Lesson 2.4: Drinking Water

Task	Page(s)	Learning Target
1	2-4	I can make and use detailed observations in order to predict the identity of an unknown substance.
2	5-6	I can use a disk model that represent atoms to determine which of the three claims about the rust in Westfield's water is possible.
3	7-9	I can use an atomic-scale model to conclude if another substance is in the water.

Task 1 Learning Target: I can make and use detailed observations in order to predict the identity of an unknown substance.

Scientists work every day to ensure that our drinking water is safe. This video will introduce you to a scientist who uses chemistry to help keep water clean and safe to use.

https://sites.google.com/a/ps207tigers.org/207sci/water-safety

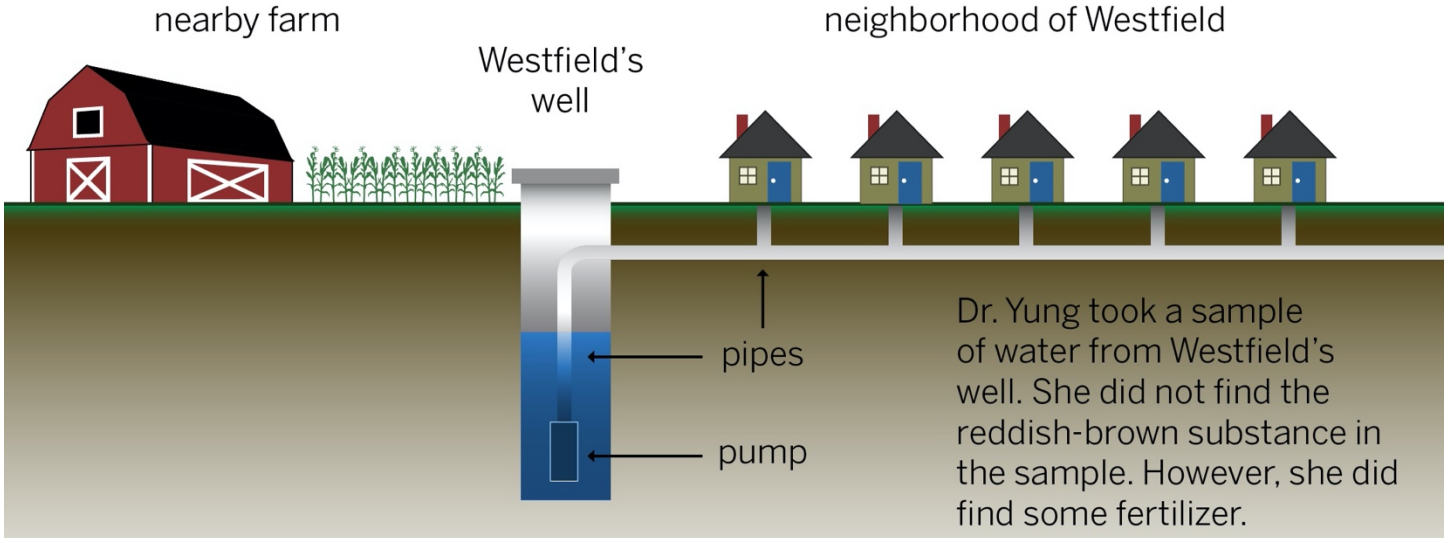
To: Student Chemists
From: Dr. Samara Yung, Lead Chemist
Re: Water Crisis in Westfield

Last week I received a call from Alexa Anderson, a resident of Westfield. When she turned on her faucet for a glass of water, a strange reddish-brown substance came out. She called a few of her neighbors and found out that the reddish-brown substance was coming out of their water pipes, too.

My lab uses chemistry to identify unknown substances, so I went to Westfield to take some samples. I took a sample of the water coming out of the pipes and another sample from the well where the neighborhood's water comes from. I analyzed the samples and made an interesting discovery. The water coming out of the pipes contains the mysterious reddish-brown substance, but I didn't find any of the reddish-brown substance in the water sample that I took from the well. However, I did find something else. It appears that some fertilizer from a nearby farm seeped into the water in the well.

We need more analysis in order to identify the reddish-brown substance, but, unfortunately, my lab is busy with other projects right now. Student chemists, I need your help to get to the bottom of this mystery. The residents of Westfield need answers!

The residents of Westfield found a reddish-brown substance coming out of their water pipes.



