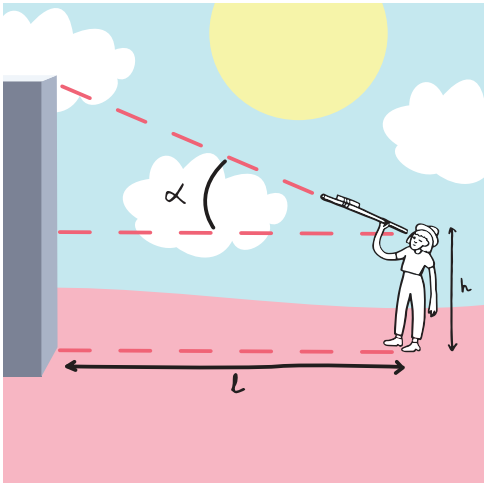
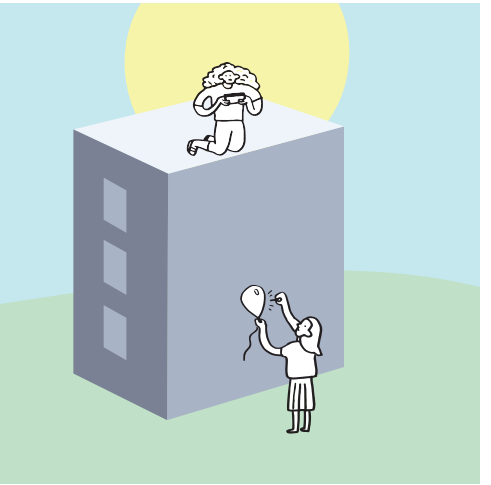
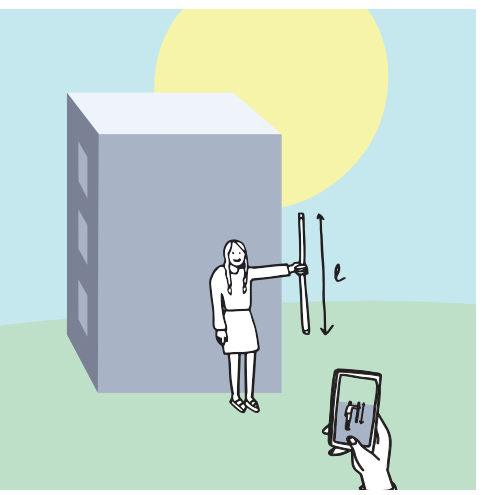


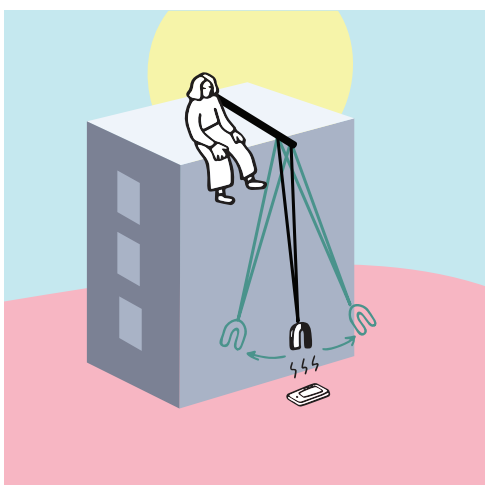


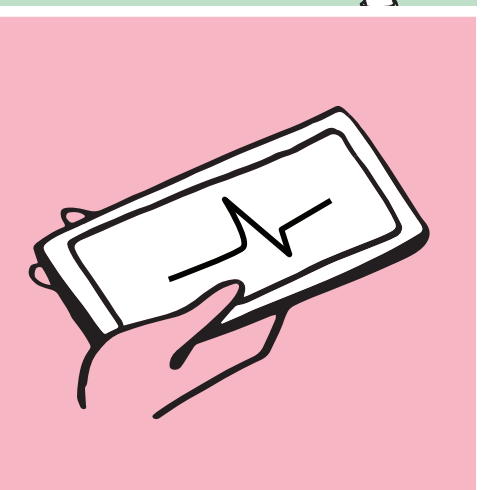
Theme:

ACOUSTICS

All the methods using acoustics principles and smartphones to determine the height of a building.







