

Name: _____ Date: _____ Period: _____

Atomic Addition

Overview

Prerequisite Skills:

- Identify integers as positive and negative numbers.
- Graph integers on a number line.
- Understand absolute value as the distance a number is from zero on a numberline.

Learning Goals:

- Identify additive inverses (zero pairs).
- Model addition of integers using protons and electrons, and extend this to a number line.
- Create a rule for adding integers.

Common Core Standards:

[CCSS.Math.Content.7.NS.A.1.a](#) Describe situations in which opposite quantities combine to make 0.
[CCSS.Math.Content.7.NS.A.1.b](#) Understand $p + q$ as the number located a distance $|q|$ from p , in the positive or negative direction depending on whether q is positive or negative. Show that a number and its opposite have a sum of 0 (are additive inverses). Interpret sums of rational numbers by describing real-world contexts.
[CCSS.Math.Content.7.NS.A.1.d](#) Apply properties of operations as strategies to add and subtract rational numbers.

Mathematical Practices:

1. Make sense of problems and persevere in solving them
2. Reason abstractly and quantitatively
4. Model with mathematics.
5. Use appropriate tools strategically

Florida Science Standards:

[SC.912.P.8.4](#): Explore the scientific theory of atoms (also known as atomic theory) by describing the structure of atoms in terms of protons, neutrons and electrons, and differentiate among these particles in terms of their mass, electrical charges and locations within the atom.

Materials:

- PhET *Build an Atom* simulation:
- http://phet.colorado.edu/sims/html/build-an-atom/latest/build-an-atom_en.html
- Computers/tablets for each student or pair of students
- Atomic Addition Activity Sheet (1 per student)

Estimated Time:

Approximately 45 minutes

Atomic Addition

Warm Up

5 minutes

Activate prior knowledge using this [problem](#) as a warm-up:

- 1) Draw a number line from -5 to 5.
- 2) Graph the following numbers on the number line: 2, 0, -4, -2
- 3) Compare the absolute values of 2 and -2.

OR: Depending on students' background knowledge, the teacher may want to give an introduction to atoms and elements before exploring the sim. This can be done by viewing the first 4 minutes of the following video:

<https://www.youtube.com/watch?v=R1RMV5ghwyE#action=share>

Simulation Introduction

7-10 minutes

Teacher will...

- Ask student to distribute activity sheet.
- Encourage students to take a few minutes to explore the Build an Atom simulation, letting them know they will be looking at

Students will...

- Explore the simulation, building whatever atoms they choose.
- Respond to teachers' informal questioning.

Comment [M1]: This can be done in students' notebooks or as a class on the whiteboard.

Name: _____ Date: _____ Period: _____

<p>the net charge of an element for today's lesson.</p> <ul style="list-style-type: none"> ● Circulate the room and ask students: <ol style="list-style-type: none"> 1. What do you think net charge means? 2. What happens to the net charge when you add protons? Neutrons? Electrons? 3. What does neutral mean? 4. When does the mass number change? 5. What could represent positive/negative integers? What could represent zero? 6. Why do you think sometimes the net charge is circled? 7. What does the arrow indicate with the net charge? ● Ask students to briefly share what they wrote down for #1 on the activity sheet, and discuss any of the questions above. 	<ul style="list-style-type: none"> ● Jot down discoveries as #1 on the activity worksheet.
15-20 minutes	
<i>Teacher will...</i>	<i>Students will...</i>
<ul style="list-style-type: none"> ● Encourage students to begin working on #2-12 in pairs. Try to give them at least 5 minutes where the teacher is silent before probing/aiding. ● Circulate the room to be available for questions and ask probing/pushing questions, such as: <ol style="list-style-type: none"> 1. Do the neutrons affect the net charge? 2. If you want a negative net charge, do you need more protons or electrons? 3. What happens if you only use electrons? 4. What happens if you only use protons? 5. What happens if you only use neutrons? 6. What happens if you make an atom with the same number of protons, neutrons, and electrons? 7. Can you make an atom with a net charge of + 3? -4? -5? 8. Can you make a Carbon atom/ion with a net charge of -2? 9. Can you make a Hydrogen atom with a net charge of + 2? 10. Can you make a Neon atom that is neutral or has a net charge of 0? 	<ul style="list-style-type: none"> ● Complete #2-12 on the activity sheet. ● Respond to teacher questions. ● Ask questions or ask for help as needed.
10-15 minutes	
<i>Teacher will...</i>	<i>Students will...</i>
<ul style="list-style-type: none"> ● Write headings on the whiteboard: Positive Sum, Negative Sum, and Sum of Zero. Then, ask students to write their addition sentences from #12 under the appropriate headings. ● Facilitate a class discussion to bridge an understanding across representations. Remind students to cover their laptop screens with their worksheets so they are not distracted. Use an established teaching strategy such as pulling name sticks, or small group discussions (print out or display questions and have groups talk to each other and write down consensus for the "speaker" to share aloud with class). Students may want to present their worksheets using document camera as they make their points. Sample questions include: <ol style="list-style-type: none"> 1. Why are the neutrons not represented in the net charge? 	<ul style="list-style-type: none"> ● Answer questions and question answers: students should be able to determine if they agree/disagree with others' claims and justify their own responses. ● Some students may go to the board to share findings, then summarize and record main ideas.

