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Atoms and Elements [6th grade]

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Unit: Atoms and Elements

Grade: 6th Grade

Stage 1: Desired Results

Understandings

Students will understand that…

Scientific truth changes based on new learning.
All physical things are made of tiny units put together.
Models are used to help us understand concepts.
Scientists can use indirect evidence to learn about things that can't be seen or touched.

Standards:

Colorado Academic Standards, 6th Grade Physical Science:

1. All matter is made of atoms, which are far too small to see directly through a light microscope. Elements have unique atoms and thus, unique properties. Atoms themselves are made of even smaller particles.

Colorado Academic Standards, 6th Grade Research and Reasoning:

1. Individual and group research projects require obtaining information on a topic from a variety of sources and organizing it for presentation.

Core Knowledge Science:

1. Scientists have developed models of atoms; while these models have changed over time as scientists make new discoveries, the models help us imagine what we cannot see.
2. Elements have atoms of only one kind.
    1. The Periodic Table: organizes elements with common properties.
    2. Atomic symbol and atomic number
    3. Some well-known elements and their symbols.

Essential Questions

1. What are all things made of?
2. How can you study something you can't see?
3. How can something true change?
4. Why do we have models?

Knowledge

Students will know…

Atoms are the building blocks of matter.
Atoms are made of smaller particles called protons, electrons, and neutrons with charges.
Scientific ideas concerning atoms have changed over time.
Elements are made of one type of atom with unique properties.
Common elements.
The Periodic Table of Elements organizes elements based on their properties, such as their atomic symbol and atomic number.
How to conduct research on a particular element.
How to present acquired information.

Skills

Students will be able to…

Break scientific ideas into their building blocks (ex: apply knowledge of atoms to cells in biology)
Research a topic and present information in writing and a model.
Describe how understandings can change with the addition of new learning.
Use indirect observation to study something.

Stage 2: Assessment Evidence

Performance Task:
Adopt an Element
After learning about atoms and gaining an understanding of how the Periodic Table of Elements is organized, students will chose an element that they would like to "Adopt." Students will conduct research on their element and create a 3-dimensional model of their choice. In addition to the model, there will be a written component that provides details and interesting facts about their element.
The assignment and rubric are in the appendix.

Other evidence:
Quizzes
Notes
Models

Stage 3: Learning Activities

(Steps taken to get students to answer Stage 1 questions and complete performance task)
Lesson 1 *What are things made of?*
Objective: Scientists have been investigating what things are made of for a very long time and they conclude that all things are made of atoms. (Students write down objective in their science notebook.)

- Pre-Assessment: On a notecard, have students draw a picture of an atom. Students can discuss what ideas they may or may not have about the word. If students do not have any background knowledge on atoms, instead ask, "What are things made of?" After students write, draw, and discuss collect the cards.
- Students rip out a page from their science notebooks. Instruct students to rip their paper in half and continue to do so until they make the absolute tiniest piece possible. What do you think eventually happens?
    - Eventually, we would get down to something so small that we couldn't even see if with a microscope. We call these objects atoms. **Atoms are the basic units of matter.** (Students write definition in notebooks) Matter is anything that has mass and volume.
- Students will then read an article about the scientific history of discovering the atom. Any article will work but here is a link to one: http://www.nobraintoosmall.co.nz/students/physics/NCEA_Level2/L2_Atoms/pdfs/phys_90256_History_of_Atoms.pdf
- Students will take notes using some kind of strategy that emphasizes sequencing (Schools that use Thinking Maps can use a Flow Map). Stress to students that science is always changing and research and discoveries are constantly being made, how exciting!

Homework: Students finish reading and taking notes about the article.

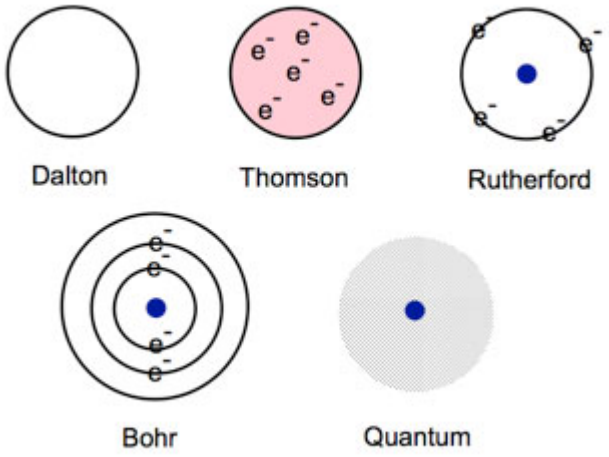
Lesson 2 *Mystery Box*
Objective: Because atoms cannot be seen, scientist study them using indirect evidence.

