# Individual Project: Chemical Reactions

**SPU EDTC 6102, Charlie Ellis**  
*All Understanding By Design elements from Wiggins & McTighe (2005)*

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Phase 1

Lesson Brief: Explaining Chemical Reactions

Having learned that substances change into different substances during chemical reactions, students investigate how this change happens at the atomic scale using a digital simulation (sim). In the sim, students choose chemicals from a virtual stockroom in a virtual laboratory in order to observe virtual chemical reactions. The lesson will take place in the context of a 7th grade public school science classroom, working within an online science curriculum. The classroom is at a 2:1 device-to-student ratio.

Initial Concerns

I wonder how the sim will engage students and if it will help them to visualize chemical reactions. The chemical reactions unit combines lessons that include real chemical reactions, hands-on manipulatives (tokens) and sims through which students will investigate chemical reactions. I appreciate the differentiated approach and I would agree that multiple means of representing chemical reactions, yet I am curious as to:

a.) which experience is most valuable for students
b.) how does the combination of experiences serve students (i.e., Would one suffice or are the experiences more effective together?).
c.) how does the sequence of the experiences affect learning (e.g., is it best to do hands-on modeling before a sim?).

Given the the questions I have, I wonder how I should measure results and student feedback.

ISTE Student Standard 2: Digital Citizen

In order to give students an opportunity to share their ideas with the entire class, and practice skills associated with ISTE 2 (e.g., awareness of permanence of their actions in the digital world, ethical online behavior, using and sharing intellectual property) I plan to supplement the lesson with some type of class-wide discussion thread. Our classroom structures along with the digital curriculum and associated website do a
fine job of enabling student-teacher communication, partner talk and group talk, but I think that a whole-class discussion may be facilitated by the use of Nearpod’s “Collaborate” feature. Students will be able to share their own ideas and comment on others, while practicing skills relevant to digital citizenship.

Phase 2

Understanding by Design (UBD) Stage 1 - Identify Desired Results

Established Goals (G)

Next Generation Science Standards (NGSS)

NGSS Practices

Practice 2: Developing and Using Models
Practice 6: Constructing Explanations
Practice 7: Engaging in Argument from Evidence
Practice 8: Obtaining, Evaluating, and Communicating Information

NGSS Disciplinary Core Ideas

PS1.A: Structure and Properties of Matter:
   Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. (MS-PS1-1)

PS1.A: Structure and Properties of Matter:
   Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (MS-PS1-2), (MS-PS1-3)

PS1.B: Chemical Reactions:
   Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. (MS-PS1-2),(MS-PS1-3),(MS-PS1-5)
Essential Questions (Q)

Unit Question
How do new substances form?

Chapter Question
How did the rust form?

Investigation Question
How do substances change into different substances during chemical reactions? (2.2, 2.3)

Understandings (U)
1. During a chemical reaction, one or more starting substances (reactants) change into one or more different substances (products). (2.1)
2. During a chemical reaction, atoms do not change from one type to another. (2.2)
3. During a chemical reaction, atoms rearrange to form different groups of atoms. (2.2)

Knowledge (K)
1. Models are similar to and different from what they represent in important ways.
2. The atoms found in the products of a chemical reaction must have been present in the reactants as well.
3. Vocabulary: atoms, chemical reaction, model, product, property, reactant, rearrange, substance

Skills (S)
1. Students will be able to draw a model of a chemical reaction given diagrams and chemical formulas of all substances involved.
2. Write a description of how the chemical reaction took place using evidence from a previous, hands-on “token” activity or simulation, and given a word bank including all vocabulary words.

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Phase 3

UBD Stage 2 - Determine Acceptable Evidence

Performance Tasks (T)

Modeling Tool

In this activity, students examine the properties and atomic models of the iron pipes, the fertilizer, and the rust to construct a model of what happened in the chemical reaction involving these substances. The teacher will determine if students’ models show sufficient information to describe the unobservable mechanism of chemical reactions (i.e., atomic rearrangement in a way that the townspeople might understand). Also, check how accurately students model rearrangement in this context.

