400 students. This is Mr.

0:16

Gails and today I'm going to bring you

0:18

the chemistry of water screencast

0:19

session number one. We're going to kind

0:21

of leave behind our look at atoms,

0:23

elements in the periodic table and begin

0:26

applying what you learned in the first

0:27

part of our basic chemistry unit by

0:29

looking at the unique properties of

0:31

water which derive from really the

0:34

structure of the water molecule and

0:35

hydrogen bonds that we find between

0:37

molecules. That'll be the focus of this

0:39

first screencast. And hopefully by the

0:40

end of this first screencast, you'll

0:42

have a better idea of what causes what

0:44

you see here on this picture. You've

0:46

probably seen this before where you have

0:48

water droplets that are sort of pulled

0:49

up on the surface of uh could be a leaf

0:52

like you see in this picture or even on

0:53

on the surface of a car in the early

0:56

morning. The hope is that after you've

0:58

seen about the structure of water and

1:00

been introduced to a hydrogen bond that

1:02

you would be able to explain what causes

1:04

this. So keep that kind of in the back

1:06

of your mind. Why do water droplets form

1:08

the way that they do? So let's get right

1:10

into looking at the structure of water

1:12

and then we'll follow up with looking at

1:13

something called a hydrogen bond.

1:16

All right. So, we're going to begin by

1:17

looking at this water molecule over

1:19

here. We have two hydrogen atoms.

1:21

Remember, we know the chemical formula

1:23

of water is H2O. So, we have two

1:24

hydrogen atoms that are each joined to

1:27

this oxygen atom by a single polar

1:29

coalent bond. You should remember from

1:32

the electro negativity screencast that

1:35

whenever we have an oxygen atom that's

1:37

going to bond with either carbon or

1:39

hydrogen, oxygen has a a greater electro

1:42

negativity value. Not so much that it's

1:44

going to completely pull the electrons

1:45

away, but enough that it's going to pull

1:48

the electrons closer to itself. So they

1:50

are the electrons are essentially being

1:52

shared unequally, right? And that's what

1:54

makes this a polar covealent bond. If we

1:57

could visualize this, these these two

1:58

shared electrons will spend more time

2:01

around the oxygen atoms nucleus than

2:04

they will around the hydrogen atoms

2:06

nucleus. That's what makes it polar. And

2:08

so we have these two hydrogen atoms each

2:11

having polar covealent bonds with the

2:13

oxygen atom.

2:15

Um the when we have polar bonds present

2:19

polar coalent bonds present within a

2:21

molecule we say that that makes the

2:23

entire molecule itself polar. Now this

2:26

is a very important picture. Um I would

2:29

recommend that you draw this into your

2:31

notes. What this represents here is the

2:34

result of those polar coalent bonds.

2:36

This is what a polar molecule looks

2:38

like. And this is going to play a very

2:39

important role in much of what we do for

2:41

the remainder of the first semester. So

2:43

let's take a moment and draw that. Now

2:46

what we have here, remember the oxygen

2:48

atom is going to be a little bit more

2:50

electrogative than the hydrogen. So it's

2:52

going to pull the electrons closer to

2:54

itself. What that means if you think

2:56

about an electron is negatively charged.

2:58

So if there are more electrons that are

2:59

going to spend more time around oxygen,

3:01

that's going to give that end of the

3:04

molecule a slightly negative

3:06

charge. On the other side of the

3:08

molecule where there are the hydrogen

3:10

atoms, the electrons spend a little bit

3:12

less time. They're still being shared,

3:14

but it's an unequal sharing. And so the

3:17

hydrogen end of the water molecule

3:19

receives a slightly positive

3:21

charge. Polar, think north pole, south

3:24

pole, opposites, right? So we have a

3:26

slightly negative charge on the oxygen

3:28

end and a slightly positive charge on

3:30

the hydrogen end. This is a a critical

3:32

concept. This is really important in

3:34

understanding not only the structure of

3:36

water but also its interactions with

3:38

other materials that we'll learn about

3:40

in subsequent screencasts.

3:42

Now, I'm going to show you a a brief

3:45

video that will explain in a little bit

3:47

more detail the structure of water, and

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it's going to introduce to you the idea

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of the hydrogen bond, which was also

3:52

going to be an important concept as we

3:53

move forward in biology. So, let's take

3:55

a look at that video.