The water from the pipes contains the reddish-brown substance, but the well water has no such reddish-brown substance. Although the water taken from the well appears clean, Dr. Yung actually found fertilizer in the sample.

A. Make a prediction: What is the reddish-brown substance in the water?

-Claim 1: The reddish-brown substance is the same as the substance that makes up the pipes.
-Claim 2: The reddish-brown substance is the same substance as the fertilizer.
-Claim 3: The reddish-brown substance is not the same as either the fertilizer or the substance that makes up the pipes.

Dr. Yung has provided samples of the three substances for you to examine as you begin your investigation.
-Pipe: This is a sample taken from the water pipes used in Westfield. Dr. Yung broke down a piece of the pipe at her lab to make it easier to examine the substance.
-Fertilizer: This is a sample of the fertilizer Dr. Yung found in the well water. She evaporated the water in order to observe the solid by itself.
-Reddish-Brown substance: This is a sample of the reddish-brown substance that Dr. Yung found coming out of the water pipes. She filtered the water to observe just the reddish-brown substance.

Safety Note: Using Chemicals

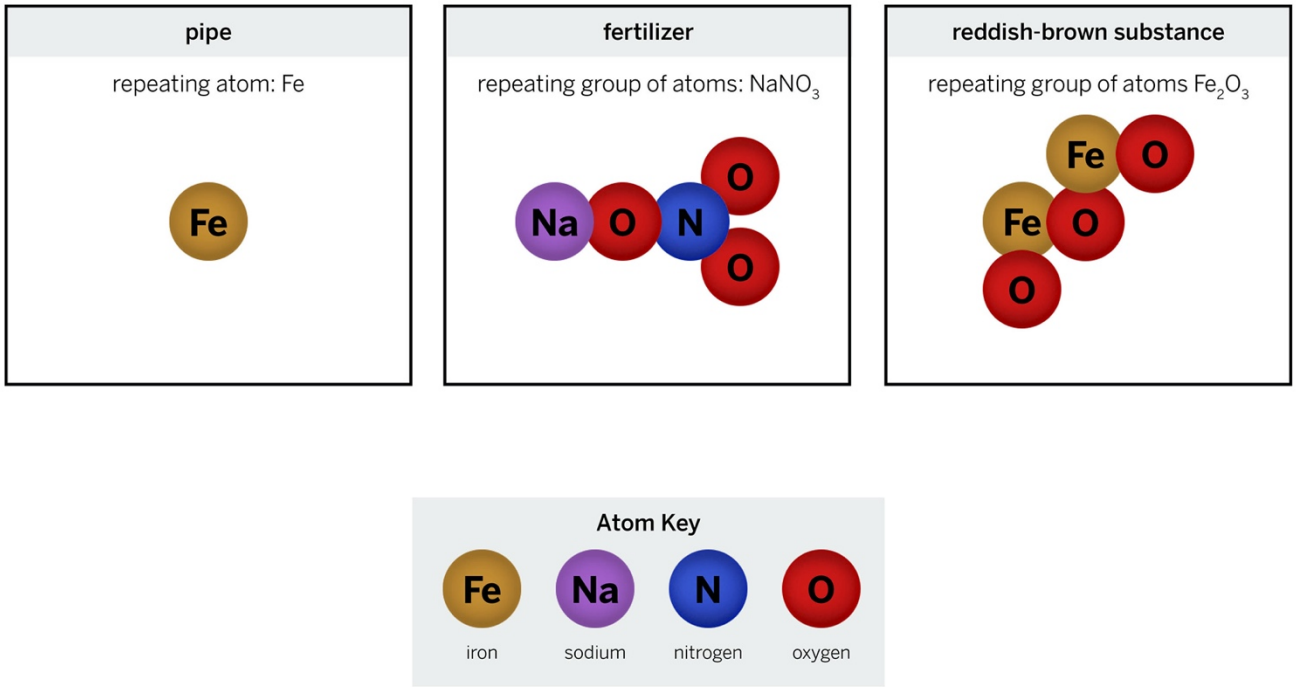
The substances in this investigation should remain sealed in their containers. Do not taste or touch the substances in the investigation. The sodium nitrate and iron oxide granules present irritation risks. If sodium nitrate gets on your skin or clothes, rinse the substance off with water. If you get a substance in your eyes, rinse the affected area with water for 15 minutes. If iron oxide is inhaled, move to fresh air and seek medical help for any breathing difficulties.

