Thread NSTA Physical and Chemical changes

Found on [physicalscience-request@list.nsta.org](mailto:physicalscience-request@list.nsta.org)

**From:** Fred Dias <sciguy1@myacc.net>  
**To:** physicalscience@list.nsta.org   
**Sent:** Saturday, October 6, 2012 8:37 AM  
**Subject:** Fresh Lemonade

**We are having a debate among science teachers at our school.**

**Is FRESH LEMONADE a physical or chemical change?**

**What is your opinion?**

**Fred Dias**

**Deerfield Beach Middle School**

**Deerfield Beach, FL**

**-----------------------------------------------------------------**

Lemonade is a noun, not a verb.

Juicing is a physical change, however the juice does undergo chemical changes: oxidation once exposed to air, dissolution in water, etc...

Perry

Perry Schlanger [lists@mrschlanger.com]

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not sure how you make it, but i'd use fresh lemon juice, water, and sugar. mix and sugar dissolves into solution, lemon juice mixes with water for a suspension. not seeing any chemical change on my part. but maybe i'm missing something?

Karen

Karen Huddleston [karen.huddleston@petalschools.com]

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No, it's a delightful beverage. There is no change in your question.

By definition, making lemonade is a physical change, because things are dissolving, lemons cut up, etc. But there are not any covalent chemical bonds made  or broken.

Jeff

Jeff Utz [jeff.utz@gmail.com]

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Until you drink it.

KERRY HOESCHEN [KHOESCHEN@burnsville.k12.mn.us]

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can i "like" kerry's response? because i do!

Karen Huddleston [karen.huddleston@petalschools.com]

I agree,

Jeff !!!!!

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Acids are dissociating in water...would that not count as a chemical change?

Perry

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I don't think so.  Sodium chloride dissolving in water is a physical change.  The salt retains it's properties.  I often tell my kids if you taste the salt before it dissolves and after it dissolves, it still tastes the same.  Plus if you vaporize the water the salt will remain behind, since it can be easily recovered, it is a physical change.  
  
Acids dissociating in water would be the same process, thus a physical change.  
  
Big problem... not everyone agrees with me.  Just do a search and ask if dissolving salt is a chemical or physical change.  You will easily find both answers.  IMHO breaking ionic bonds (dissolving in water) is not the same as breaking and MAKING bonds to form a new substance.  Just like sugar and sugar water taste the same (physical change) sugar and burnt sugar taste different (chemical change)...  
  
Nanette

Nanette Fladung [nanfladung@gmail.com]

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It's funny, but we study these in chemistry and not physics class.

It really is a false dichotomy, because all the chemical changes involve physical changes (temp, volume, density) as well. When things dissolve in water, like a ethanol and oil, there are chemical bonds (hydrogen

bonds) formed and broken. I think it is really so that kids can understand that chemical changes involve changes in the type of matter and physical changes are other types of changes

jeff

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depends on where on the continuum you want to put it....  if dissolution is a physical change, then probably not (since dissolution is typically considered a physical change).

I prefer to think of it as a contnuum that helps us organize and classify.

I guess I'd say that making fresh lemonade is primarily physical changes, but those physical changes (exposure to air, etc) permit some chemical processes to occur.

kathy g

Kathleen Gorski [kmgorski@concentric.net]

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Dissolution isn't always a physical change: While lemon juice is dilute form of a weak acid, the dissolution of strong acids (say concentrated HCl) certainly creates covalent bonds: the complexing of hydronium ion to water molecules. It is also fairly exothermic which is indicative of a chemical change. I would imagine that this also occurs (although to a far lesser degree) with weak acids.

Perry

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They are not covalent bonds, but hydrogen bonds. And as pointed out before when something dissolves, it is a physical change. But, when salt dissolves in water, the negative sides of the water molecules surround the sodium ions, the positive sides of water molecules surround chloride ions. And this is definitely related to the chemical properties of waters.

I think this both a chemical change and physical change, but it is by definition, only a physical change. I don't think the definitions really capture what is going on.

Jeff

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Who said physical changes are reversible? I can turn graphite into diamonds, but I don't know that the process is reversible.

And if I am not mistaken, citrus juices are concentrated and reconstituted all the time. It would seem trivial to do the same to lemonade.

