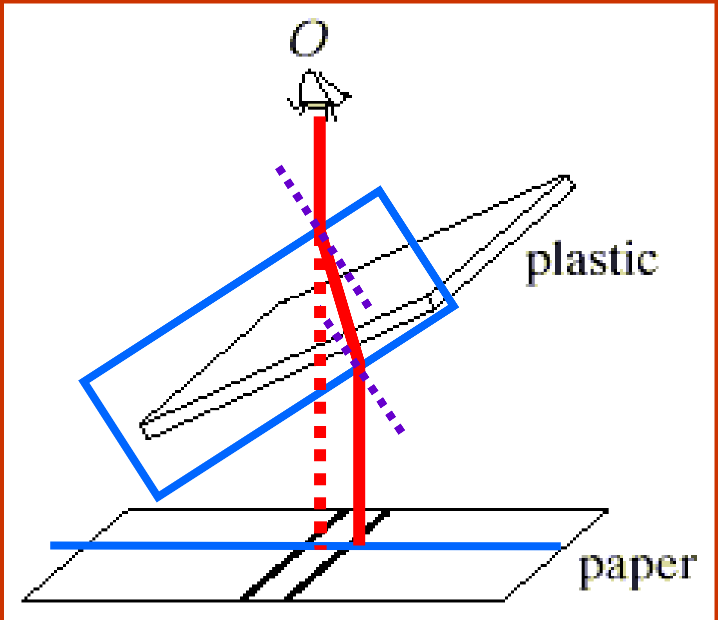
4) spaced closer together
5) no change – same as before

The light rays get refracted twice, so they remain parallel, but they **shift to the left**, as seen in the figure. Their relative spacing does not change, just the overall position.



Follow-up: What happens when the top glass moves toward the bottom glass?