Disclaimer: This packet is intended ONLY for the use of students enrolled in Leon County Schools.

Complete the assignments below.

Physical Science

Week 1:
☐ Chemical Reactions Part 1 (SC.912.P.8.7) ☐ Content Area Reading: Life's Little Essential

Week 2:
☐ Chemical Reactions Part 2 (SC.912.P.8.8) ☐ Content Area Reading: Gravitational Waves

Week 3:

Week 4:

Chemical Reactions

Chemical Equations

- A **chemical equation** is a representation of a chemical reaction; the formulas of the reactants (on the left) are connected by an arrow with the formulas of the products (on the right).
- Skeleton Equation does not indicate the amounts of reactants or products.
  - No coefficients
- Example

$$Fe + O_2 \rightarrow Fe_2O_3$$

All chemical reactions

- have two parts
- Reactants - the substances you start with (the ones reacting)
- Products- the substances you end up with (the ones produced)
- The reactants turn into the products.
- Reactants → Products

Word Equations

- Example

  Methane + Oxygen → Carbon dioxide + Water

- The arrow means yields, gives, or reacts to produce.

Rules for balancing

1. Write the correct formulas for all the reactants and products
2. Count the number of atoms of each type appearing on both sides
3. Balance the elements one at a time by adding coefficients (the numbers in front)
4. Check to make sure it is balanced.

Never

- Change a subscript to balance an equation.
- If you change the formula you are describing a different reaction.
- H_2O is a different compound than H_2O_2
- Never put a coefficient in the middle of a formula
- 2 NaCl is okay, Na2Cl is not.

Practice

__ H_2 + ___ O_2 → ___ H_2O

__ SO_2 + ___ O_2 → ___ SO_3

Answers

2 H_2 + O_2 → **2** H_2O

2 SO_2 + O_2 → **2** SO_3

Try to balance this reaction

$\underline{2}\,Al(OH)_3(s) + \underline{3}\,H_2SO_4(aq) \rightarrow \underline{\quad}\,Al_2(SO_4)_3(aq) + \underline{6}\,H_2O(l)$

Al	~~1~~ 2	Al	2
S	~~1~~ 3	S	3
H	~~5~~ ~~8~~ 12	H	~~2~~ 12
O	~~7~~ ~~10~~ 18	O	~~13~~ 18

Balance these equations

- __ Mg + __ $O_2 \rightarrow$ __ MgO
- __ $KClO_3 \rightarrow$ __ KCl + __ O_2
- __ Cu + __ $AgNO_3 \rightarrow$ __ $Cu(NO_3)_2$ + __ Ag
- __KOH + __ $H_3PO_4 \rightarrow$ __ K_3PO_4 + __ H_2O

Balancing Act

Name ______________________

Atoms are not ______________ or ____________ during a chemical reaction. Scientists know that there must be the __________ number of atoms on each __________ of the ___________. To balance the chemical equation, you must add ______________ in front of the chemical formulas in the equation. You cannot _______ or __________ subscripts!

1) Determine number of atoms for each element.

2) Pick an element that is not equal on both sides of the equation.

3) Add a coefficient in front of the formula with that element and adjust your counts.

4) Continue adding coefficients to get the same number of atoms of each element on each side.

☐ Mg + ☐ O_2 → ☐ MgO

Mg = Mg =

O = O =

Try these:

☐ Ca + ☐ O_2 → ☐ CaO

Ca = Ca =

O = O =

☐ N_2 + ☐ H_2 → ☐ NH_3

N = N =

H = H =

☐ Cu_2O + ☐ C → ☐ Cu + ☐ CO_2

Cu = Cu =

O = O =

C = C =

☐ H_2O_2 → ☐ H_2O + ☐ O_2

H = H =

O = O =

Balancing Act Practice Name ____________________

Balance each equation. Be sure to show your lists! Remember you cannot add subscripts or place coefficients in the middle of a chemical formula.

1. $Na + MgF_2 \rightarrow NaF + Mg$

2. $Mg + HCl \rightarrow MgCl_2 + H_2$

3. $Cl_2 + KI \rightarrow KCl + I_2$

4. $NaCl \rightarrow Na + Cl_2$

5. $Na + O_2 \rightarrow Na_2O$

6. $Na + HCl \rightarrow H_2 + NaCl$

7. $K + Cl_2 \rightarrow KCl$

Challenge: This one is tough!

$C_2H_6 + O_2 \rightarrow CO_2 + H_2O$

Life's Little Essential

Everybody knows liquid water is necessary for life, at least as we know it. But just why exactly?

- By Peter Tyson

- Posted 01.04.04

NOVA

A friend of mine once had a poster on his office wall that asked at the top in big letters "WHY IS THE SKY BLUE?" I first saw the poster from a distance, and my initial reaction was to snicker slightly, thinking "Everybody knows why the sky is blue." The rest of the poster proved to be the perfect rejoinder, for beneath that simple question lay row upon row of complex equations, originally published by Albert Einstein in 1911, that described in mathematical terms precisely why the sky is blue.