B. With your group, observe each of these samples and discuss what you observe. Then, record your observations.

Substance	Observations
Pipe	
Fertilizer	
Reddish-Brown Substance	

Dr. Yung has provided you with atomic-scale models of each of the three substances, so you can use these models as evidence in your explanation to the townspeople of Westfield. These models help explain why these substances are different. They show us that each of these substances is made up of different repeating groups of atoms.

Now that we have an atomic-scale model of the reddish-brown substance, we can also identify it. Iron oxide is the scientific name of the substance commonly known as rust. The name iron oxide comes from the atoms that repeat to make up rust: iron and oxygen.



C. Review your observations and identify which claim is best supported by the evidence.

What is the reddish-brown substance in the water? Explain your choice.

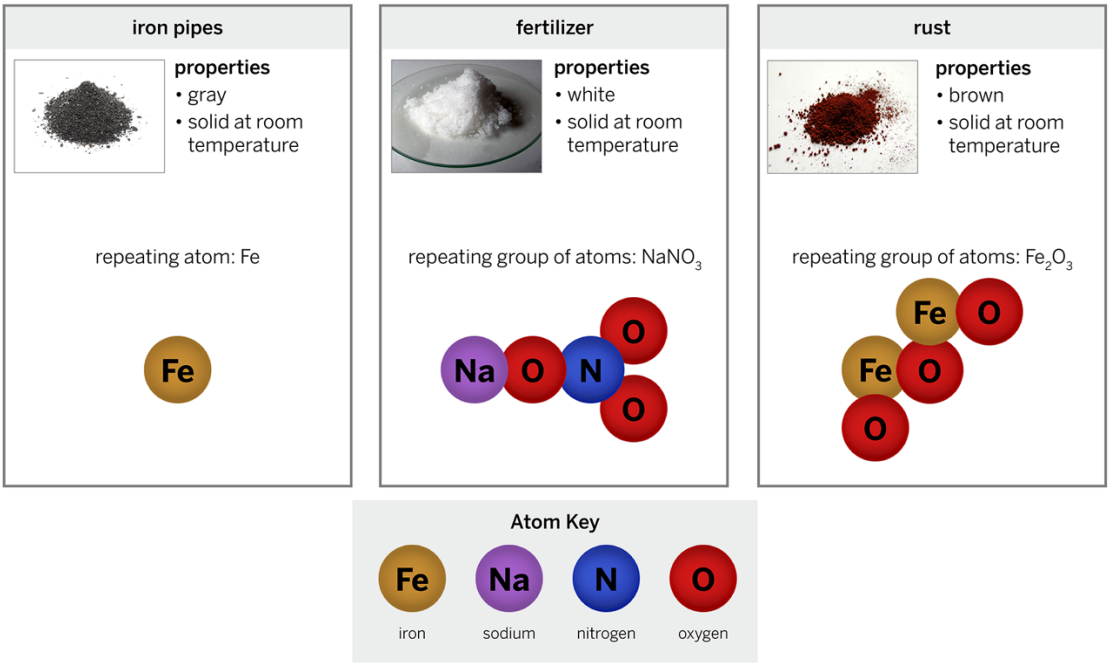
Claim 1: The reddish-brown substance is the same as the substance that makes up the pipes.

Claim 2: The reddish-brown substance is the same substance as the fertilizer.

Claim 3: The reddish-brown substance is not the same as either the fertilizer or the substance that makes up the pipes.

Task 2 Learning Target: I can use a disk model that represent atoms to determine which of the three claims about the rust in Westfield's water is possible.

Substance Reference Guide



Modeling atoms with disks makes it possible for us to study atoms by counting them, moving them around, and telling them apart. These things are impossible to do with actual atoms, which are much too small to see with the human eye. Just as atoms cannot change type during a chemical reaction, our disks cannot change color. However, remember: disks are not a perfect model. The colors we are using to represent different atoms are only representations.

A. Testing the Claims

Use the tokens to test each of Dr. Yung's three claims.
Discuss whether the atoms of the substance or substances in each claim could possibly rearrange to form rust. Then, complete the sentences below, recording whether or not you think each claim is possible.

Claim 1: The iron pipes changed into rust. (check one)
-A chemical reaction of the iron pipes could form rust
-A chemical reaction of the iron pipes could not form rust.

Claim 2: The fertilizer changed into rust. (check one)
-A chemical reaction of the fertilizer could form rust.
-A chemical reaction of the fertilizer could not form rust.