Discover The Smartphone Physics Challenge at VULGARISATION.FR

«Physics Reimagined» team (Paris-Saclay University)

Precision: intermediate

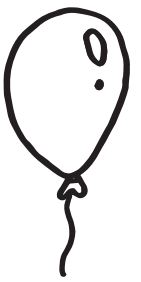
Difficulty: minimum

№39. Acoustic Stopwatch

Formula

$$H = v \frac{\delta t}{2}$$

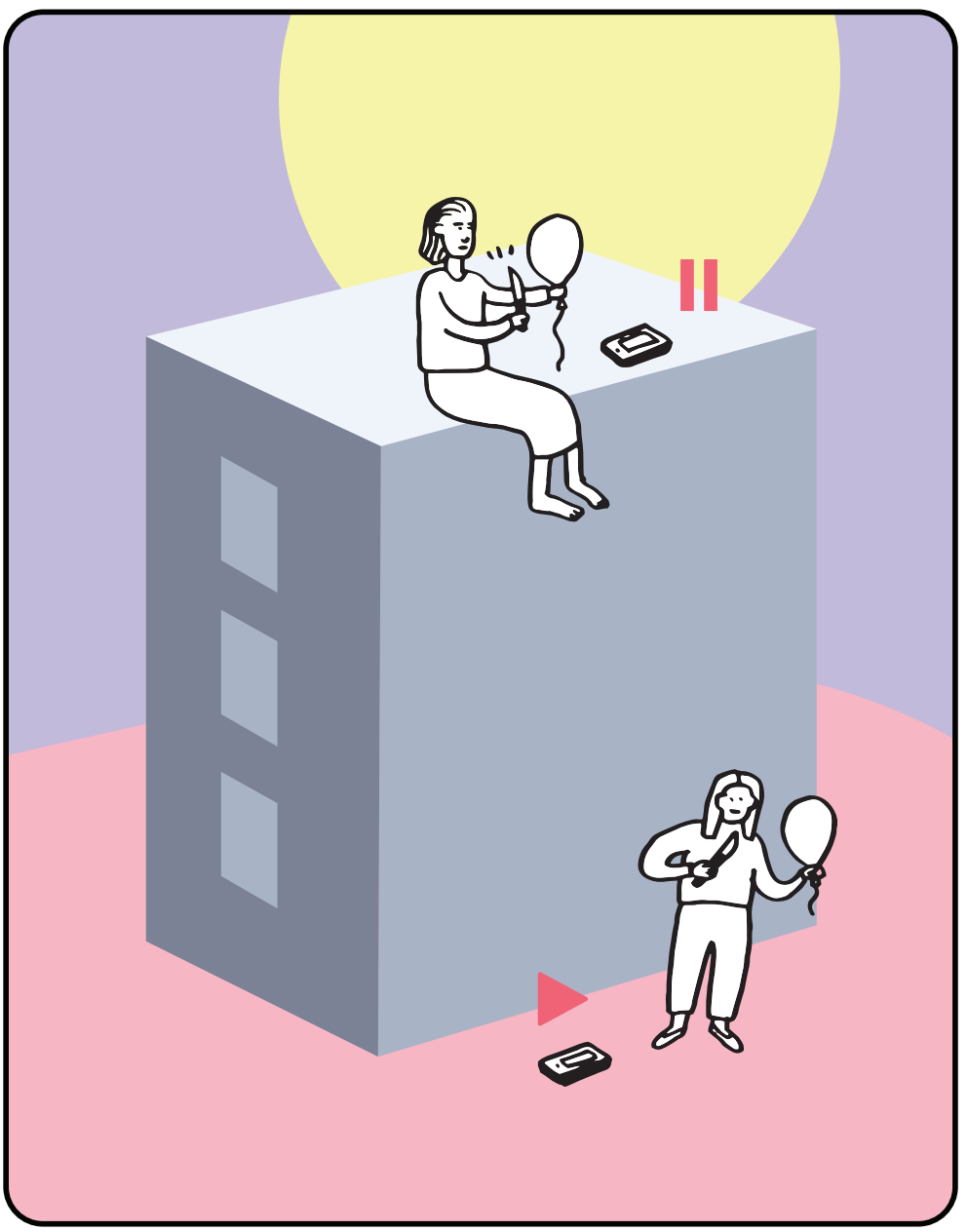
Material



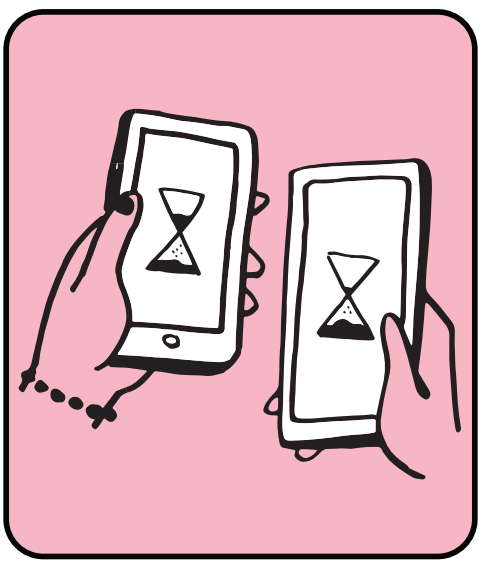
2 balloons

Sensor: **microphone**

2 smartphones



Install an acoustic stopwatch application on both smartphones (Phyphox for example). Launch the application, a smartphone at the bottom of the building, one at the top. Trigger the timers by popping a balloon at the bottom, then stop the timers by popping a balloon at the top.



