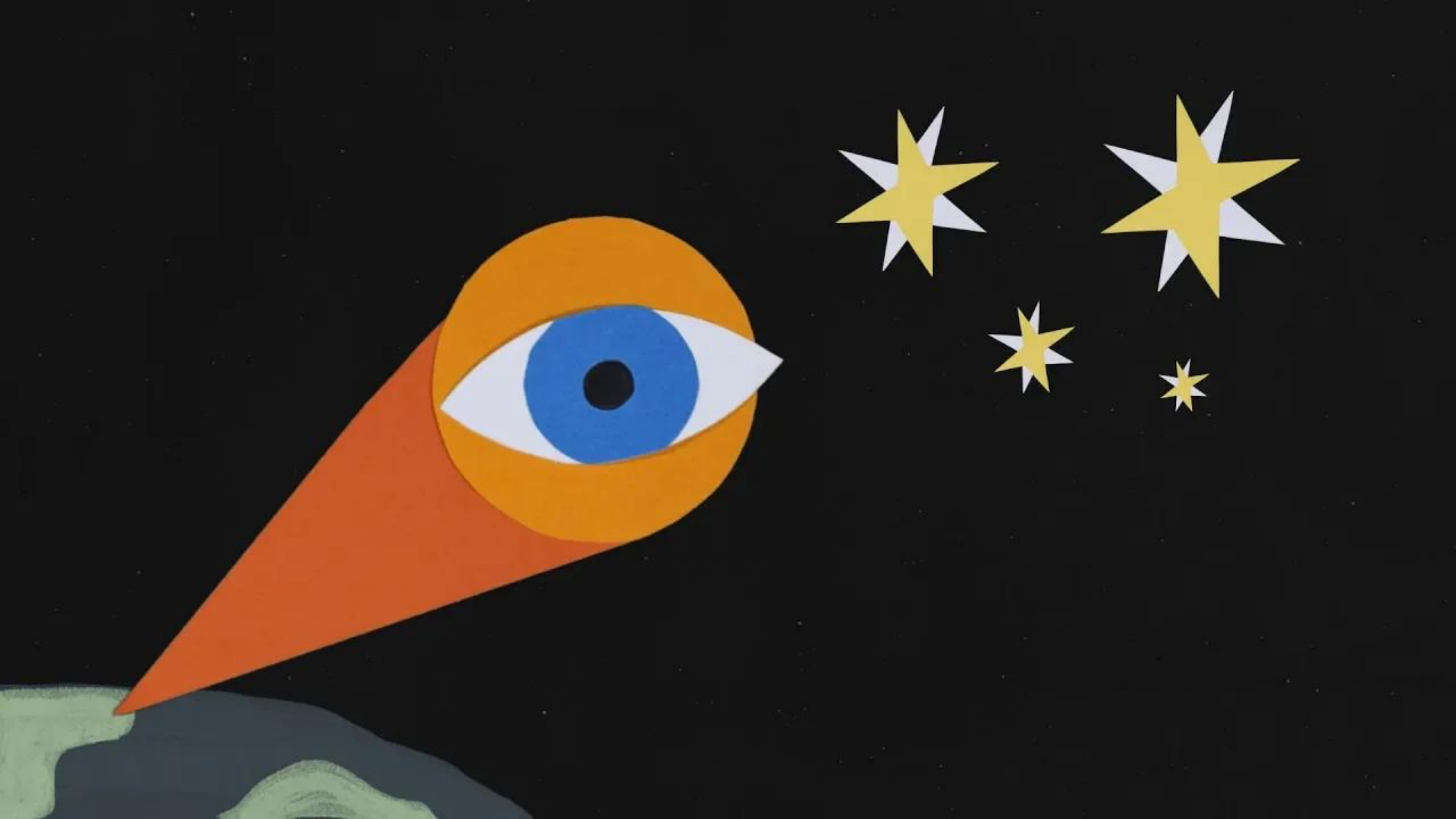

1
00:00:00,000 --> 00:00:02,990
The Sun’s core is the hottest part of the Sun.

2
00:00:03,010 --> 00:00:06,600
But our star’s temperature doesn’t behave as you might expect.

3
00:00:06,620 --> 00:00:09,980
The core is roughly 27 million degrees Fahrenheit

4
00:00:10,000 --> 00:00:12,420
and 10 times more dense than gold.

