Research-Based, Standards-Aligned Instruction:
IQWST Middle School Science Curriculum

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National Academy of Sciences
Literacy for Science in the Common Core ELA Standards and
The Next Generation Science Standards

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What are we going to do?

- Illustrate: how IQWST integrates science content, literacy, and scientific practices
- Describe: research base
- Illustrate: how IQWST (+instruction) aligns with NGSS and CCSS

IQWST

Investigating and Questioning our World through Science & Technology

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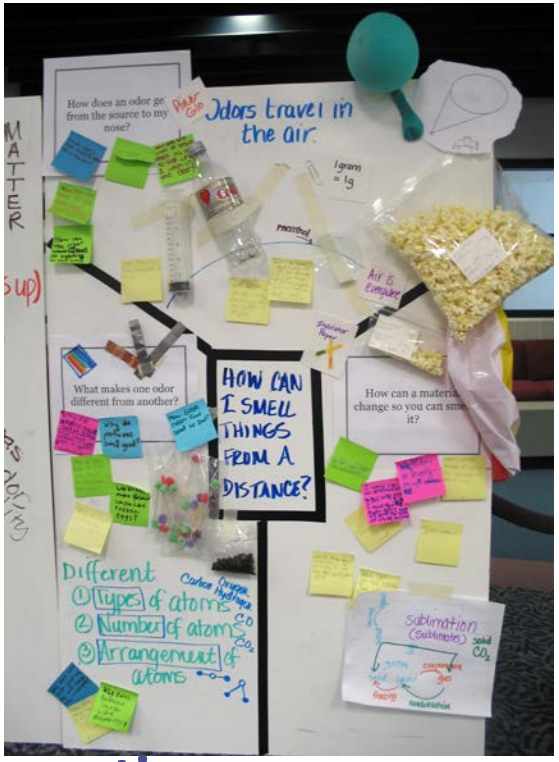
Scope & Sequence

Level 1	**Physical Science** ***Can I Believe My Eyes?*** Light Waves, their Role in Sight, and their Interaction with Matter	**Chemistry** ***How Can I Smell Things From a Distance?*** Particle Nature Of Matter, Phase Changes	**Life Science** ***Where Have All The Creatures Gone?*** Organisms and Ecosystems	**Earth Science** ***How Does Water Shape Our World?*** Water and Rock Cycles
Level 2	**Chemistry** ***How Can I Make New Stuff From Old Stuff?*** Chemical Reactions, Conservation of Matter	**Physical Science** ***Why Do Some Things Stop While Others Keep Going?*** Transformation and Conservation of' Energy	**Earth Science** ***What Makes the Weather Change?*** Atmospheric Processes In Weather and Climate	**Life Science** ***What's Going On Inside of Me?*** Body Systems and Cellular Processes
Level 3	**Earth Science** ***How Is the Earth Changing?*** Geologic Processes, Plate Tectonics	**Life Science** ***Why Do Organisms Look the Way They Do?*** Heredity and Natural Selection	**Physical Science** ***How Will It Move?*** Force and Motion	**Chemistry** ***How Does Food Provide My Body with Energy?*** Chemical Reactions In Living Things