v = speed of sound, δt = difference between the two chronometers

№40. Recording

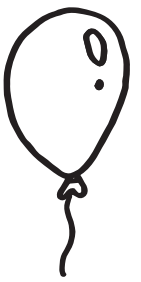
Precision: high

Difficulty: low

Formula

$$H = vt$$

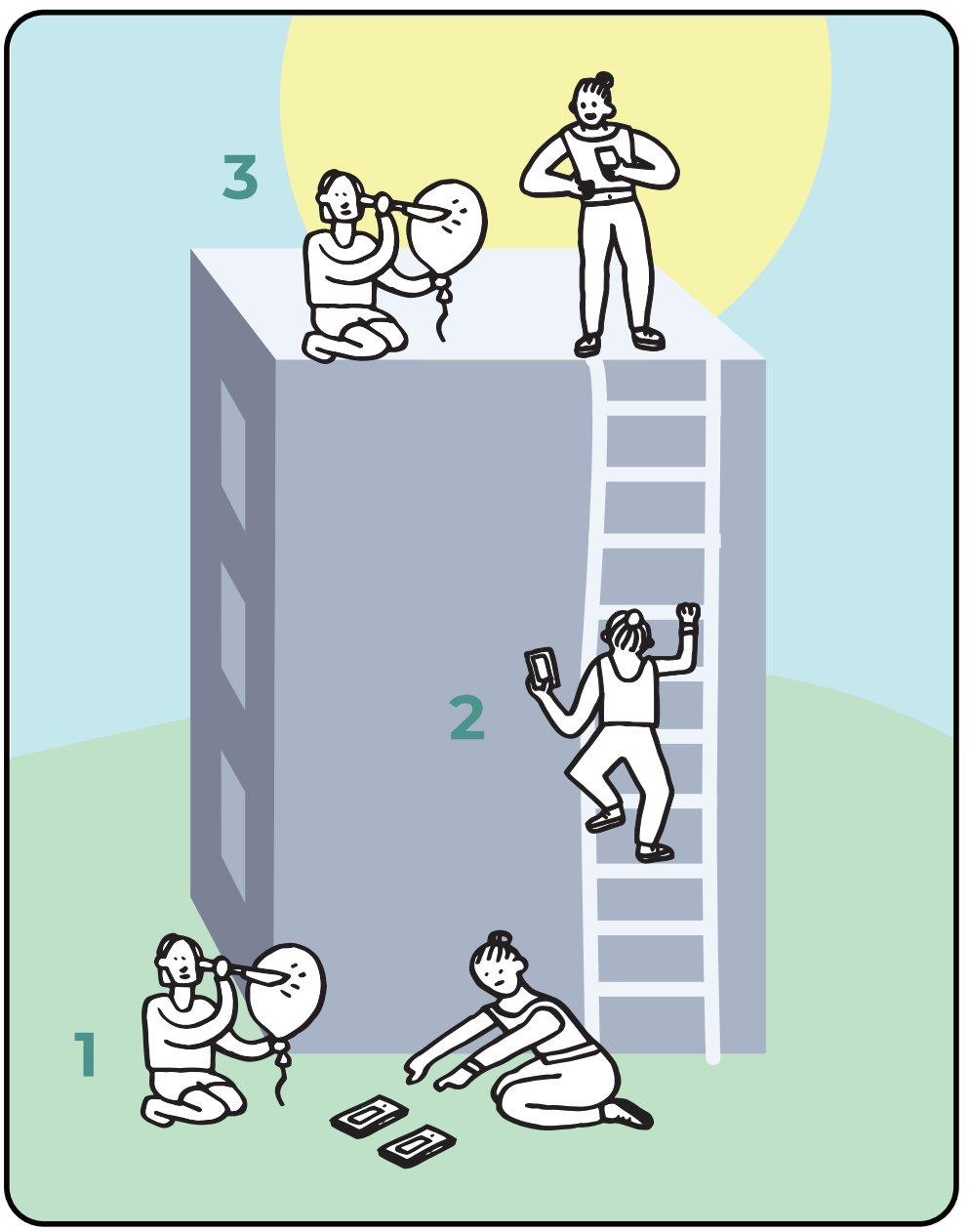
Material



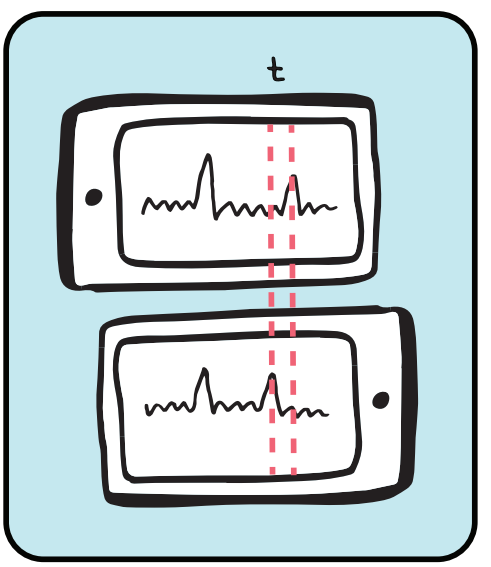
2 balloons

Sensor: **microphone**

2 smartphones



Launch audio recording on both smartphones at the bottom of the building, and pop a balloon. Without stopping the recordings, bring one smartphone at the top of the building and pop a second balloon. The first pop synchronizes the two recordings, the second gives the height of the building.