- How do scientist know about atoms? How can you learn about something you can't see?
- We can use indirect evidence. **Indirect evidence is evidence gained by observation**.
- Working in groups, students receive some type of box with about 4 items in it. Students must use the questions to guide them through their exploration. (Questions are in the appendix)
- When they have answered questions and hypothesized about what is in their box they may open the box and see what it is. Then, groups can trade boxes or put in items of their own choice for others to figure out.
- Summary Discussion: Scientists use many tools to help them explore atoms. Indirect observation means using observation to gain new understanding. New tools and understandings are always being introduced so our understanding of the atom changes with new information.

- Students finish their observation guide for homework.

Lesson 3 *Structure of an Atom (2 days)*
Objective: Students can explain what an atom looks like.

- So, if we can't see or touch atoms, what do they look like?
  - Students take notes on this website (or any other website describing the 3 main subatomic particles: protons, electrons, neutrons), depending on access to computers they may do it alone or as a class. http://www.chem4kids.com/files/atom_structure.html
  - In their science notebooks they should have these three definitions
    - Proton: positively charged particle found in the nucleus.
    - Electron: Negatively charged particle outside of the nucleus.
    - Neutron: Neutral particles found in the nucleus.
- Once students have the language and understanding of the three particles then discuss again how understandings have changed and give a history of atomic theory.
  - Go back to the article from Lesson 1 and have students draw pictures in their notes of each stage of development. This can be done through whole group lecture, group work, or this video is also very informative, although a little bit above a typical 6th grader but with great visuals: https://www.youtube.com/watch?v=thnDxFdkzZs
    - Ancient Greeks (Democritus and Leucippus): 300s BC believed that everything was made of Fire, Earth, Air, Water, and Aether. They believed that there was something that could not be broken down into smaller pieces - atomos.
    - John Dalton: 1805 Students will draw a plain circle for their model. Without knowing about protons or electrons, John Dalton proposed that atoms cannot be divided into smaller particles and elements are made of atoms. (A similar idea to the Greeks, just resurfaced thousands of years later.)
    - J.J. Thomson's Plum Pudding Model: 1897 JJ Thomson discovered that there were positive and negative charges in an atom using a tube and electric charges. He proposed that negatively charged particles were floating around in a "pudding" of positively charged substance. Students label, date and draw the plum pudding model in their journals.
    - The Rutherford Model: 1894 Rutherford discovered there was a positively charged nucleus! He conducted an experiment using gold foil and made observations to do this. Students draw the model with a nucleus and electrons orbiting around.
    - Bohr Model: 1911 Bohr suggested there were energetic levels of electrons orbiting the nucleus. Students draw a model in their notebook with a nucleus and electrons orbiting in concentric circles.
    - Erwin Schrodinger: 1926 Schrodinger concluded that it is impossible to know where an electron will be. Therefore, instead of modeling electrons using predictable patterns, he depicts them in a "cloud" or "cotton candy" and used mathematical equations to find the probability of where the electrons were most likely to be. Students draw a picture in their notes of the atom with an electron cloud around a nucleus.
    - Below is an example of possible models to draw in their notebooks.
    - https://www.learner.org/courses/chemistry/visuals/visuals.html?dis=U&num=Ym5WdElUQS9OQ289



- Students get into groups of 6. Each student gets a particle. Tell them they are now a Helium atom. There should be 2 Protons, 2 Electrons, and 2 Neutrons. You could use name tags to reinforce the point. Then, go through each model and have students act how an atom would behave in that model. Students should also verbally practice saying the name of each model and talking about each particle. (Sentence structures projected on the board are good for this: This is the _____ model. The electrons _____. The protons and neutrons _____.) This activity can be done as a summary or after talking about each model.

- Ticket out the door: Students draw and label an atom using the "cloud model."
- If you want more worksheets or activities, I found I really liked this website:
  - http://www.nclark.net/Atom

Lesson 4 *Build Your Own Atom*

Objective: Students will model the structure of an atom.

- Start class with this video: http://ed.ted.com/lessons/just-how-small-is-an-atom
  - I always introduce this video as "Mind Blowing" because it describes how small atoms are. This is a difficult abstract concept for 6th graders and the video shows many examples. Understanding how small atoms are makes the discoveries even more amazing and sheds light on the importance of models in science. It even addresses the big idea that models are not perfect but help us understand concepts.
- Then, challenge students to build their own 3 – D model using classroom materials. Teachers can provide things like cotton balls, toothpicks, string, marshmallows or anything else around the room. They use the instruction sheet to guide them found in the appendix.

Homework: Study for Quiz

Lesson 5 *It's Elemental!*

Objective: Elements are made of the same type of atom and are organized on the Periodic Table of Elements.

