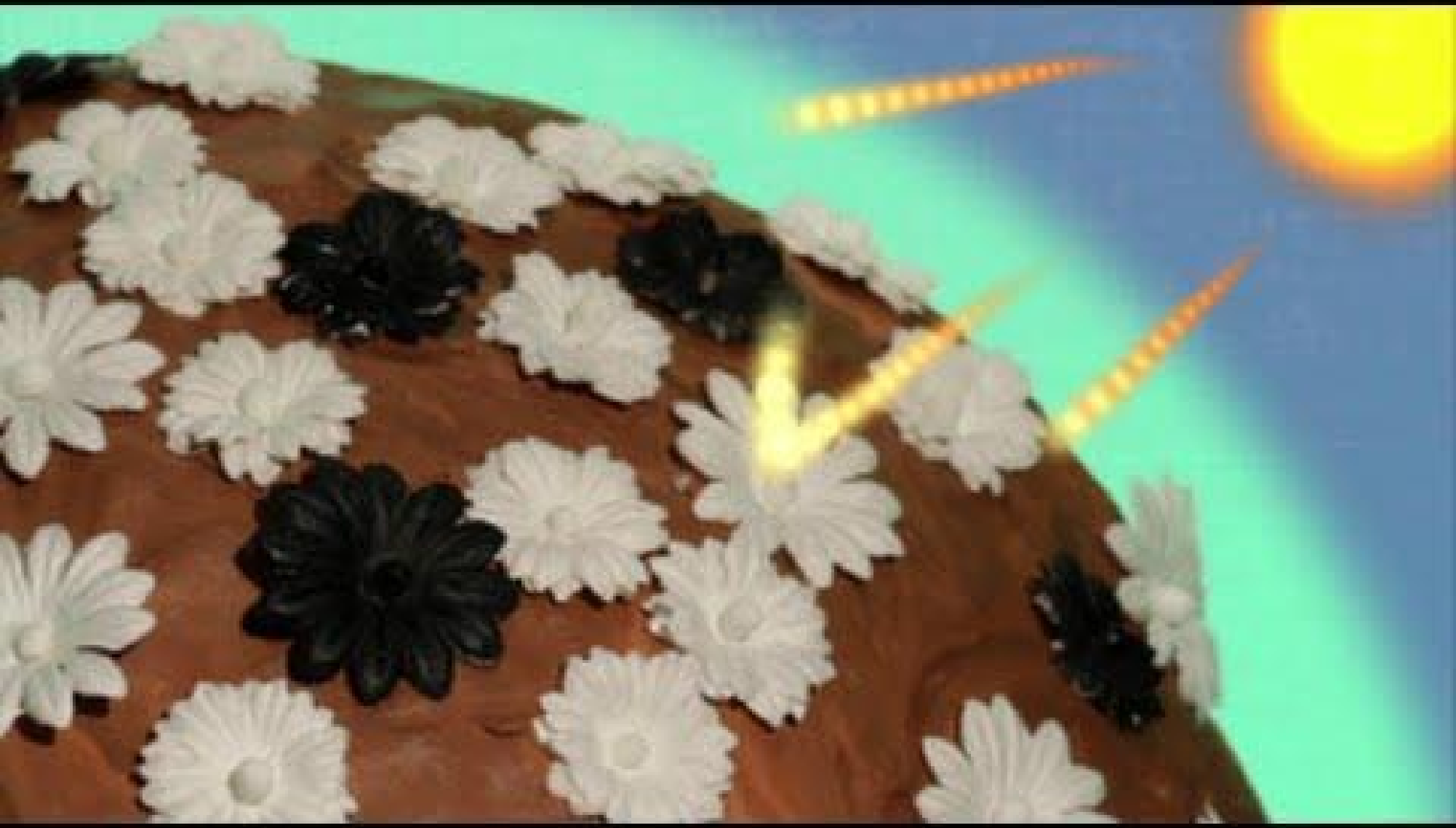

1
00:00:00,000 --> 00:00:04,040
Picture a simple theoretical planet. Simpler.

2
00:00:04,060 --> 00:00:08,070
Simpler. Keep, keep going, keep--nope that's

3
00:00:08,090 --> 00:00:12,110
too far. That is just a dot. Not even trying. Ok,

4
00:00:12,130 --> 00:00:16,130
there. This is DaisyWorld, a place where only two things

5
00:00:16,150 --> 00:00:20,150
live: black daisies and white daisies.

