2021-2022 Louisiana Pacing Guidance

OpenSciEd Grade 7 Chemical Reactions and Matter

This document contains the OpenSciEd Chemical Reactions and Matter storyline with Louisiana-specific pacing suggestions. Adaptations have been made with permission under Creative Commons 4.0 licensing. Making any changes, including the ones suggested in this document, is not recommended if this is the first time implementing the unit. Teachers and instructional leaders are best placed to make pacing decisions that meet the needs of their individual students and unique school settings and may or may not choose to use these suggestions. In any setting, deep learning through authentic engagement with all three dimensions of the Louisiana Student Standards for Science for all students should be emphasized over covering content and should inform any decisions made with regard to pacing.

This guidance document is considered a "living" document as we believe that teachers and other educators will find ways to improve the document as they use it. Please send feedback to STEM@la.gov so that we may use your input when updating this guide.

Published October 29, 2021

Pacing suggestions appear as highlighted text for Lessons 3 & 4.

UNIT STORYLINE

How can we make something new that was not there before?

How students will engage with each of the phenomena

HANDS-ON/ LAB ACTIVITIES | VIDEOS OR IMAGES | DATA SETS | READINGS | COMPUTER INTERACTIVES

Lesson Question	Phenomena or Design Problem	What we do and figure out	How we represent it

LESSON 1

4 days

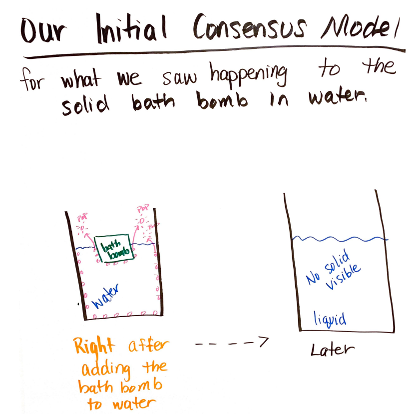
What happens when a bath bomb is added to water (and what causes it to happen)?

Anchoring Phenomenon

When solid bath bombs are added to water, they start breaking apart, and gas bubbles appear on and around them for a few minutes, until no solid is left.

We observe different bath bombs and what they do when added to water and then develop individual models and explanations to show what is happening at a scale smaller than we can see. We develop an initial class consensus model, brainstorm related phenomena, develop a DQB and ideas for investigations to pursue. We figure out that:

- We had competing ideas for whether the matter in the solid that we started with is still there after it is added to water. Some thought that it was all still there, while others thought not all of it was still there.
- We had competing ideas for where the gas came from that was in the bubbles that appeared. One was that it was there to start with (trapped inside the solid). The other was that it formed from some of the stuff we started with (e.g., in the solid and/or water).



⇓ **Navigation to Next Lesson:** We want to collect some data to see whether we can find evidence for the gas being in the solid before it is added to water.

LESSON 2

2 days

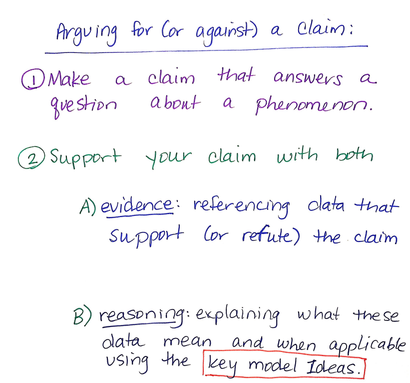
Where is the gas coming from?

Investigation

The mass of a bath bomb put in water in an airtight container does not change, but the mass decreases after the cap on the bottle is opened and gas is heard escaping.

We investigate bath bombs, measuring their mass in a closed and open system before and after crushing them and before and after we add the bath bomb to water. We argue from evidence about where the gas came from. We figure out that:

- The gas we observed from the bath bomb does *not* come from any gas that was originally trapped in the bath bomb itself.
- Instead, the gas we observed when the bath bomb was placed in water comes from some change to the matter that is already there.



⇓ **Navigation to Next Lesson:** Students agree to investigate common ingredients in bath bombs next and to test each ingredient one at a time in water.

Lesson Question	Phenomena or Design Problem	What we do and figure out	How we represent it

LESSON 3

2 days

What's in a bath bomb that is producing the gas?

Investigation

Bath bombs have different ingredients and recipes. The ingredients in them interact with water in different ways, but none cause bubbles to appear when added to water on their own.

In this lesson, we make observations and collect data on each of the main ingredients in a bath bomb, recording the properties of each. We also investigate each ingredient as it mixes with water and record our observations. However, we see that the ingredients interact with water in different ways. We figure out that:

- Substances in the bath bomb have properties that can help us identify them (e.g., solubility, odor, state of matter at room temperature, melting point, density, and color).
- Mixing only one substance from a bath bomb with water does not cause gas bubbles to appear.