Hallmarks of IQWST



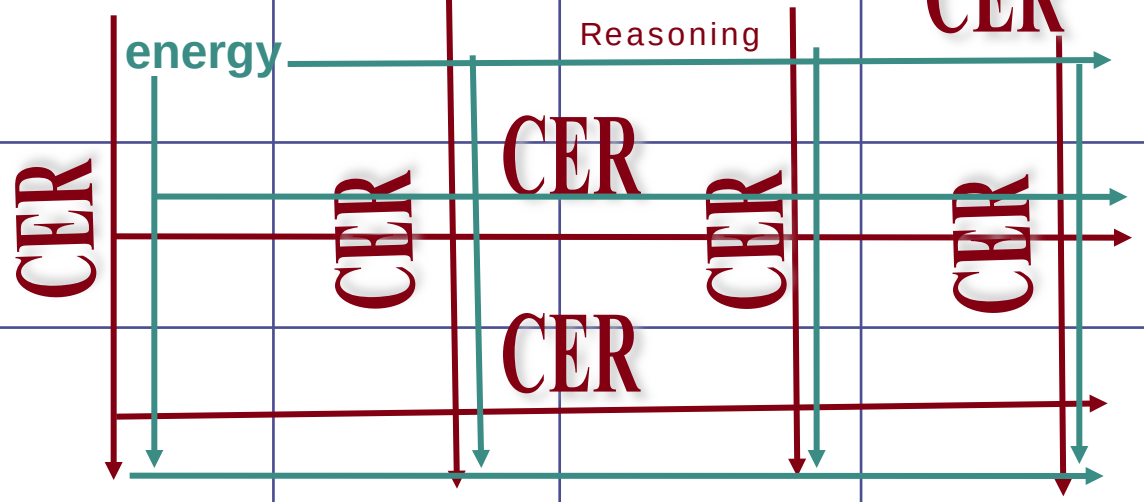
- **Coherence**
- **Engagement**
  - **Questions** (NGSS #1)
  - **Prior knowledge & experience**
- **Integration of content, literacy and scientific practices**
  - **CCSS**: reading, writing, speaking & listening, attention to language in every lesson
  - **NGSS:** analyze and interpret data (#4), develop and use models (#2), construct explanations (#6), engage in argument from evidence (#8)

Typical Address of Scientific Practices and Content

	Physics	Chem	Life Science	Earth Science
6th			argumentation	
7th	energy			
8th				
Student Understanding	Context/Task-specific			

What happens in IQWST

	Physics	Chem	Life Science	Earth Science
6th	evidence	evidence	Claim Evidence Reasoning	CER
7th	CER	CER	CER	CER
8th			CER	
Student Understanding and Facility	Deep and Meaningful			



In every IQWST lesson:

A) Students investigate (*do* science) plus read, write & talk science

B) Texts incorporate research on comprehension, and the TE supports teachers in introducing and following up reading

A) As students explain the *how* and *why* of science, or engage in argument from evidence, they obtain info from in-class activities and reading, evaluate and integrate the two, and must communicate understanding orally and in writing, individually and collaboratively.

Obtaining, Evaluating, and Communicating Information

- *Obtain*: via investigations, discussion, text

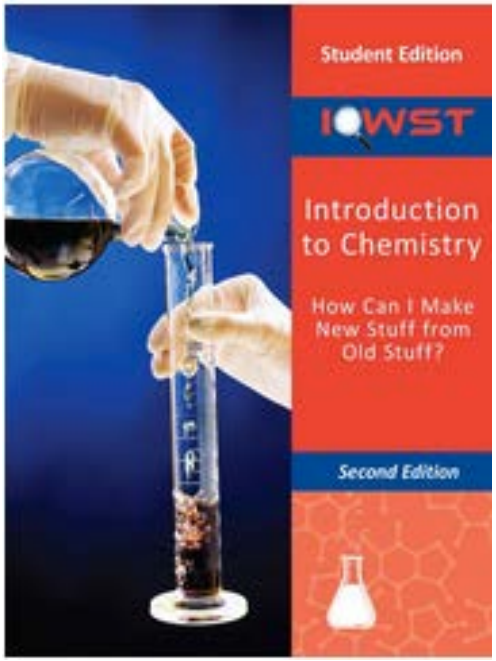
  Repeatedly #4 Analyzing and Interpreting Data

- *Evaluate*: informational texts; peers' models, explanations and arguments

- *Communicate:* discuss; share understanding through writing, drawing, and presenting to peers for feedback

NGSS #2 Developing and Using Models
NGSS #6 Constructing Explanations
NGSS #7 Engaging in Argument from Evidence

Obtaining Information



Obtaining Information

In class you will focus on properties because identifying properties of substances helps you answer questions such as how do nylon and animal hair compare? Properties can also be important outside of science class. For example, imagine that someone wanted to sell you a very expensive ring with a shiny stone in it that looked like a diamond. How would you know whether the stone was a real diamond or a fake diamond?