Writing

Students write to townspeople:

Use the model you created to help you write an argument for the townspeople 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.
Other Evidence (OE)

Critical Juncture Assessment

Students will take a quiz that includes multiple choice and written response questions.

Student Self-Assessment and Reflection

Self-Assessment and Process Survey

Students will complete a survey to assess their learning so far and give feedback on the learning process, including an evaluation on the effectiveness of the various learning activities.

Phase 4

1. **WARM-UP [W]**
   Students reflect on what they have learned about how substances form. (5 min.)
   - **[W]** - The Warm-Up helps students know where the lesson is going and what is expected.

2. **TESTING THE CLAIMS [H][E][R][T][O]**
   Project message from Dr. Yung (lead chemist in ongoing classroom simulation)
   Students use tokens that represent atoms to determine which of the three claims about the rust in the town's water is possible. (10 min.)
   - **[H]** - The message from Dr. Yung hooks students back into the purpose of their investigation: to explain to the townspeople how the rust formed in their water.
   - **[E]** - The use of tokens to model atoms in a chemical reaction equips students and helps them experience key ideas.
   - **[R]** - The manipulative and recursive nature of the token activity allows students to rethink and revise their model.
   - **[T]** - The visual and hands-on modeling tool (students use color-coded tokens to represent atoms) provides tailored opportunities for learners with non-linguistic representations of chemical reactions.
allowing the students to test claims with tokens and diagram their chemical reaction model (next) is a sound organizational strategy that prepares students for the writing activity at the end of the lesson.

3. **MODELING HOW THE RUST FORMED [E][R][T]**

Students use the Modeling Tool to show how the iron pipe and the fertilizer changed into rust. (10 min.)

- **[E]** - The use of the “modeling tool” (graphic organizer) to model atoms in a chemical reaction equips students and helps them experience key ideas.
- **[R]** - Students can use the modeling tool in tandem with the tokens to revise their model.
- **[T]** - The visual and colorful (students use their own color code to represent chemical reactions on paper) modeling tool provides tailored opportunities for learners with non-linguistic representations of chemical reactions.

4. **COLLABORATIVE QUICKWRITE [E][R][T]**

Students use Nearpod to write and share ideas about what happens to atoms during chemical reactions. (10 min.)

**WORD BANK:**

atoms, reactant, chemical reactions, rearrange, model, substance, product

- **[E]** - The quickwrite task equips students and helps them experience key ideas.
- **[R]** - Students to rethink and revise their ideas about chemical reactions in writing.
- **[T]** - The final writing task is tailored for students who are able to express their knowledge linguistically. The word bank provides tailored support for students.

5. **WRITING TO THE TOWNSPEOPLE [E][R][E][T]**

Students write an argument for the townspeople explaining how the rust in their water formed. (15 min.)

Chapter 2 Question: How did the rust form?

- Claim 1: The iron pipes changed into rust.
- Claim 2: The fertilizer changed into rust.
- Claim 3: The iron pipes and the fertilizer changed into rust.

Writing Prompt:

Explain to the townspeople how the rust in their water formed.

**Word Bank:**

atoms, reactant, chemical reactions, rearrange, model, substance, product

- **[E]** - The writing task equips students and helps them experience key ideas.
- **[R]** - Students to rethink and revise their claims, evidence and reasoning in writing.
- **[T]** - The final writing task is tailored for students who are able to express their knowledge linguistically. The word bank, reasoning tool and sentence starters provide
tailored support for students.

6. **METACOGNITIVE SURVEY (NEXT DAY) [E]**
   Students answer a poll question about which activity throughout the unit so far helped them most to understand how chemical reactions work and why.
   
   ○ [E] - Students evaluate their work and the effectiveness of different learning tasks.

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**References**