When I looked beneath the surface of it, the question that opens this article elicited a similar effect: I was surprised by how much I didn't know about why water is thought necessary for life. Once I learned the particulars, it became clear why planetary scientists on the lookout for life on Mars and elsewhere in the solar system are on the lookout for water.

Of the essence

So why is liquid water the sine qua non of life as we know it? *Liquid water* may sound redundant, but planetary scientists insist on using the qualifier, for solid or vaporous water won't do. The biochemical reactions that sustain life need a fluid in order to operate. In a liquid, molecules can dissolve and chemical reactions occur. And because a liquid is always in flux, it effectively conveys vital substances like metabolites and nutrients from one place to another, whether it's around a cell, an organism, an ecosystem, or a planet. Getting molecules where they need to go is difficult within a solid and all too easy within a gas—vapor-based life would go all to pieces.

And why is water the best liquid to do the job? For one thing, it dissolves just about anything. "Water is probably the best solvent in the universe," says Jeffrey Bada, a planetary scientist at the Scripps Institution of Oceanography in La Jolla, Calif. "Everything is soluble in water to some degree." Even gold is somewhat soluble in seawater. (Before you get any ideas about extracting gold from the oceans, I should add that, according to Bada, the value of dissolved gold in a metric ton of seawater comes to about $0.0000004).

Water plays another key role in the biochemistry of life: bending enzymes. Enzymes are proteins that catalyze chemical reactions, making them occur much faster than they otherwise would. To do their handiwork, enzymes must take on a specific three-dimensional shape. Never mind how, but it is water molecules that facilitate this.

Ice, ocean, cloud: Water is the only chemical compound on our planet's surface that comes naturally in all three physical states.

Black sheep of the liquids

Water's ability to so successfully further the processes of life has a lot to do with just how unusual a fluid it is. Not long ago, if I had to guess, I would have said that water is about as normal a liquid as they come. In fact, despite its ubiquity and molecular simplicity, H_2O is abnormal in the extreme.

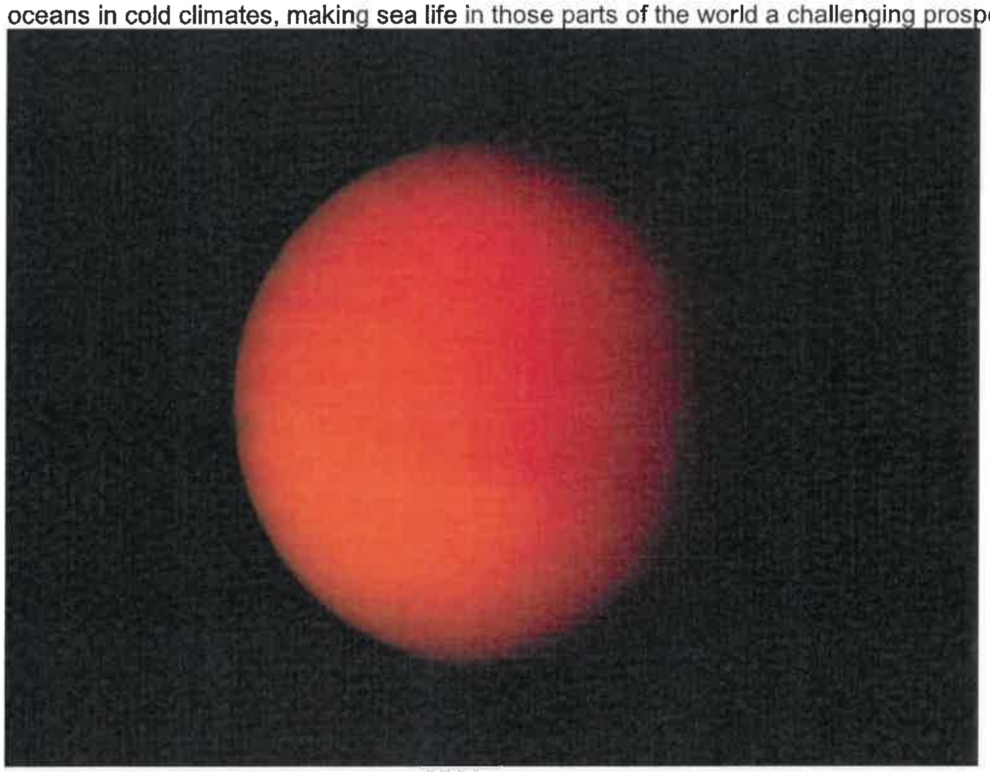
Liquid water is still the Holy Grail for planetary scientists.