v = speed of sound, t = time between the two second pops

№41. Phone Call

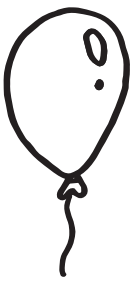
Precision: minimum

Difficulty: low

Formula

$$H = vt$$

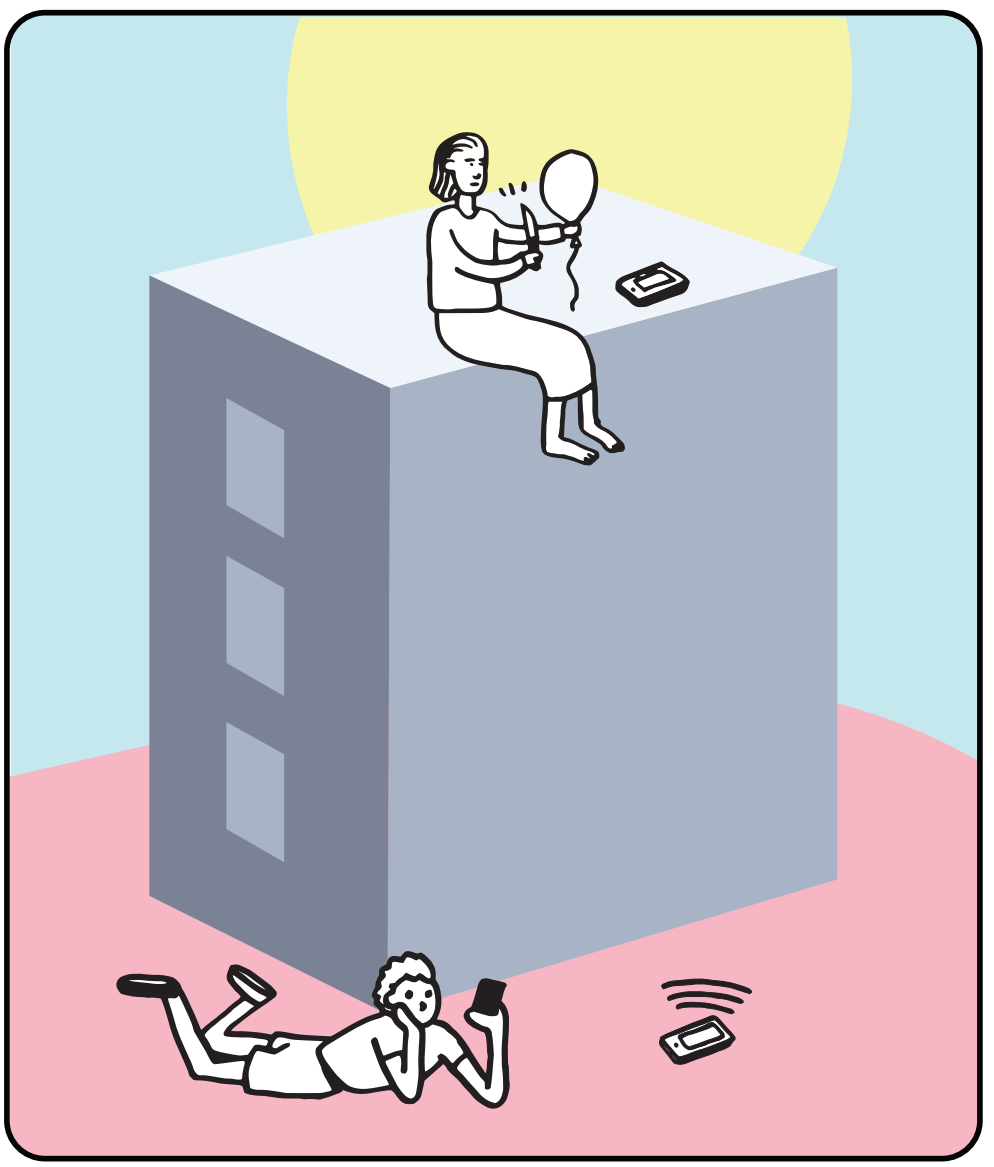
Material



1 balloon

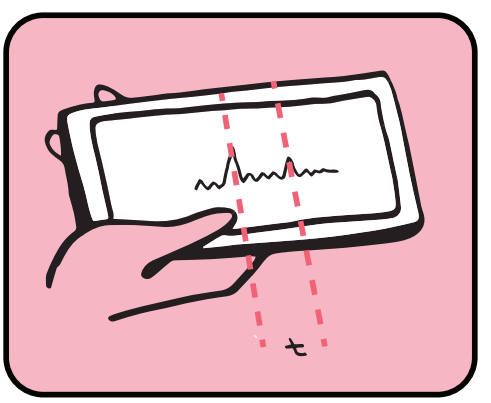
Sensors: **microphone, phone**

3 smartphones



From the bottom of the building, call someone at the top. Put your smartphone on loudspeaker, and start an audio recording on the third smartphone. The person at the top pops a balloon. On the recording, measure the delay between the pop coming from the speaker and the pop coming from the balloon.

v = speed of sound, t = time between the two pops



This method assumes an instant connection between the two phones...