L1: Intro Problem, Pose Question

Some stones that look like diamond are not real diamond. Cubic zirconia is one kind of artificial (fake) diamond. Cubic zirconia is a fake because it looks like a diamond, but it is made of different atoms than diamond. Diamond is a substance. It is made only of carbon atoms. Those atoms are arranged in a specific way that makes diamond. Cubic zirconia is also a substance. It is made of zirconium atoms and oxygen atoms (ZrO_2). They are arranged in a specific way that makes cubic zirconia. Cubic zirconia and diamonds are different substances because they are made of different atoms.

Build Conceptual Understanding

Reading 3.2 – Which Properties Can I Use When?

Getting Ready

Imagine that you wanted to test whether the stone in your ring is a diamond or cubic zirconia. What properties could you use to test it? Are there any properties you would not use? To help you answer these two questions, look back at the list of properties you have studied so far.

L3: Prompt researchable questions, focus inquiry

This reading will help you think about which properties make sense to use to learn about different substances.

Anyone can make a claim, but a good scientific explanation includes the evidence and reasoning that show the claim to be true. You do not know any of this kind of information if someone only says, "Shampoo X is better for your hair than Shampoo Y." There is no reason to believe this person's claim to be true without more information.

Constructing a Scientific Argument

In this section, you will practice constructing an argument by looking at data from two rings. Here are two rings that look very similar. The stones in the rings look the same. They are the same size. Both rings occupy the same volume.

The following table summarizes some properties of the stones in each ring. The table gives you data you need to compare the stones. Decide whether they are the same or different substances. Your argument needs a claim, evidence, and reasoning that shows how the data you choose connects with the claim you make. Your reasoning will need to include scientific principles about substances and properties.

L5:Provide data for constructing argument

	Properties				
	Density	Color	Hardness	Melting Point	Solubility in Water
Stones in Ring #1	5.92g/cm³	No color	8.5	2759°C	No
Stones in Ring #2	3.52g/cm³	No color	10.0	3547°C	No

CCSS Reading

Reading: Key Ideas and Details

expository text, make inferences, cite to support conclusions, use info from readings and investigations as evidence for claims

Reading: Craft & Structure

assess how details are chosen to support a position, how word choices (vocab) shape meaning in their texts and others' texts

Reading: Integration of Knowledge and Ideas

cycle parallels ELA process writing, evaluate one another's texts (claims, validity of reasoning, relevance and sufficiency of evidence)

CCSS Writing

Writing: Research to Build and Present Knowledge

to learn and to demonstrate understanding

Writing: Production and Distribution of Writing

write in a manner whose organization and style are appropriate to the task, purpose, and audience

Writing: Text Types and Purposes

evidence-based, reasoned arguments to support claims; select and analyze text content and data; write to convey complex ideas

Evaluating and *Communicating* Information

as they investigate

Data Collection:

Unknown Stuff	Descriptions
#1	Smells like soap, feels hard and slightly, looks like styrofoam, is white can be broken by medium force, Is wet, but dries very quickly, Smooth, Rectangular shape
#2	Is wet and moist, smells like chicken, is yellowish-white, very moist and stays moist, greasy, gooey, looks like petroleum jelly, No shape

Conclusion:

1. Write a conclusion that states whether #1 and #2 are the same stuff or different stuff. Provide evidence to support your conclusion.

"#1 and #2 are different stuff. My evidence for this claim are they smell different and look different. My reasoning is that they both have different descriptions. They they are similar in some ways, they are more different than the same.

2. Think about stuff in your everyday life - What do you think #1 and #2 are? Why do you think that?

"I think that #1 is soap and #2 is chicken grease. I soap because of mainly it's smell. From day to day ences I can tell. I think #2 is chicken grease becau smell. It smells like chicken and is very greasy. It' make it suitable for this purpose.

Conclusion

1. Imagine someone who thinks the two white materials are the same because they both look the same. How could you argue that they are different substances?

2. How does the amount of a substance affect its melting point? Write an explanation below. Use your data as evidence.

Scientific Explanations and Argumentation

- Claim: Answers the research question defined at the beginning of the investigation. Answers, "What can you conclude?"

- Evidence: Data (from observations or measurements) used to support a claim.

- Reasoning: Using scientific principles to show how particular data support a claim.

Reading 5.1 – What Evidence Would I Use to Tell if the Stones in a Ring Are the Same or Different?

