1
00:00:00,300 --> 00:00:04,120
We can learn about what's inside an apple
by slicing it in half.

2
00:00:05,140 --> 00:00:09,880
We can learn a lot about what's inside a planet by slicing it in half, but

3
00:00:10,080 --> 00:00:12,460
they're planets, you can't really slice them in half.

4
00:00:13,020 --> 00:00:17,580
So, how will the Juno
spacecraft find out what's inside Jupiter?

5
00:00:27,050 --> 00:00:33,999
We don't know what's inside Jupiter. Jupiter
could have a core made of heavy metal that's

6
00:00:33,999 --> 00:00:40,719
sunk to the center. Or it might be that Jupiter
has this exotic material that's hydrogen,

7
00:00:40,720 --> 00:00:48,100
squeezed down to such a high pressure, that the hydrogen acts like a metal: metallic hydrogen.

8
00:00:48,340 --> 00:00:55,880
Now, we can't cut Jupiter in half, we don't
have that capability, instead we have a happy little spacecraft

9
00:00:55,980 --> 00:00:58,860
in orbit around Jupiter.

10
00:00:59,120 --> 00:01:02,100
I'm a happy spacecraft orbiting a great big planet.

11
00:01:02,280 --> 00:01:08,140
Now as it orbits, we strongly believe
that there will be slight variations in its

12
00:01:08,140 --> 00:01:14,600
path due to tiny variations in the gravity
of Jupiter. And that will help us figure out

13
00:01:14,600 --> 00:01:21,170
what's inside. Now, how would we measure the
tiny variations of the orbit of a spacecraft

14
00:01:21,170 --> 00:01:27,170
around a great big planet millions of kilometers
from here? Well, we would do it by measuring

15
00:01:27,170 --> 00:01:32,219
the frequency of radio waves; radio waves
coming from the spacecraft, and radio waves

16
00:01:32,220 --> 00:01:39,520
coming from Earth. We can measure those variations like this, using the Doppler effect.

17
00:01:40,280 --> 00:01:44,680
Listen to the sound as the alarm clock moves toward you.

18
00:01:44,680 --> 00:01:48,420
[ALARM RINGING]

19
00:01:48,580 --> 00:01:51,520
Now listen to the sound as the alarm clock moves away.

20
00:01:51,520 --> 00:01:54,880
[ALARM RINGING]

21
00:01:55,080 --> 00:01:59,880
As it's moving toward you,
the sound gets higher-pitched.

22
00:01:59,880 --> 00:02:03,220
As it's moving away, the sound gets lower-pitched.

23

00:02:03,220 --> 00:02:06,940
Now this effect, or this phenomenon, was described

24
00:02:07,149 --> 00:02:12,840
at first by a man named Christian Doppler.
And to this day, my brother would like to

25
00:02:12,840 --> 00:02:16,800
have a rock-n-roll group called Christian
Doppler and the Effects.

26
00:02:16,980 --> 00:02:21,500
But my brother's first name isn't Christian.

27
00:02:21,680 --> 00:02:27,460
So, we believe that by precisely measuring the path of Juno

28
00:02:28,180 --> 00:02:33,640
as it orbits Jupiter using the Doppler effect,
we'll be able to determine, from Jupiter's