Claim 3: The iron pipes and the fertilizer changed into rust. (check one)
-A chemical reaction of the iron pipes and fertilizer could form rust.
-A chemical reaction of the iron pipes and fertilizer could not form rust.

B. <u>Create a visual model of your claim to help explain to the people of Westfield how the rust in their water formed.</u>

How to complete the model:

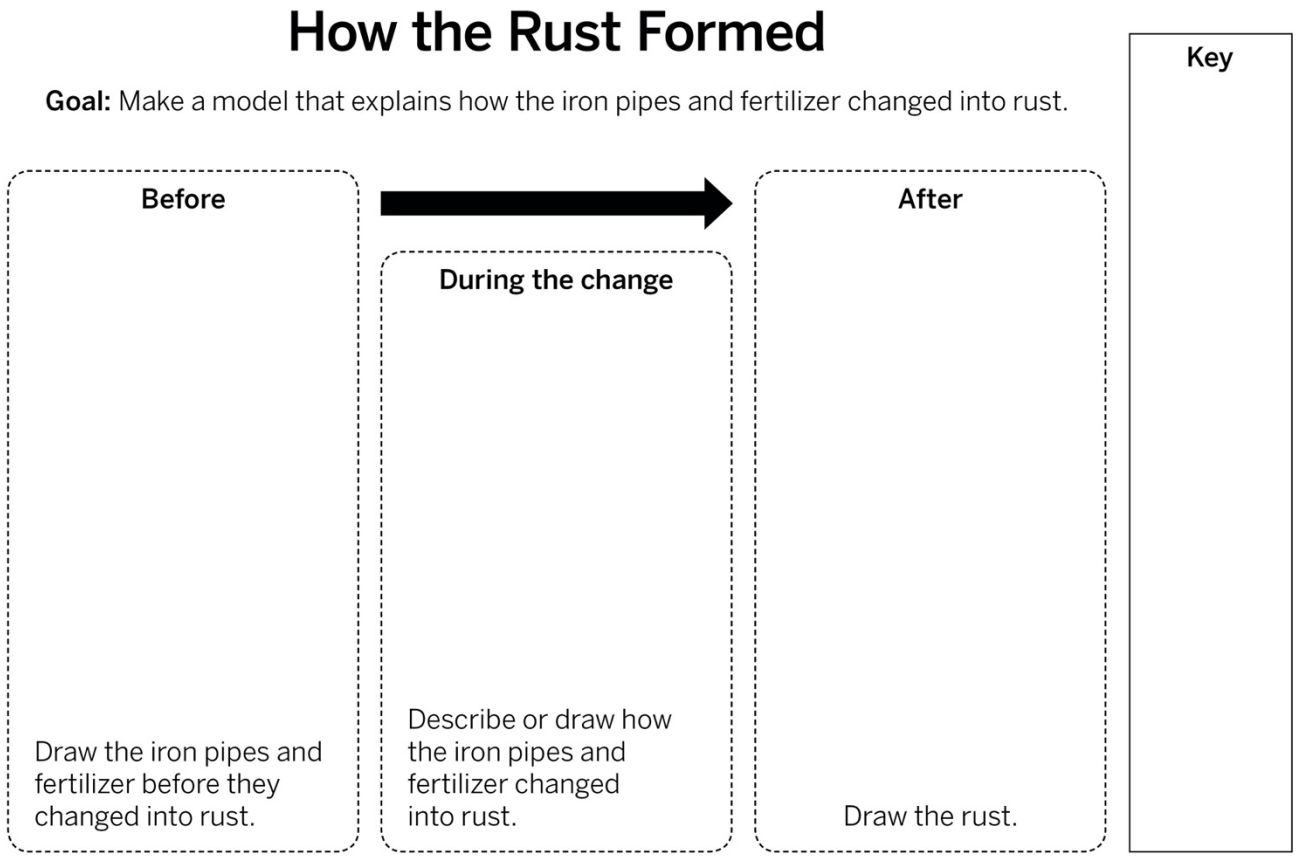
Before: This space is where you should draw the iron pipe and fertilizer before they changed into rust.

During the change: This box is where you should draw or describe what happened to cause the iron pipe and fertilizer to change into rust.

After: This is where you should draw the rust that formed from the pipes and fertilizer.

Key: You can add a key in this space or add labels to your model.

