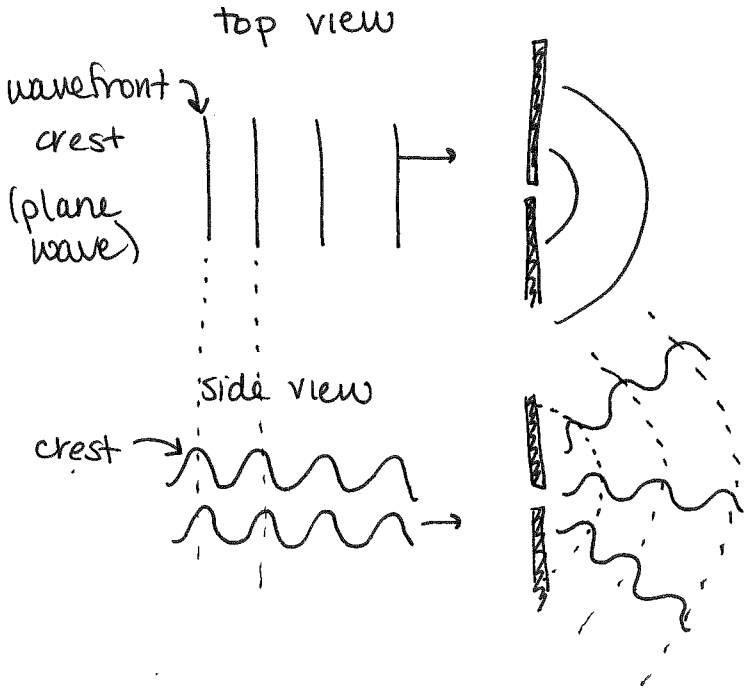
Double slit diffraction

Water waves: imagine water passing through tiny slit - what happens?

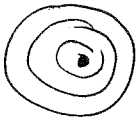


the opening bends the wavefronts — now they travel radially

Why does this happen?

we can imagine a wavefront as a line of individual point sources

point source is a source of waves that originates at a point, like a stone in a lake



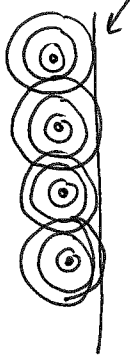
point source for water waves

Now imagine throwing a hundred stones all in a line. Each stone individually creates a bullseye

remember that lines represent wave crests - places where wave is biggest

Remember that the full wave is the superposition sum of all the individual waves (they interfere w/ each other)

~~Where the lines intersect, we have constructive interference~~



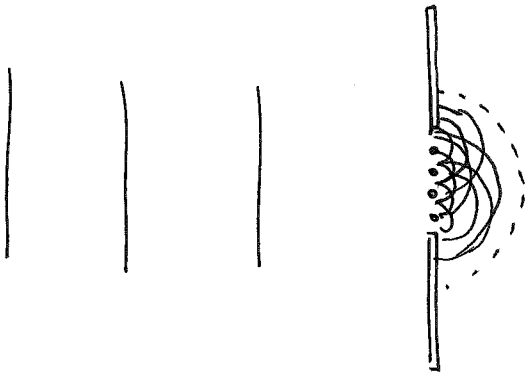
as we shrink the distance between points (imagine they get infinitessimally close together), the leading edge looks like another line
(in practice, how do we add up an infinite number of contributions? ⟶ integration)

Now we have a new line (a new wavefront), that can again be thought of as a line of point sources

This way of deconstructing waves into point sources is called the <u>Huygens-Fresnel principle</u>.

Now, if we sent these plane waves ||| toward a slit, what happens?

⟶ the slit selects only some of the point sources (only so many stones can fit inside the slit)



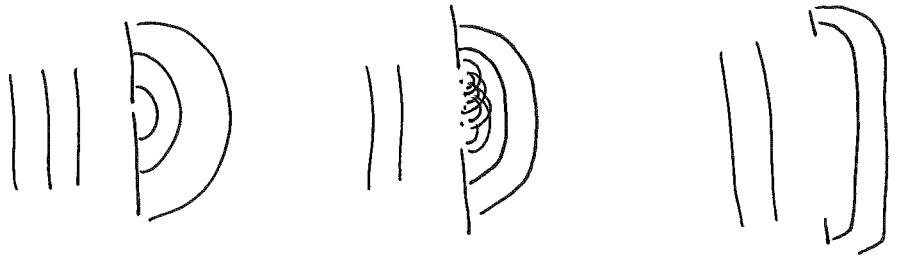
the wavefront that leaves the slit is curved. why?

⟶ b/c it lacks the contributions from the other point sources (stones)

This is called <u>diffraction</u>.
(spreading / diffracting of waves incident on a barrier)

As we shrink the size of the slit, the diffracted wavefronts look increasingly circular (an open tank is just the limit as we take the slit size to the size of the tank)

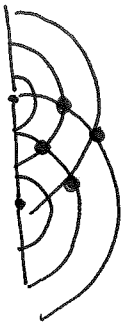
small slit | medium slit | large slit



→ starts to look more + more like plane wave

Now, what happens when we add another slit?

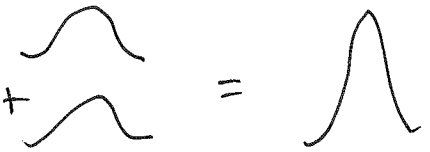
In the simplest case, ~~prete~~ imagine that each slit can only fit a single point source (a single stone). This is a good approx if the distance ~~betttw~~ between slits is much bigger than the size of the slits, so that the slit looks small in comparison.



What happens?

→ interference

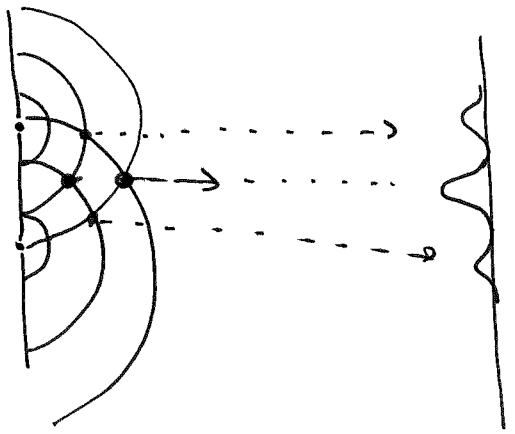
Where the lines cross, you have two overlapping wave crests (two overlapping peaks). What happens when you add two peaks together?

→  get one larger peak

constructive interference

Now if we could put a screen at the end of our tank and measure how much water is hitting it, which places would have the most water?

→ the points of constructive interference



Since it is hard to measure this with water, we will measure diffraction w/ something else. What do you suggest? → light.

Show single + double slit diffraction w/ light, varying slit ~~see~~ size and separation.