№42. Echo

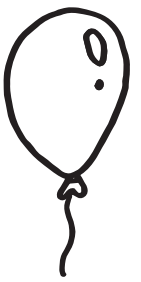
Precision: minimum

Difficulty: minimum

Formula

$$H = v\frac{t}{2}$$

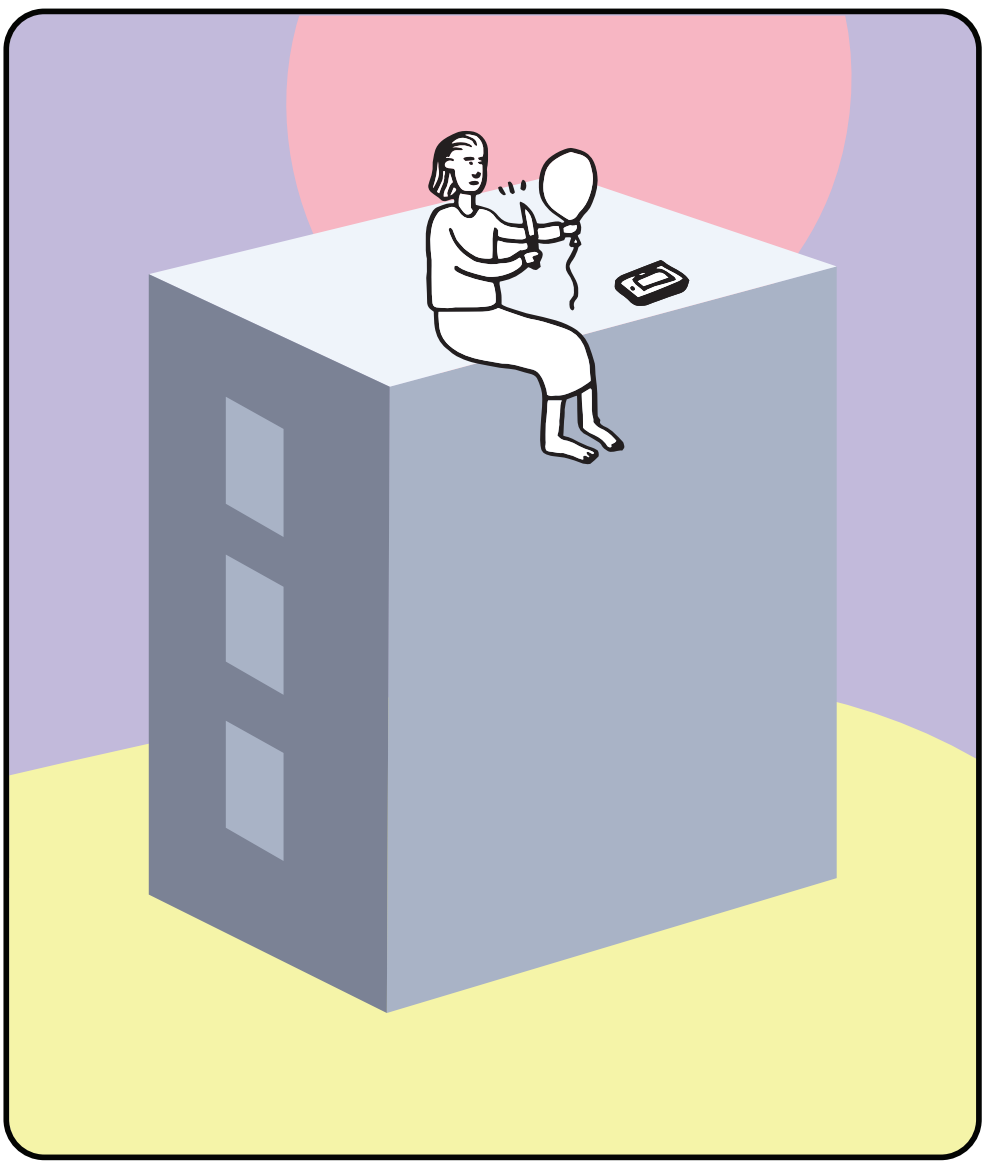
Material



1 balloon

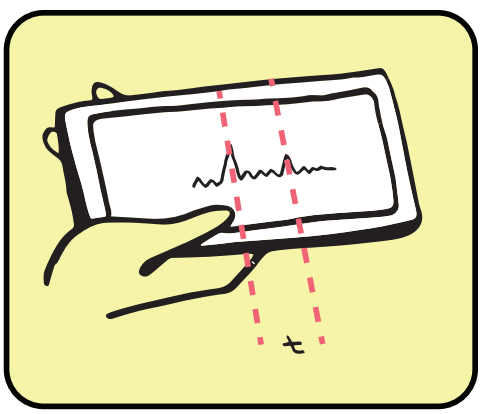
Sensor: **microphone**

1 smartphone



Post yourself at the top of the building. Launch an audio recording on the smartphone, and pop a balloon. Measure the delay between the pop and its echo.

v = speed of sound, t = time between pop and echo



There must be an echo for this method to work...