Getting Ready

Scientists often investigate something and then share their findings with other people. Imagine a scientist telling you that "Shampoo X" is better for your hair than "Shampoo Y." What are some things you would want to know about that scientist's investigation before you make a decision about whether to buy Shampoo X or Shampoo Y?

***Claims*, *evidence, and reasoning* in a familiar context—advertising—shampoo**

Just saying one is better than another is not useful in helping you choose which shampoo to buy. You might ask questions like the following: "How did you figure out that Shampoo X is better?" "What evidence do you have?" "Did you test it on hair that is different colors and different textures?" "In what way is Shampoo X better?" "Does it matter how often you use it?" You might ask these questions because the answers would help you to decide if you agree or disagree with the scientist. The answers would also help you decide if Shampoo X is better than Shampoo Y. This section is about one reason scientists use scientific explanations. Scientific explanations communicate your ideas so that other people can decide whether they agree or disagree with you or whether they think your explanation of something in science makes sense. In class you wrote a scientific explanation about whether fat and soap were the same substance; to support your claim you provided evidence and reasoning.

Explanation & Argumentation

CER approach:

IS a way that scientists explain and defend their ideas

IS NOT a fill-in-the-blank strategy for writing in science

Purpose: Communication

Scientific Discourse is Scaffolded

- What is the *evidence* for your idea? Why would someone believe you?
- Your *idea* becomes your *claim*
- Scientific claims supported by *data* (qual & quant)
- Need to have *appropriate* and *sufficient evidence*
- Appropriate evidence based on "What we already know in science" – *Scientific Principles*

ACTIVITY 5.1 – ARE FAT AND SOAP THE SAME OR DIFFERENT SUBSTANCES?

What Will We Do?

We will construct an explanation about whether soap and fat are the same substance using our data from several lessons as evidence.

Procedure

1. Look at your activity sheets from Lessons 1–4 to complete the data table.
2. Fill in all of the properties for fat and soap in the following table.

Data

	Properties				
	Color	Hardness	Solubility	Melting Point	Density
Fat					
Soap					

Conclusion

Write a scientific explanation that answers the following question: How do you know scientifically that fat and soap are different substances?

We already knew fat and soap are used for different things. In science, we know they're different substances because they have different properties. All substances have unique properties. The data are different for solubility in water and oil, melting point, and density of fat and soap. If even one property is different we know they're different. So fat and soap have to be different substances.

Conclusion:

Write a scientific explanation stating whether you think fat and soap are the same substance or different substances. Provide evidence.

I think that fat and soap are different substance

My evidence for this claime are the results listed on the chart for melting point, solubility and density. Evidence #1, melting point shows about 35° seperating the two substance. Soap is 10c fat is 65°C. Evidence = 2, solubility shows that soap melts better in water, while fat melts better in oil. Evidence = 3 density shows that fat is .92g/cm³ and soap is .8g/cm³

My reasoning for all this is that the difference between the three stated properties is way to great. If a substance is even partially close there would be at least 10 units seperating them, There is actually 35° seperating them in melting point, .84 g/cm³ seperating them in density and their solubility is opposite of each other. This is enough evidence to prove that they are different substances.

rate: 10

= claim
= evidence
= reasoning

Locate C,E,R

Evaluate C,E,R,

Provide fb

Discuss

Revise

CCSS: Speaking & Listening and Language

- Range of Conversations
- Use domain-specific vocab
- Build on others' ideas
- Present ideas persuasively
- Present so others can follow line of reasoning
- Organization & style appropriate to task, purpose, audience
- analyze speaker's use of evidence and reasoning

Assessment

Shayna had a small bottle of Bromine gas. The bottle was closed with a cork. She tied a string to the cork, and then placed the bottle inside a larger bottle. She sealed the large bottle shut (Figure 1). Next, Shayna opened the small bottle by pulling the string connected to the cork. Figure 2 shows what happened after the cork of the small bottle was opened.

1. Draw a model that shows what is happening in this experiment.

2. Explain in writing what is happening in your model.

Figure 1

Figure 2

IQWST

Research-based, standards-aligned curriculum
that deeply integrates
content, literacy and scientific practices.

An exemplar of NGSS & CCSS
instantiated in curriculum
and enacted via quality instruction.

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