



COOL

1  
00:00:00,834 --> 00:00:02,635  
Look at these  
delicious baked goods.

2  
00:00:02,668 --> 00:00:03,669  
They're all quite different.

3  
00:00:03,769 --> 00:00:06,172  
But they're made from the  
same basic ingredients:

4  
00:00:06,205 --> 00:00:09,309  
flour, eggs and yeast.

5  
00:00:09,409 --> 00:00:10,977  
The solar system is like that.

6  
00:00:11,010 --> 00:00:12,912  
We really have just  
a few elements.

7  
00:00:13,012 --> 00:00:14,947  
But they're mixed  
together in all these

8  
00:00:14,980 --> 00:00:16,916  
different and extraordinary ways

9  
00:00:16,949 --> 00:00:19,385  
so that we end up with all the  
planets in the solar system.

10  
00:00:19,418 --> 00:00:22,188  
So, how does Jupiter  
help us learn

11  
00:00:22,221 --> 00:00:24,190  
how this mixture came to be?

12

00:00:24,290 --> 00:00:33,499

(■)

13

00:00:33,532 --> 00:00:35,769

This is Jupiter.

14

00:00:35,869 --> 00:00:38,404

Uh, well, it's not Jupiter,  
it's a model of Jupiter.

15

00:00:38,437 --> 00:00:40,706

See, Jupiter is huge.

16

00:00:40,739 --> 00:00:45,645

Jupiter is big--big--bigly,  
gigantically, enormously huge.

17

00:00:45,678 --> 00:00:47,213

Jupiter is bigger than

18

00:00:47,246 --> 00:00:50,050

all of the other planets in  
the solar system, combined.

19

00:00:50,150 --> 00:00:52,385

Jupiter probably formed first.

20

00:00:52,418 --> 00:00:55,121

And it's got an enormous  
amount of gravity.

21

00:00:55,154 --> 00:00:58,458

And that gravity  
flung all the elements

22

00:00:58,491 --> 00:01:00,960

of the solar system  
all over the place.

23

00:01:00,993 --> 00:01:02,795

I mean we're talking  
about carbon,

24

00:01:02,828 --> 00:01:05,064

and nitrogen,  
hydrogen, and oxygen.

25

00:01:05,097 --> 00:01:06,866

Hydrogen and oxygen,  
that's water.

26

00:01:06,899 --> 00:01:10,069

All the water got flung  
around the solar system

27

00:01:10,102 --> 00:01:11,638

by Jupiter's gravity.

28

00:01:11,738 --> 00:01:14,607

Now this is what  
we call diffusion.

29

00:01:14,640 --> 00:01:18,211

Diffusion is from old words  
that mean "to pour out."

30

00:01:18,244 --> 00:01:20,546

And you can do some  
diffusion yourself.

31

00:01:20,579 --> 00:01:24,016

Here is room temperature  
water in this jar

32

00:01:24,049 --> 00:01:27,620

and cool water, which we've  
dyed blue, in this jar.

33

00:01:27,653 --> 00:01:29,722  
Now when something is cool,

34

00:01:29,755 --> 00:01:32,425  
its molecules are  
moving more slowly.

35

00:01:32,458 --> 00:01:34,994  
And they're packed  
closer together.

36

00:01:35,027 --> 00:01:37,663  
So the blue water  
is a little heavier

37

00:01:37,696 --> 00:01:39,632  
than the room temperature water.

38

00:01:39,665 --> 00:01:43,402  
Watch what happens when we  
pull this slippery card out.

39

00:01:43,435 --> 00:01:45,438  
(drumroll)

40

00:01:45,538 --> 00:01:48,441  
Nothing happens.  
(crickets chirping)

41

00:01:48,474 --> 00:01:51,578  
They stay right in position.

42

00:01:51,678 --> 00:01:55,047  
But here, dyed red,  
I have warm water.

43

00:01:55,080 --> 00:01:56,983  
Its molecules  
are moving faster,

44

00:01:57,016 --> 00:01:58,284

and they're pushed  
farther apart.

45

00:01:58,317 --> 00:02:01,187

So there's actually just  
a tiny bit less water

46

00:02:01,220 --> 00:02:03,055

down here than up here.

47

00:02:03,088 --> 00:02:04,891

This water is denser.

48

00:02:04,924 --> 00:02:06,893

So when I pull  
this card out,

49

00:02:06,926 --> 00:02:10,530

the warm water is  
going to diffuse

50

00:02:10,563 --> 00:02:12,131

into the room  
temperature water.

51

00:02:12,164 --> 00:02:14,534

(drumroll)

52

00:02:14,567 --> 00:02:16,102

(impressed exclamations)

53

00:02:16,135 --> 00:02:17,670

Look how fast it happens.

54

00:02:17,703 --> 00:02:21,507

Gravity is driving the cool,  
room temperature water down

55

00:02:21,540 --> 00:02:24,644

which is forcing the  
warm, red-dyed water up.

56

00:02:24,744 --> 00:02:27,513

Diffusion is driven  
here by gravity.

57

00:02:27,546 --> 00:02:28,714

(impressed exclamations)

58

00:02:28,747 --> 00:02:31,184

Now Jupiter and the  
solar system's a little

59

00:02:31,217 --> 00:02:33,486

over 4 1/2 billion years old.

60

00:02:33,519 --> 00:02:36,189

So that was enough time  
for Jupiter's gravity

61

00:02:36,222 --> 00:02:40,893

to diffuse all of the elements  
all over the solar system.

62

00:02:40,926 --> 00:02:43,996

All the stuff that  
you and I are made of

63

00:02:44,029 --> 00:02:47,767

got here on earth because  
of the enormous gravity

64

00:02:47,800 --> 00:02:51,437

of this enormous  
planet diffusing us