Remember: In order for a product to form during a chemical reaction, atoms from the reactant need to rearrange to form the atom groups of the product. In this case, the iron atoms from the pipe and the oxygen atoms from the fertilizer changed position and formed the different group of atoms that repeats to make up the rust.



C. <u>Explain to the people of Westfield how the rust in their water formed.</u>

Use the model you created to help you write an argument for the people of Westfield in which you support a claim about how the rust in their water formed. As you write your argument, remember to:

-State your claim about how the rust formed.

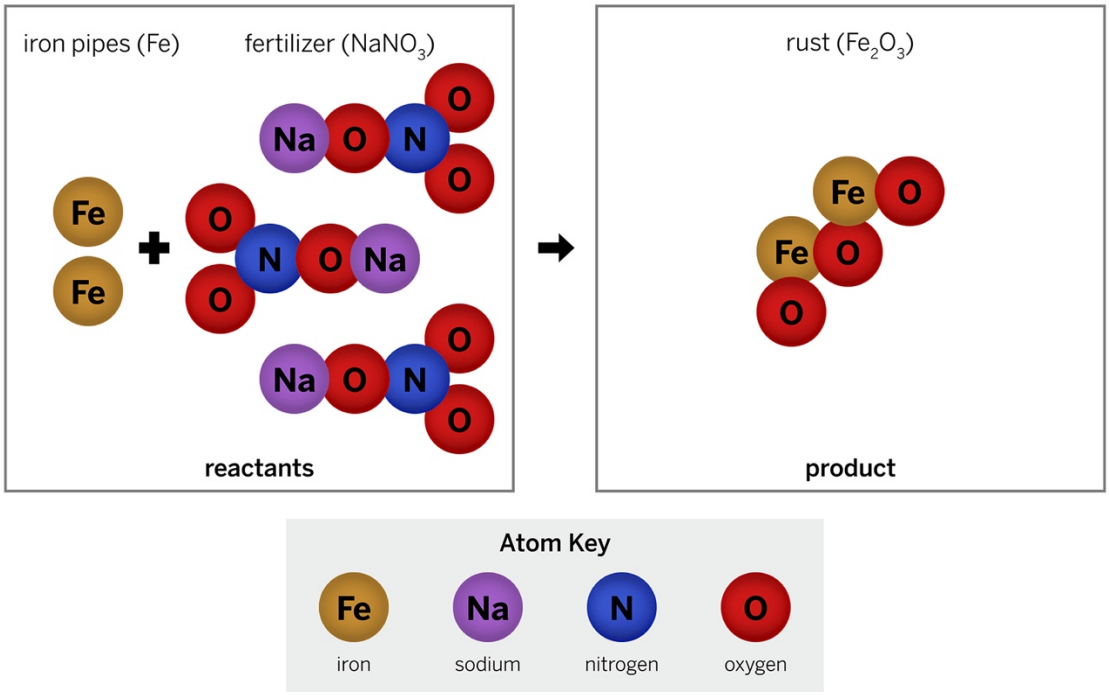
-Use evidence from the token activity to support your claim.

-Include vocabulary terms from the word bank below in your argument.

<u>Word Bank:</u>			
atoms	chemical reaction	model	product
reactant	rearrange	substance	

Task 3 Learning Target: I can use an atomic-scale model to conclude if another substance is in the water.

The people of Westfield are still waiting on an answer to their question:
What was produced during the reaction between the iron pipes and the fertilizer?
To help answer this question, Dr. Yung has provided you with the atomic-scale model below.
Examine this model and use it to answer the question below.



A. What was produced during the reaction between the iron pipes and the fertilizer? Explain.
Claim 1: During the chemical reaction, only the rust was produced.
Claim 2: During the chemical reaction, the rust and another substance were produced.