- Students take quiz on the first 4 lessons. (Quiz is in the appendix)
- Students will read an article (any on what elements are will do, here is an example from Chemkids: http://www.chem4kids.com/files/elem_intro.html)
  - Key Points that should be in their notes: Atoms can be organized by how many protons, electrons and neutrons they have. **An element is a substance that is made of only one type of atom.** All of the known materials in the universe are made from elements. **There are currently 118 known elements**.
  - This is a fun video that very quickly goes through the elements:

https://www.youtube.com/watch?v=-I7l8TgtuLQ
    - Project a Periodic Table of Elements. Tell students that the Periodic Table of Elements organizes all of the elements based on common properties. 2 main groups are metals and non-metals.
    - Then, tell what each symbol and number mean for the elements. Students should draw a model in their notebook and label and define the atomic number, atomic mass, element name, and symbol.
- Students complete a "Periodic Table Scavenger Hunt." Below are some examples from online:
    - http://www.whsd.k12.pa.us/userfiles/1646/Classes/22118/01%20Matter%20and%20Change%20-%20Periodic%20Table%20Scavenger%20Hunt.pdf
    - file:///C:/Users/ncate/Downloads/periodic-table-scavenger-hunt-reviewing%20(4).pdf

Lesson 6 *Getting to Know Common Elements*

Objective: Students get familiar with Periodic Table and memorize common elements and their symbols.

- Start class with a review. Half the class will have an element on a notecard and half of the class will have numbers. They must use the Periodic Table to match up with their partner.
- Review how the periodic table is organized and how to read it.
- Then, discuss metals and non-metals. This is a good online article to ground the discussion/note taking: http://chemistry.about.com/od/elementgroups/tp/elementgroups.htm
- Core Knowledge has a list of common elements that people should know. With the remainder of class, students use notecards to make flashcards of these elements. Element and atomic number on one side, atomic symbol and possibly a picture on the other.
    - Hydrogen H, Helium He, Carbon C, Nitrogen N, Oxygen O, Sodium Na, Aluminum Al, Silicon Si, Chlorine Cl, Iron Fe, Copper Cu, Silver Ag, Gold Au
- Students finish their flashcards and study for homework.

**There is also a good PBS Nova video on elements called "Hunting the Elements." It is currently on Youtube at https://www.youtube.com/watch?v=r81hUk5qe5w

Lesson 7 *Start "Adopt an Atom" project*

Objective: Students will begin researching their chosen element.

- You will need computers for this lesson!
- Pass out Performance Task and discuss what is expected.
- Then, students will begin conducting research on their specific element. I have found the following websites helpful:
    - http://education.jlab.org/itselemental/
    - http://www.ptable.com/#Writeup/Photos
- Students use class time to research, plan, and write their paper to accompany their model.

References:

http://www.coreknowledge.org/mimik/mimik_uploads/lesson_plans/1466/7_atomicstructure-uwp.pdf

The assessment is adapted from ScienceSpot.net

Other references embedded in text.

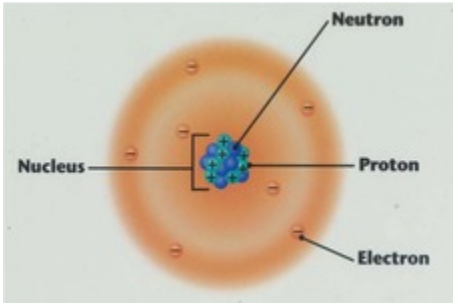
Appendix:

Below you will find accompanying documents.

Name _____ Date _____

Adopt an Element

Performance Task



You've thought about it a lot, and now you are ready to adopt . . . an atom that is! You will choose an atom to adopt from the Periodic Table of Elements. We have learned that scientists use models to help them understand concepts more clearly, so here is your chance! You will create a 3 dimensional model of an atom based on the properties of your specific element. You also will get to explore your atom more by investigating its properties and unique aspects on the internet.

You will have class time to research and write but most of the model building will be done at home.

Use your imagination and creativity in selecting materials for this project. It can be presented as a free standing model, suspended from something like a coat hanger, mounted on a poster board, or something else that you have in mind.

Your model needs to have the correct number of protons, neutrons, and electrons with their charges labeled. It needs to have positively charged nucleus and space in between the electrons and nucleus. You may use the Rutherford, Bohr, or Cloud model to represent your element, please identify which one you chose on your model.

For the written piece, you need to use the "Element Fact Sheet" to guide your research. It should include all the information from the fact sheet, any additional information, clear transitions, and proper grammar.

Use the rubric to make sure you have included all the requirements. Now, go adopt an element!

Name _____ Date _____

Element Fact Sheet

Element name _____

Symbol _____

Atomic Number _____

Atomic Weight _____

Number of Protons _____

Boiling Point _____

Classification _____ Metal _____ Nonmetal _____ Metalloid

Normal Phase _____ Solid _____ Liquid _____ Gas

Discovered by _____

What are three interesting facts you learned about your element?

1.

2.

3.

Why did you choose to adopt this element?