3:57

[Music]

3:59

Now, water's physical properties, tough

4:02

yet fluid, make it the backbone of

4:05

everything from tiny cells to the

4:07

world's weather systems. It's a small,

4:09

simple molecule that covers 70% of the

4:13

planet. It's a liquid that carves out

4:16

the planet's surface and an electrically

4:18

lopsided chemical that makes all life

4:21

possible. And over time, it cuts like a

4:23

knife. But what makes it so tough? As in

4:27

much of life, the key to success is

4:29

sticking together. Water's countless

4:31

molecules flow as if one. And that flow

4:34

has everything to do with water's

4:36

electrochemical makeup.

4:40

Water is something called a

4:42

dipole. A dipole simply means that it's

4:45

a material that has one kind of charge

4:48

on one end and another kind of charge,

4:50

the opposite one on the other end. So

4:53

it's got a slightly negative part over

4:55

near the big fat oxygen atom. and near

4:58

the hydrogen atoms, it's a slightly

5:00

positive part. So, this enables water to

5:03

do something pretty spectacular. When

5:06

it's in combination with other water

5:08

molecules, the hydrogen parts get

5:10

attracted to the oxygen part of its

5:13

nearest neighbor. And so, the molecules

5:15

kind of squeeze

5:18

together. This attraction, known as the

5:21

hydrogen bond, is at the core of water's

5:24

amazing properties.

5:26

All right. In the video that you just

5:27

watched, obviously we reviewed the idea

5:29

that water itself is a polar molecule

5:31

with a slightly negative end near the

5:33

oxygen atoms and a slightly positive end

5:35

near the hydrogen atoms. You were also

5:38

introduced to the hydrogen bond. Now a

5:40

hydrogen bond is a weak attraction. It's

5:44

not as strong as an ionic or a covealent

5:46

bond, but it's a very important type of

5:48

bond in biological compounds and

5:50

substances. Essentially, the way a

5:52

hydrogen bond works is it's the weak

5:53

attraction between the hydrogen atom of

5:55

one molecule and a slightly negative

5:58

atom within another molecule. Now, a key

6:00

idea here, and this I can't overstate

6:02

this enough. A lot of times what

6:04

students will mistake is that the

6:05

hydrogen bond is between the oxygen and

6:08

the hydrogen here within the molecule.

6:10

And that's not correct. If you look at

6:12

the picture here on the right, this is a

6:14

more accurate representation. A hydrogen

6:16

bond is is a the attraction between the

6:19

slightly positive hydrogen on one

6:22

molecule. So we see it right here and

6:24

then the slightly negative atom within

6:27

another molecule and that would be over

6:29

here. So this oxygen. Okay. Now what'll

6:32

happen with water molecules is each

6:34

water molecule is going to form up to

6:36

three additional hydrogen bonds. And as

6:39

you can see here that's going to um

6:41

produce sort of a a cluster of water

6:44

molecules. each with these weak

6:46

attractions holding them together. Okay.

6:49

Now, what we want to take a look at next

6:50

here is an an animation that will show

6:53

you how the hydrogen bond works. And

6:56

again, this is a very important concept

6:58

as we move forward through our our water

7:01

chemistry portion of the basic chemistry

7:03

unit and then into organic chemistry and

7:06

cell biology. So, really for the

7:07

remainder of this semester, this is an

7:09

important concept to build on. So, let's

7:11

make sure you pay attention to this.

7:12

Let's look at the animation and we'll

7:13

wrap it all up.

7:44

All

7:57

right. So in that animation, what you

7:59

saw was how uh the water molecule

8:02

itself, the structure of the water

8:03

molecule makes hydrogen bonding

8:05

possible. We get the interaction between

8:07

the slightly positive hydrogen atom on

8:09

one molecule and a slightly negative

8:12

atom within another molecule. So in this

8:14

case when we talk about water obviously

8:16

that slightly negative atom is the

8:17

oxygen atom. All right so a brief

8:20

screencast here but the structure of

8:22

water and the hydrogen bonds that form

8:25

as a result of it play a hugely

8:27

important role in what we're going to

8:28

learn next. So please make sure you've

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taken really good notes. I would even

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recommend that you go back and watch

8:33

this screencast one more time. Uh and

8:35

then when we come back into class

8:37

together we'll go through some practice.

8:39

We're going to use some of these models

8:41

here. You'll get a chance to work with

8:44

these little models of water molecules

8:46

and you'll actually be able to see how

8:48

hydrogen bonds form between

8:50

them. They're kind of fun to play with.

8:53

And then as we are playing around with

8:55

these models, we're going to learn about

8:57

some of the properties of water that

8:58

make life possible. So until we see you

9:01

in class, this has been Mr. Gails. See

9:04

you in biology.

9:06

[Music]

9:15

[Music]