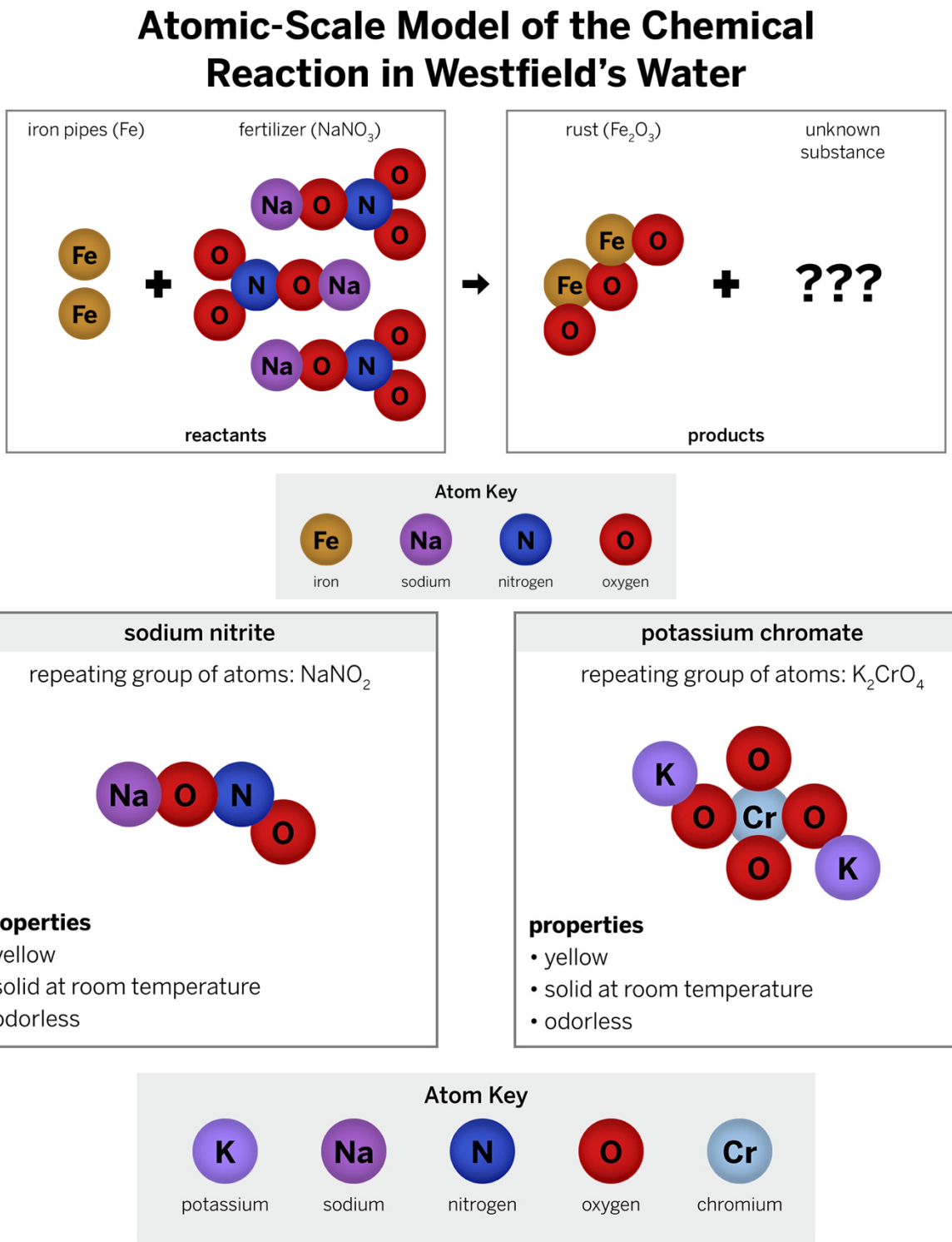
To: Student Chemists
From: Dr. Samara Yung, Lead Chemist
Subject: Something Else Is in the Water!

Based on your suggestions, I decided to run some more tests on the water sample I took from Westfield. As it turns out, you were right. The reaction between the iron pipes and the fertilizer seems to have produced another substance besides rust. I hadn't noticed it before because it dissolved in the water, but once I removed the substance from the solution, I was able to observe some of its properties.

The unknown substance is a solid, yellow powder at room temperature; it has no odor. Based on these observations, I was able to narrow down the list of possible substances to those that share all of these properties. I think the substance is either sodium nitrite or potassium chromate.

I'd like you to determine which of these substances is the unknown substance in Westfield's water. I'm sending along an atomic-scale model of each substance for you to use as evidence. Once you've identified the substance, be sure to inform the people of Westfield.

This diagram shows you that reactants were made of iron, sodium, nitrogen, and oxygen atoms. This information should be useful. According to the Law of Conservation of Matter, none of the atoms could have been destroyed or changed into other atoms during the chemical reaction.