Precision: high

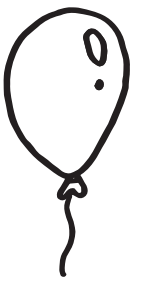
Difficulty: low

№43. Slow Motion

Formula

$$H = vt$$

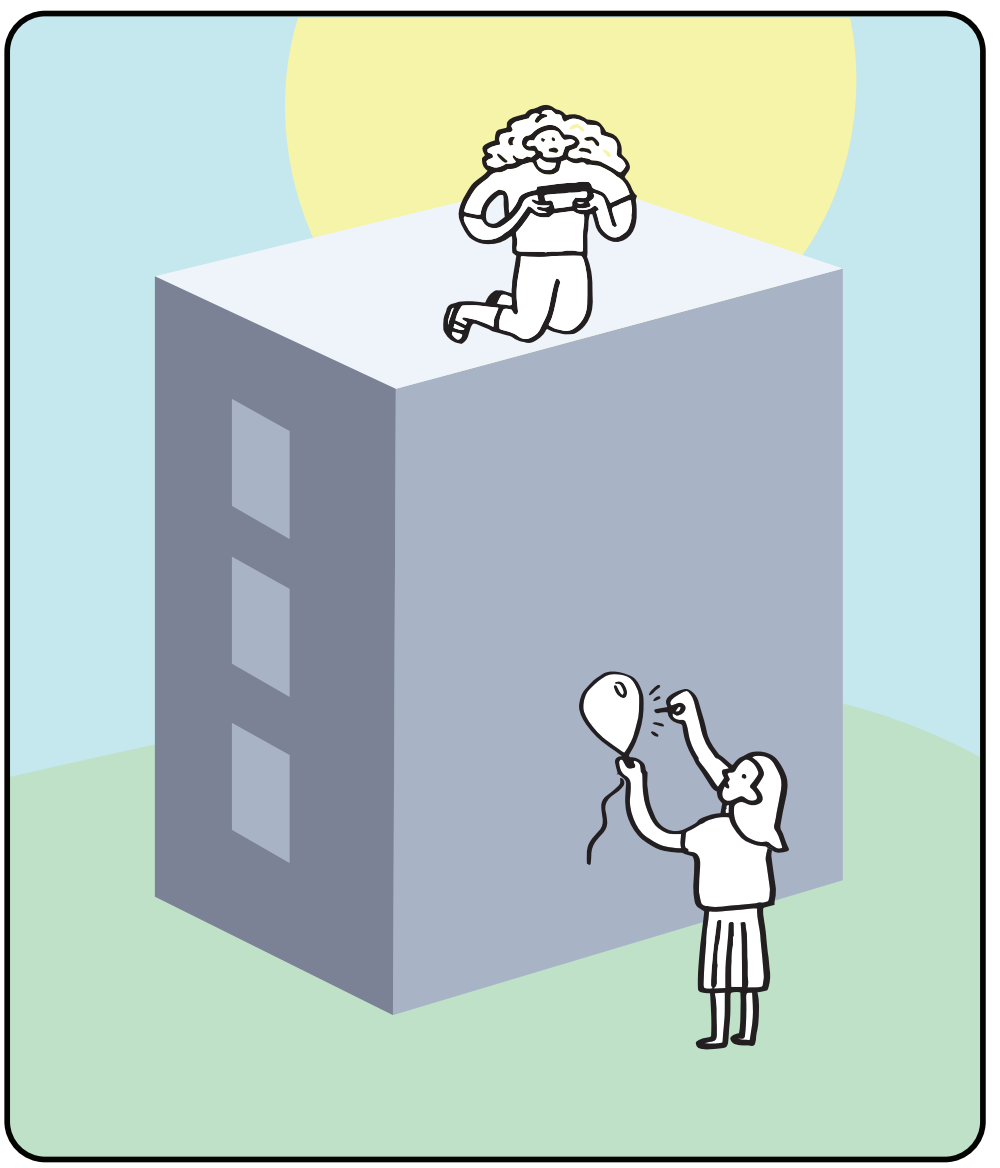
Material

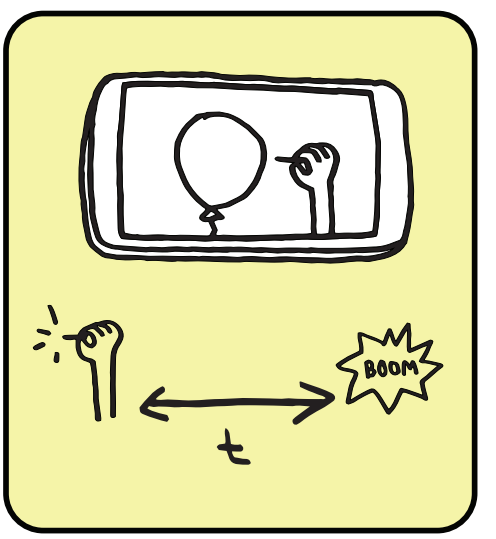


1 balloon

Sensors:
camera, microphone

1 smartphone with slow motion





From the top of the building, film in "slow motion" the bursting of a balloon at the bottom of the building. Measure the time elapsed between the image and the sound of the exploding balloon.

v = speed of sound, t = delay between pop image and pop sound

Some smartphones do not record sound in slow motion.