Perry

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On 10/6/12 10:28 PM, Paula Borstel wrote:

> There is a video online of Julia Child and a scientist putting a

> diamond into an oven at 3000 degrees and low pressure for 2 hours

> turns back into black carbon -

> <http://www.youtube.com/watch?v=PJ-mVHoosdI>

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> Part of the "Ring of Truth" video.

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Cool - keep diamonds out of the high-temperature oven (normal ovens only go to maybe 600 F).

Jeff

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I love this discussion. What fun to be in tune with fellow nerds on a Saturday night. This all brings to mind the question why salt lowers freezing point. How cold is this lemonade anyway?

**WILSON,** Peggy [PeggyWILSON@aseschool.org]

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As I understand it, the H3O+ is a coordinate covalent bond.

Perry

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The H++ and it's charge is spread over several water molecules. But this shows where the difference between a physical change and a chemical change is blurred. I think it is more accurate to say there are both chemical and physical changes, but that's not the way it is taught in school.

Jeff

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But wouldn’t going from graphite to diamond be a chemical change?  The bonding structure for the two forms of carbon are different, thereby implying a change in the chemical structure.

Anna Crabtree

amcchemist66 [amcchemist66@att.net]

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I have the same question regarding a few other items.

What about popcorn popping - is it just heat causing the water molecules to move faster, gas expands and the kernel pops open or are there proteins denaturing?

What about cooking rice? If I cook it, but then let it dry out, I can cook it again, and again. OR, are there proteins denaturing, and instant or quick cooking rice is really a different substance than uncooked rice?

Same with pasta.

What about wax? if it melts - physical - but if it burns - chemical?

Same with butter. I can let it sit out and get soft - physical change, but if I put in a hot skillet, and forget it, it separates and the solids turn brown - chemical.

Breaking a bone may be a physical change, but it takes chemical reactions to mend it.

What about putting salt in water? It does break into ions - but if you evaporate the water, you have salt, once again - just a reversible chemical change? after all, adding salt to ice causes an endothermic reaction, doesn't it?

Ice cream separates when it melts - Chemical?

And the one I love - Health teachers for years have told students that growing up and going through puberty is a physical change - yes, we can see various changes - but....all of them require a chemical change in order to occur.

Re: Lemonade, I agree that act of cutting the lemons and squeezing them is probably a physical change, but, as the acid is dissociated, and as it oxidizes, I'm inclined to say that is Chemical.

Paula Borstel M.Ed.

Miraleste Intermediate

Paula Borstel [neap\_tidez@yahoo.com]

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There is a video online of Julia Child and a scientist putting a diamond into an oven at 3000 degrees and low pressure for 2 hours turns back into black carbon -

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Part of the "Ring of Truth" video.

Paula Borstel M. Ed

Miraleste Intermediate

Paula Borstel [neap\_tidez@yahoo.com]

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On 10/6/12 9:47 PM, Paula Borstel wrote:

> I have the same question regarding a few other items.

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> What about popcorn popping - is it just heat causing the water

> molecules to move faster, gas expands and the kernel pops open or are

> there proteins denaturing?

Physical change. Maybe chemical, too (proteins denaturing).

> What about cooking rice? If I cook it, but then let it dry out, I can

> cook it again, and again. OR, are there proteins denaturing, and

> instant or quick cooking rice is really a different substance than uncooked rice?

> Same with pasta.

Physical change. Maybe chemical, too (proteins denaturing).

> What about wax? if it melts - physical - but if it burns - chemical?

Correct. Actually, if it burns, it is physical and chemical (because it melts and vaporizes before it burns).

> Same with butter. I can let it sit out and get soft - physical change,

> but if I put in a hot skillet, and forget it, it separates and the

> solids turn brown - chemical.

Correct.

> Breaking a bone may be a physical change, but it takes chemical

> reactions to mend it.

Correct. And physical changes, too (when the calcium carbonate goes from liquid to solid).

> What about putting salt in water? It does break into ions - but if you

> evaporate the water, you have salt, once again - just a reversible

> chemical change? after all, adding salt to ice causes an endothermic

> reaction, doesn't it?

These are just physical changes. When things change physically, heat can be generated or used, but they are still physical changes. Just like you can generate heat when you spin a wheel on your bike and then use brakes to stop it.

> Ice cream separates when it melts - Chemical?

Physical.

> And the one I love - Health teachers for years have told students that

> growing up and going through puberty is a physical change - yes, we

> can see various changes - but....all of them require a chemical change

> in order to occur.