B. Based on these atomic-scale models, what other substance could be in the water besides rust?

-Sodium nitrite (NaNO2)

-Potassium chromate (K2CrO4)

-Both sodium nitrite (NaNO2) and potassium chromate (K2CrO4)

C.<u>Create a visual model of your claim to help explain to the people of Westfield what is in their water.</u>

How to complete the model:

In the After space, draw an atomic-scale model of what was produced during the chemical reaction between the iron pipes and the fertilizer.

Color the atoms using the key found on your screen.

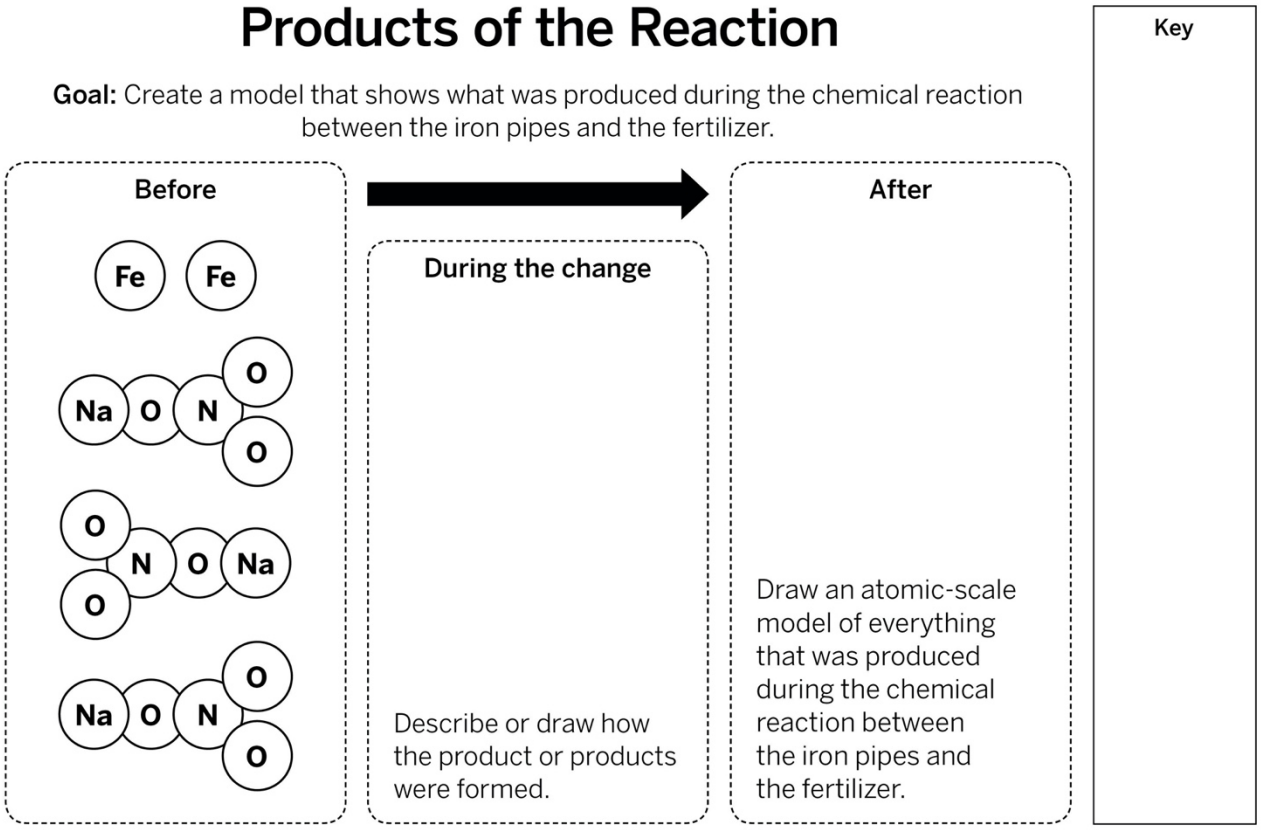
In the During the change space, describe or draw how the product or products were formed.

Tips:

An atomic-scale model of the iron pipes and fertilizer is already shown.

Use the Substance Reference Guide provided on your screen.

You can draw more than one repeating group of atoms for a substance if needed.



D. <u>Use the model you created to help you write an argument for the people of Westfield explaining what is in their water.</u>

As you write your argument, remember to

-state your claim and identify the substances in the water.

-use evidence from the model you created to support your claim.

-include vocabulary terms from the word bank below in your argument.

<u>Word Bank:</u>			
atoms	chemical reaction	model	product
reactant	rearrange	substance	