№49. Loudness

Precision: intermediate

Difficulty: low

Formula

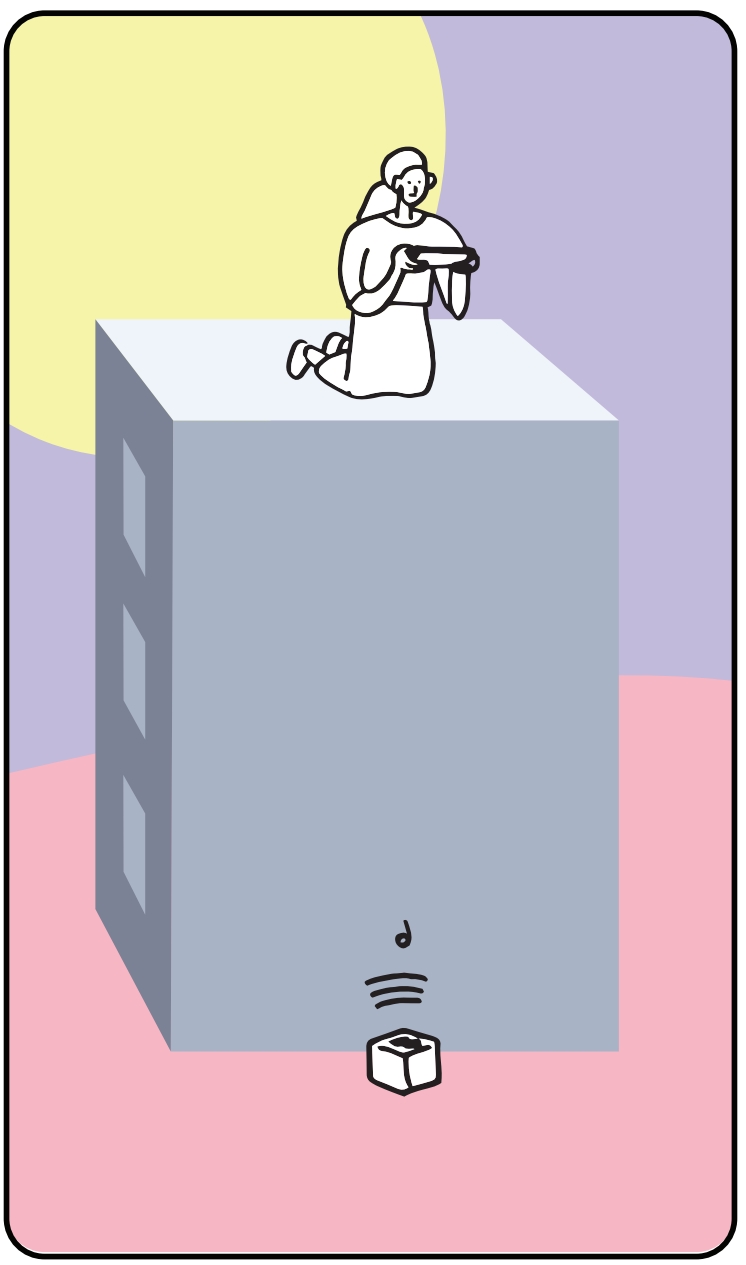
$$H \propto \frac{\Lambda}{\sqrt{I}}$$

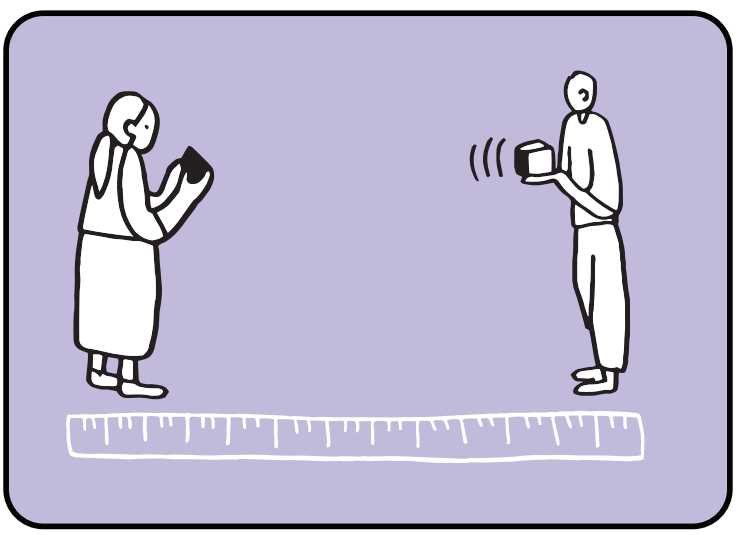
Material

1 bluetooth speaker

Sensor: **microphone**

1 smartphone





Install the speaker at the bottom of the building, and measure the sound intensity at the top. Turn off the sound to determine the ambient noise. The intensity varies in $1 / R^2$, and must be calibrated before.

I = sound intensity

This project was imagined by Frédéric Bouquet (Paris-Saclay University) and Giovanni Organtini (Sapienza Università di Roma, Italy).

Physics: Frédéric Bouquet, Giovanni Organtini, Julien Bobroff

Videos, photos, gifs: Amel Kolli

Graphic design and illustrations: Anna Khazina

This project is a production of «Physics Reimagined» from Paris-Saclay University and CNRS. It benefited from the support of the IDEX Paris-Saclay and of the «Physique Autrement» Chair, held by the Paris-Sud Foundation and supported by the Air Liquide Group.