For starters, while other substances form liquids, precious few do so under the conditions of temperature and pressure that prevail on our planet's surface. In fact, next to mercury and liquid ammonia, water is our only naturally occurring inorganic liquid, the only one not arising from organic growth. It is also the only chemical compound that occurs naturally on Earth's surface in all three physical states: solid, liquid, and gas. Good thing, otherwise the hydrological cycle that most living things rely on to ferry water from the oceans to the land and back again would not exist. As science journalist Philip Ball writes in his informative book *Life's Matrix: A Biography of Water*, "This cycle of evaporation and condensation has come to seem so perfectly natural that we never think to remark on why no other substances display such transformations."

Compared to most other liquids, water also has an extremely large liquid range. Pure water freezes at 0°C (32°F) and boils at 100°C (212°F). Add salt and you can lower the freezing temperature; natural brines are known with freezing points below -50°F. Add pressure and you can raise the boiling temperature; deep-sea vent waters can reach over 650°F. Water also has one of the highest specific heats of any substance known, meaning it takes a lot of energy to raise the temperature of water even a few degrees.

Water's broad liquid range and high heat capacity are good things, too. They mean that temperatures on the Earth's surface, which is more than two-thirds water, can undergo extreme variations—between night and day, say, or between seasons—without its water freezing or boiling away, events that would throw a big wrench into life as we know it. As it is, the oceans serve as a powerful moderating influence on the world's climate.

Liquid water has yet another unusual property that means the difference between life and essentially no life in cold regions of the planet. Unlike most other liquids when they freeze, water expands and becomes less dense. Most other frozen liquids are denser than their melted selves and thus sink. If it sank, ice, being unable to melt because of the insulating layer of water above it, would slowly fill up lakes and oceans in cold climates, making sea life in those parts of the world a challenging prospect.



Saturn's moon Titan has organic chemicals like methane and ethane in its thick atmosphere, leading some scientists to speculate on whether hydrocarbon-based life might exist there. Enlarge Photo credit: © NASA, Voyager 2

Waterless life

Could life as we *don't* know it have gotten a start without water? Some planetary scientists have suggested that on certain very cold planetary bodies liquid ammonia might serve in place of water to incubate life. But even though it's the most common non-aqueous solvent, liquid ammonia would seem to have several other things going against it as a medium for life. Its liquid range is small, only about 30 degrees. Also, when it freezes, it sinks, and we know what that would do.

Some have suggested that oceans of methane or other hydrocarbons on places like Saturn's moon Titan could also serve the purpose. But, again, we're talking temperatures so low that chemical reactions as we know them could only proceed at a glacial pace. "At minus 150 degrees," says Bada, "most of the reactions that we think about in terms of being important in the origin of life probably wouldn't take place over the entire age of the solar system." Moreover, compounds like amino acids and DNA would not be soluble in these other liquids. "They would just be globs of gunk," Bada says.

For these and other reasons, liquid water is still the Holy Grail for planetary scientists, who, based on what they know today, consider it likely that liquid water is essential to all life, terrestrial and extra-. Says Neil de Grasse Tyson, an astrophysicist and director of the Hayden Planetarium at the American Museum of Natural History, "Given that life on Earth is *so* dependent on water, and given that water is so prevalent in the universe, we don't feel that we're going out on a limb to say that life would require liquid water."

Just as a blue sky requires blue light to scatter far more than all the other colors in the visible light spectrum—which, of course, is why the sky is blue. Well, that's the simple answer anyway.

Name______________________________ Date______________________________ Period________

CIS Student Template

Before Reading

Hook: Choose a position on the following question and circle your position. Be prepared to support your position with real world examples.

Is water the most important substance on Earth?

Option 1 – Yes, water is the most important substance on Earth.

Option 2- No, water is not the most important substance on Earth.

Predictive Writing: *Identify 3 reasons why water is important. Rank your reasons in order from most important to least important*. Write your answer based on your current knowledge.

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Vocabulary

Word	Word Part/ Context	Definition	Visual
solvent			
soluble			
facilitate			
inorganic			
organic			

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hydrological			

Reading #1

Text Marking: Consider the guiding question while reading the passage. *Why is water necessary for life?* Mark the text according to the code below:

- *Unique properties of water* = *Underline*
- *Ways water is used by living things* = *Highlight*

Writing #2: Considering what you have read, *Why is water necessary for life*? Use a detail from the passage to support your answer.

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Reading #2

Directed Note-taking: Re-read the passage looking for information to support your answer to the following question: *Why is water necessary for life?* Record your notes below.

¶ #	Notes	*Evidence that life wouldn't exist without water*	*Evidence water is unequivocal to any other substance*	*RANK*

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With your partner, discuss which notes you think are the most important as support for the answer to the guiding question. Rank your notes in order from most important (1) to least important.

Final Writing: Revisit your notes to determine your initial response to the guiding question. In your final writing, state your thesis, provide supporting details, textual evidence, and commentary.

Why is water necessary for life?

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Name______________________________ Date_________________________ Period______

Question Generation

Review the text again and your notes to write, at least, 2 questions that will help you *deepen your understanding of the text, prepare for an extended text discussion, or prepare for further research.*

¶ #	Questions Sparked from the Reading