Now, use this information to write a neat written piece describing your element. To earn full credit you must include all the information on this fact sheet!

Be sure to include your sources at the bottom of your piece.

Name _____ Date _____

Rubric for Adopt an Element

Expectation:				
Model labels and correctly shows the protons, neutrons, and electrons of an atom. Charges are labeled and there is clearly a nucleus with spaced in the middle of the electrons. 16 points	All components are included and correctly labeled. 16 points	Model has most of the elements but is lacking 1 or 2 parts. 12 – 15 points	Model is lacking 3 – 4 components. 8-11 points	Model is lacking 5 or more components. 0-7 points

Model is neat and creative. 8 points	Student goes above and beyond to use materials in an extremely creative fashion. The model is neat and clear. 8 points	Model used materials creatively and combines them neatly and clearly.	Model looks messy and materials were not used very creatively.	Model is copied directly from another source or not turned in.
Written piece includes information from the Element Fact Sheet 16 points	All facts are included. 16 points	The piece is missing 1 – 3 facts. 10 – 15 points	The piece is missing 4-6 facts. 5 – 10 points	The piece is missing 7 or more facts. 0-5 points
Written piece has structure. There should be an opening, transitions, and closing. Proper grammar is used. 8 points	Written piece reads nicely and has a good flow. Errors do not impede the meaning. 8 points	Written piece is choppy at times or 1 component is missing. Errors confuse reader at times. 6 – 7 points	Written piece is unclear at times or is missing 2-3 components. Errors confuse reader often. 4 – 5 points	Piece is unclear and does not include an opening, transitions, or a closing. Errors significantly hold the reader back. 0-3 points
Effort 6 points	Students' effort is clearly observed in class and reflected in their project. Time is managed and used wisely. 6 points	Student uses most of time wisely. Student displays effort in class and project reflects this. 4 -5 points	Student uses some of class time wisely. Work choices are reflected in project. 2-3 points	Student uses little of their class time wisely. Their project suffers because of this. 0-1 point
Total Score _____/54				

Name _____ **Date** _____

Mystery Box

Use with Lesson 2

Atoms are crazy small! Not even with a traditional microscope can we see them. However, scientist have a good idea of what they look like, how is this possible?

As scientists, we can use **indirect evidence** to study and support our ideas about things. **Indirect evidence means we make predictions and theories based on our observations.** You, as a scientist, will be using observations to make a hypothesis of something you cannot see.

<u>Materials</u>

Box with objects inside from your teacher

Triple beam balance

Procedure

1. Obtain a box from your teacher.
2. Without being able to look inside your box, use strategies to figure out what is inside. For example, you may weigh, shake, tip, slide, or make comparisons to other objects.
3. After each action, record your observations.
4. Based on your observation, sketch the object(s) in your box. Include as many characteristics as you can.

Observations

Make a table to display your observations. Record your action and what you observed.

Analysis

1. How is this activity similar to what scientists have done to learn about the atom?

_____
_____
_____
_____

2. How could you test your model of the box contents to see if you are correct?

_____
_____
_____
_____

3. What tools could help you study the contents of your box more?

_____
_____
_____
_____

4. Open your box. How does your hypothesis compare to the actual contents?

_____
_____
_____
_____

Conclusions

1. What can we learn from this about the current model of an atom?

_____
_____
_____

2. What did you like about this activity? What would you do differently next time?

_____
_____
_____

3. What did you learn today?

_____
_____
_____

Lesson Adapted from: http://www.coreknowledge.org/mimik/mimik_uploads/lesson_plans/1466/7_atomicstructure-uwp.pdf

Name _____ **Date _____**

Challenge: Build an Atom

Use with Lesson 4

Now that you know all about atoms and their subatomic particles. You will build one! Think about the structure and components of an atom. Now, look at the materials in the classroom and think about items could be used to model the parts of an atom.

First, list the materials you will use below:

Now, draw out and label your design (Label protons, neutrons, electrons and their charges):

Next, build it!

Finally, make conclusions. Think about the questions below and write down your thoughts.

What was difficult? What worked well? How does this apply to what scientists do? Did your model perfectly show an atom? What are the things about your model that aren't really the way an atom is?

_____

_____

_____

_____

_____

_____

_____

_____

Name _____ Date _____

Atom Quiz

Use after Lesson 4

1. What is the smallest unit that matter is made up of? _____
2. How do scientists study atoms?

_____

_____

_____

_____

3. Who developed the "Plum Pudding" model of an atom?

_____

_____

_____

4. What was significant about the Rutherford model?

_____
_____
_____

5. What did Schrodinger propose about electrons? How did that change his model?

_____
_____
_____
_____
_____

6. Why are there so many different models of an atom?

_____
_____
_____
_____
_____

7. Draw an atom using the cloud model. Label the protons, electrons, and neutrons with their charges.