6
00:00:20,170 --> 00:00:24,170
In the early days, the atmosphere of DaisyWorld

7
00:00:24,190 --> 00:00:28,190
is cooler and black daisies thrive in these cooler temperatures.

8
00:00:28,210 --> 00:00:32,200
The black daisy population does so well in fact

9
00:00:32,220 --> 00:00:36,250
that it absorbs more energy and begins the warm the little planet.

10
00:00:36,270 --> 00:00:40,290
But now it's too warm for black daisies, but it's just right for the white

11
00:00:40,310 --> 00:00:44,390
daisies to blossom and expand. And while the planet is covered with

12
00:00:44,410 --> 00:00:48,430
more and more white daisies, they begin to reflect more energy back

13
00:00:48,450 --> 00:00:52,460

into space. We call this amount of reflectance albedo. The more reflective

14
00:00:52,480 --> 00:00:56,480
the surface of the planet, the higher its albedo. We can think of it

15
00:00:56,500 --> 00:01:00,520
as a percentage of how much energy is coming in and then bouncing back out

16
00:01:00,540 --> 00:01:04,540
into space. For instance, the albedo of a perfect mirror would

17
00:01:04,560 --> 00:01:08,570
be one hundred percent. If we had a completely

18
00:01:08,590 --> 00:01:12,680
black surface the albedo would be zero percent.

19
00:01:16,740 --> 00:01:20,760
Or a waterworld, that could be twenty percent.

20
00:01:20,780 --> 00:01:24,800
Now the white daisies cool the planet again,

21
00:01:24,820 --> 00:01:28,840
and that makes it more favorable for black daisies to thrive once again.

22
00:01:28,860 --> 00:01:32,900
Now we're back to where we started. The black daisies have taken over

23
00:01:32,920 --> 00:01:36,950
but they'll warm up the planet, and then they'll die and the white daisies will grow

24
00:01:36,970 --> 00:01:41,000
but then they'll reflect more heat back out and then they'll die and on and on and on and back

25
00:01:41,020 --> 00:01:45,020
and forth.

26
00:01:45,040 --> 00:01:49,050
And over time, within a narrowly defined temperature range,

27
00:01:49,070 --> 00:01:53,070
DaisyWorld stays resilient and makes it possible for daisies to exist

28
00:01:53,090 --> 00:01:57,090
at all. Of course, this is a theoretical planet; there are no

29
00:01:57,110 --> 00:02:01,110
variables, like rotation, seasons,

30
00:02:01,130 --> 00:02:05,120
diseases,

31
00:02:05,140 --> 00:02:09,170
geography, or even humans.

32
00:02:09,190 --> 00:02:13,210
It does illustrate how a change in one environmental condition

33
00:02:13,230 --> 00:02:17,250
can cause a change in a second condition, which in turn, can change the first condition

34
00:02:17,270 --> 00:02:21,280
again. We call this a feedback loop.

35
00:02:21,300 --> 00:02:25,310
The DaisyWorld model is an example of a negative feedback

36
00:02:25,330 --> 00:02:29,340
loop because the initial changes to the climate are muted by the combination

37
00:02:29,360 --> 00:02:33,370
of black and white daisies. On Earth

38
00:02:33,390 --> 00:02:37,390

we can see this kind of negative feedback loop with clouds. Let's say

39
00:02:37,410 --> 00:02:41,400
increasing temperatures cause more surface evaporation, which cause more

40
00:02:41,420 --> 00:02:45,460
cloud formation, and clouds, much like our white daisies, have a

41
00:02:45,480 --> 00:02:49,510
higher albedo than the Earth's surface. Then the clouds will

42
00:02:49,530 --> 00:02:53,540
reflect more heat and cool the planet. When we look at snow

43
00:02:53,560 --> 00:02:57,570
and ice at the poles, which have a high albedo, we can see a positive

44
00:02:57,590 --> 00:03:01,610
feedback loop. When temperatures rise, the snow and ice

45
00:03:01,630 --> 00:03:05,630
melt, and so even more energy is absorbed by the water, and this

46
00:03:05,650 --> 00:03:09,640
continues to melt the snow and ice even further. With increasing climate change

47
00:03:09,660 --> 00:03:13,660
the natural reflectance of our icy poles dramatically declines.

48
00:03:13,680 --> 00:03:17,670
DaisyWorld is a much simpler place than our own planet,

49
00:03:17,690 --> 00:03:21,730
but it shows us that maintaining a population on Earth requires a

50
00:03:21,750 --> 00:03:25,780
delicate balance with the right organisms and the right range of