Comment [M2]: Many of students' discoveries may have to do with the science (mass number, element name, stability of the atom, cloud, etc. Allow these discoveries to be vocalized so students will have some sort of context for the problems. After the introduction, guide the focus to the number of protons, neutrons, electrons, and the net charge.

Comment [M3]: Students may wonder about why they can only put 2 electrons in the first orbit. I would let them know that the first orbit can only hold two electrons, but that is a chemistry concept and not to worry about it

Comment [M4]: This is an optional question, but would stretch kids to see that the atoms are named by their number of protons. With this sim, you cannot make a Hydrogen atom with a net charge of +2 because it turns into Helium.

Comment [M5]: Students who finish early can write these on the board to reduce some of the transition time between the exploration and discussion.

Name: _____ Date: _____ Period: _____

2. How can we represent an atom's charge with addition of integers?
3. What do you notice about all of our addition sentences that have a positive sum? Negative sum? Sum of zero?
4. What do you think a zero pair is? How many electrons and protons make a net charge of zero?
5. Do you think it matters whether we write $-5 + 7$ or $7 + (-5)$? Does it matter whether we write $3 + 4$ or $4 + 3$?
6. What does it seem like is actually happening when you combine integers with different signs? (Or when you add 5 protons and 3 electrons to get a net charge of 2?)
7. Can we create a rule that describes the number of protons, electrons, and the net charge?
8. Can we revise our rule to refer to integers instead of parts of an atom?
9. How can we represent this on a number line?
10. Are there any other discoveries we haven't yet discussed?

Comment [M6]: At this point, the teacher may want to formally introduce the terms zero pair and additive inverses.

Comment [M7]: Here the teacher may point out that the Commutative Property applies to integers also.

Comment [M8]: Here, some students might realize that adding electrons and protons (integers with different signs) is similar to subtracting, because they neutralize each other, or the zero pairs are eliminated.

Informal Assessment **5 minutes**

Teacher will... *Student will...*

Exit Ticket: • Complete exit ticket.

On an index card, draw a model and find the sum for each:

Front of Index Card	
$3 + (-5)$	$-2 + 6$
Back of Index Card	
$-4 + 4$	$6 + (-5)$

Going forward...

- Teacher should try to make connections between modeling using the building an atom sim and modeling addition of integers using a number line.
- Teachers can refer to the Build an Atom sim to introduce subtracting negative integers by starting with a specific atom, then asking what happens when you take away one electron?

Name: _____ Date: _____ Period: _____

Atomic Addition!

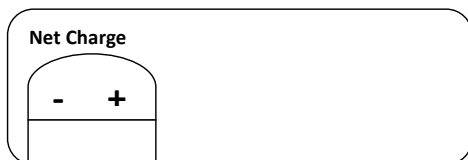
Learning Goals:

- Identify additive inverses (zero pairs).
- Model addition of integers using protons and electrons, and extend this to a number line.
- Create a rule for adding integers. ‘

1. **Explore** the Build an Atom simulation for a few minutes, building whatever atoms you choose. Write down 1-3 observations you have about building an atom.

2. Build an atom with a **positive net charge**, then **complete the table** below, and **draw the diagram** of its net charge using + and – symbols for protons and electrons.

Protons	
Electrons	
Neutrons	
Net Charge	



3. Build a new atom with a **different positive net charge**, then **complete the table** below, and **draw the diagram** of its net charge using + and – symbols for protons and electrons.

Protons	
Electrons	
Neutrons	
Net Charge	



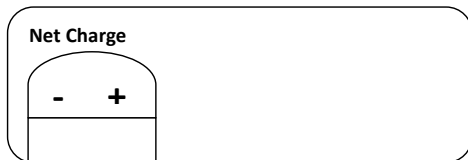
4. Build an atom with a **negative net charge**, then **complete the table** below, and **draw the diagram** of its net charge using + and – symbols for protons and electrons.

Protons	
Electrons	
Neutrons	
Net Charge	



5. Build a new atom with a **different negative net charge**, then **complete the table** below, and **draw the diagram** of its net charge using + and – symbols for protons and electrons.

Protons	
Electrons	
Neutrons	
Net Charge	



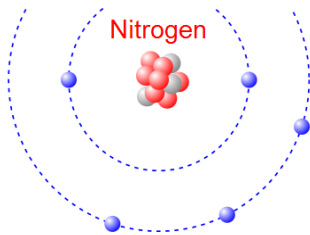
Name: _____ Date: _____ Period: _____

6. **Discuss** with a partner and **record** your thoughts:

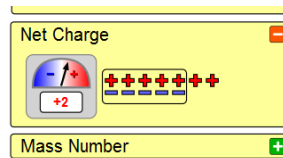
- a) In order to have a positive net charge, what must be true about the number of protons and electrons?
- b) In order to have a negative net charge, what must be true about the number of protons and electrons?
- c) What could the value of a neutron be, if represented by an integer?
- d) Why are some of the + and – signs circled in the net charge?

11. Create an atom with a **net charge of zero**. What do you notice about the number of protons and electrons?

12. The net charge of the Nitrogen atom below can be written as the addition sentence $7 + (-5) = 2$



Model:
● Orbits
○ Cloud



Re-write the net charge of the atoms you created above as addition sentences.