5
00:00:12,440 --> 00:00:16,930
As you move outward, the layers of the Sun become cooler and less dense.

6
00:00:16,950 --> 00:00:21,320
Something unusual, however, occurs when you reach the outermost layer.

7
00:00:21,340 --> 00:00:24,920
While the surface is around 10,000 degrees Fahrenheit,

8
00:00:24,940 --> 00:00:29,580
the corona – the Sun’s outer atmosphere — is several hundred times hotter.

9
00:00:29,600 --> 00:00:34,950
That’s the opposite of what happens with a fire, when it gets cooler the farther away you get.

10
00:00:34,970 --> 00:00:37,520
Scientists call this the coronal heating problem

11
00:00:37,540 --> 00:00:42,380
and evidence for this was first uncovered during an eclipse in the 1800s.

12
00:00:42,400 --> 00:00:48,420
The corona is usually hard to see -- it’s too dim to be seen next to the Sun’s bright body.

13
00:00:48,440 --> 00:00:50,730

But it can be seen with the naked eye,

14
00:00:50,750 --> 00:00:54,190
when the moon blocks the sun during a total solar eclipse.

15
00:00:54,210 --> 00:00:57,070
To understand how this mystery was discovered,

16
00:00:57,090 --> 00:01:02,680
it helps to know how scientists started studying the chemical properties of materials on Earth.

17
00:01:02,700 --> 00:01:06,270
In the early 1800s, instruments named spectroscopes

18
00:01:06,290 --> 00:01:10,060
were invented to identify materials that emit light when heated.

19
00:01:10,080 --> 00:01:16,380
Light enters the spectroscope and is filtered through a tiny hole to isolate a single area.

20
00:01:16,400 --> 00:01:21,500
It then bounces off a special grating that disperses light into its different wavelengths.

21
00:01:21,520 --> 00:01:24,450
While sunlight contains every wavelength,

22
00:01:24,470 --> 00:01:28,090
scientists discovered that every chemical element and compound

23
00:01:28,110 --> 00:01:30,180
contains a unique pattern of wavelengths

24
00:01:30,200 --> 00:01:33,800
that allows scientists to determine the composition of light sources.

25
00:01:33,820 --> 00:01:40,160
It wasn’t long before astronomers started extracting information from the light of distant stellar objects.

26
00:01:40,180 --> 00:01:48,570
In 1869, two scientists independently decided to point a spectroscope toward the corona during a total solar ec

27
00:01:48,590 --> 00:01:53,150
As the Sun’s light disappeared, the pattern of wavelengths changed.

28
00:01:53,170 --> 00:01:55,580
They saw something they had never seen before.

29
00:01:55,600 --> 00:02:00,930
A bright green line that did not relate to any element found on Earth.

30
00:02:00,950 --> 00:02:04,180
For a short while, scientists named it ‘coronium’.

31
00:02:04,200 --> 00:02:08,610
It wasn’t until 70 years later that a Swedish scientist discovered

32
00:02:08,630 --> 00:02:14,110
that these lines were the result of elements such as iron being stripped of its electrons.

33
00:02:14,130 --> 00:02:18,440
Every element has a specific number of electrons surrounding the nucleus.

34
00:02:18,460 --> 00:02:23,050
As each electron is removed, more energy is needed to remove the next one.

35
00:02:23,070 --> 00:02:28,830
The green line shows that iron has been stripped of 13 of its 26 electrons –

36
00:02:28,850 --> 00:02:35,870
– indicating that the corona needed to be millions of degrees -- counterintuitively far hotter than the Sun’s surfa

37
00:02:35,890 --> 00:02:39,670
Scientists have since proposed a variety of theories

38
00:02:39,690 --> 00:02:43,560

for what mechanisms could be adding that extra heat into the atmosphere.

39
00:02:43,580 --> 00:02:50,320
One theory suggests that small waves in the Sun’s surface pushes particles and heat into the atmosphere

40
00:02:50,340 --> 00:02:53,210
- a bit like how ocean waves push surfers.

41
00:02:53,230 --> 00:03:00,090
Another theory suggests small bomb-like explosions from the realignment of the Sun’s magnetic field create he

42
00:03:00,110 --> 00:03:02,690
Many scientists think it may be a mix of both.