Here, the health teacher is using physical in a different sense.

Physical as opposed to mental or emotional. Physical, here, means dealing with things you can see and touch, including chemicals and such.

Of course, all emotions and mental processing is physical because they are made by the brain.

> Re: Lemonade, I agree that act of cutting the lemons and squeezing

> them is probably a physical change, but, as the acid is dissociated,

> and as it oxidizes, I'm inclined to say that is Chemical.

As the acid is dissociated, it is a physical change (i.e., dissolving), but as it oxidizes, it is a chemical change.

Most of the things that I said are physical changes above involve chemistry (dissolving in water), and I would say that they are chemical changes, too, but, because they don't involve forming or breaking covalent bonds, they are just physical changes, but I definition. It is really an artificial dichotomy between physical and chemical changes. I think the definitions came from the 19th century before we had the theories to understand what is happening a the molecule level, and the dichotomy is useful to help students understand the difference.

Jeff

> Paula Borstel M.Ed.

> Miraleste Intermediate

On Sun, Oct 7, 2012 at 6:48 AM, Jeff Utz <[jeff.utz@gmail.com](mailto:jeff.utz@gmail.com)> wrote:

Here, the health teacher is using physical in a different sense. Physical as opposed to mental or emotional. Physical, here, means dealing with things you can see and touch, including chemicals and such. Of course, all emotions and mental processing is physical because they are made by the brain.

One minor point:

Mental processing involves chemical changes. For example, memory is the ability to remember past experiences or learned information, involving advanced mental processes such as learning, retention, recall, and recognition and resulting from chemical changes between neurons in several different areas of the brain, including the hippocampus. Immediate memory lasts for just a few seconds. Short-term memory stores information that has been minimally processed and is available only for a few minutes, as in remembering a phone number just long enough to use it. Short-term memory is transferred into long-term memory, which can last for many years, only when repeated use of the information facilitates neurochemical changes that allow it to be retained.

Joe

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Joseph J. Morin  
  
Science Teacher

This message was not sent encoded and uncrackable in quantum mechanically entangled packets of light.

On 10/6/12 9:20 PM, amcchemist66 wrote:

> But wouldn’t going from graphite to diamond be a chemical change? The

> bonding structure for the two forms of carbon are different, thereby

> implying a change in the chemical structure.

It is a chemical change. You're correct. And, it is a reversible chemical change. It happens slowly and spontaneously in your valuable diamonds. In a billion years or so, you can write with your former diamonds.

Jeff

> Anna Crabtree

Uh. I think you meant chemical.

Joe

No, I meant physical, not in the sense of a chemical vs. physical change that we've been talking about, but in the more general sense that something that is physical is something that is based on matter and energy, like, in the case of emotions, thoughts, and other mental processing, the physical things include electrical potentials (like the electrical potential across a cell membrane and how it changes during an action potential and can be measured with electrodes and crudely, with EEGs and MEGs in people), increased energy use (measured by functional MRI), synapses and changes in synaptic strength, release of neurotransmitters, etc.

To me, to say that emotions, thoughts, etc., are merely chemical doesn't really make sense, because they are far more than just chemical. The processing that takes place in your brain when you read one letter is amazing. And, you can recall things for the first time in many years without having thought about those things (e.g., think about a song that you haven't heard in many years, but you instantly recognize it on the radio or immediately recognize a face you have seen in years). To say that the changes are chemical doesn't begin to cover it. Plus, when people say depression is a chemical imbalance in the brain, I have no clue what people mean by this. I am pretty sure I am right on this, because I have studied the brain in medical school, wrote a computer simulation of the brain, and did much graduate level work in neuroscience. Sadly, I never got my Ph.D.

Plus, when people say depression, schizophrenia, ADHD and other mental disorders are caused by chemical imbalances, I have no idea what people mean. Nor do they, because people don't understand how depression, schizophrenia, ADHD and other mental disorders occur, nor do they understand how the drugs work on the brain, except in the most general terms, that are used to treat these disorders. So, to me, chemical barely begins to scratch the surface of how the brain works.

So when I said physical, I meant physical as in being real, based in matter and energy, not physical in the sense we were discussing as in physical vs. chemical changes.

Unfortunately, one of the confusion aspects of science is that the same or similar words are used to mean different things in science in different contexts.

Jeff