Store-bought bath bomb

INGREDIENTS: SODIUM BICARBONATE, CITRIC ACID, SODIUM CHLORIDE (SEA SALT), SUCROSE, MAGNESIUM SULFATE (EPSOM SALT), GLYCINE SOJA (SOYBEAN) OIL, FRAGRANCE (PARFUM), SIMMONDSIA CHINENSIS (JOJOBA) SEED OIL, PRUNUS AMYGDALUS DULCIS (SWEET ALMOND) OIL, SESAMUM INDICUM (SESAME) SEED OIL, MACADAMIA TERNIFOLIA (MACADAMIA NUT) SEED OIL, HELIANTHUS ANNUUS (SUNFLOWER) SEED OIL, HAMAMELIS VIRGINIANA (WITCH HAZEL), ALCOHOL, RED 28 (CI 45410), BLUE 1 (42090), YELLOW 5 (CI 19140), WATER (AQUA, EAU).

Homemade bath bomb ingredients

Recipe A	Recipe B	Recipe C	Recipe D
⅓ c baking soda ⅙ c sugar-free lemonade mix ⅙ c Epsom salts 1 T cornstarch 1 t olive oil ⅓ t water	⅙ c Epsom salts ⅓ c baking soda ⅙ c citric acid 1 t olive oil ⅓ t water	½ c baking soda ¼ c citric acid ⅛ c coconut oil 1 t table salt 1 t sugar	⅙ c non-sugar-free lemonade mix ⅙ c Epsom salts ⅓ c baking soda ⅓ t olive oil 1 t water

If streamlining is needed, narrow the properties observed in Part 3 and have a pre-made data table for students. Combine Parts 4 & 5 navigation and complete Part 6 investigation on Day 1 with ingredients pre-measured and labeled with masses. Navigate to Part 7 to begin Day 2 and see suggestions for combining with Lesson 4 below.

⇓ **Navigation to Next Lesson:** We figured out that a bath bomb has several ingredients, and these are called substances. These substances all have different properties. We figured out that mixing one substance with water does not make gas bubbles. We wonder if mixing two substances in water will produce gas bubbles, and if so, can we figure out which substances produce gas bubbles?

LESSON 4

2 days

Which combinations of the substances in a bath bomb produce a gas?

Putting Pieces Together, Investigation

Combining citric acid, baking soda, and water causes bubbles to appear. Lemonade mixes (which are made of specific substances, including citric acid) also caused bubbles when combined with water and baking soda.

We will discuss and record what we've figured out so far in the unit. We will plan and carry out an investigation to test different combinations of substances from a bath bomb, and we will use the results to argue that the gas produced must be a new substance. We figure out that:

- Citric acid and baking soda combined are the only substances from the bath bomb that, when combined with water, cause gas bubbles to form.
- The gas(es) in the bubbles are substance(s) that are different from any of the substances we started with.

Ingredients		A Coconut oil	B Olive oil	C Baking soda	D Epsom salt	E Table salt	F Sugar-free Lemonade mix	G Citric acid	H Sugar-based lemonade mix	I Sugar	J Corn starch	Team
A	Coconut oil	X										1
B	Olive oil		X									2
C	Baking soda			X			Y	Y	Y			3
D	Epsom salt				X							4
E	Table salt					X						5
F	Sugar-free lemonade mix			Y			X					6
G	Citric acid			Y				X				7
H	Sugar-based lemonade mix			Y					X			8
I	Sugar									X		9
J	Corn starch										X	10

⇓ **Navigation to Next Lesson:** Since we know that the gas in those bubbles is a different substance(s) that wasn't there to start with, we want to try and figure out what substance(s) the gas is. We want to try to capture that gas and test it to figure that out.

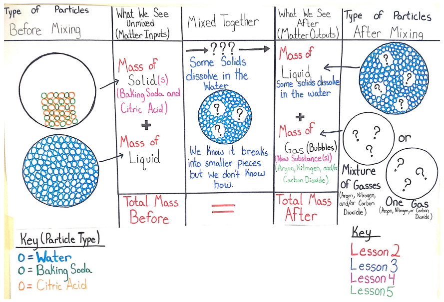
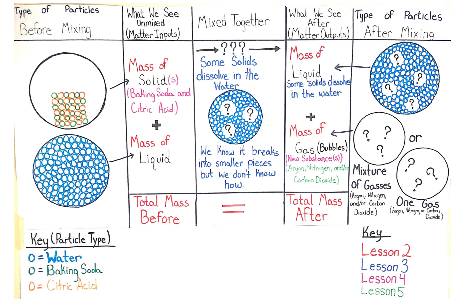
If streamlining is needed, combine Progress Tracker activities in Part 8 of Lesson 3 and Part 2 of Lesson 4 to conclude Day 2 of Lesson 3. On the next day, start with choosing a focal norm (Part 1), combine Parts 3 & 6 to plan and carry out the investigation in the same day, complete Part 7 & 8 as written and reflect on norms in Part 9 as part of Navigation to wrap up.

Lesson Question	Phenomena or Design Problem	What we do and figure out	How we represent it
LESSON 5 2 days **What gas(es) could be coming from the bath bomb?** Investigation	 *A flame goes out when put into a container of pure helium gas, gas from a bath bomb, or air mixed with helium, but does not when put in air only.*	We brainstorm phenomena related to gases and identify some different properties. We analyze the data by taking into account common gases and their known densities and flammabilities. We test the flammability of air from the room, gas from the bath bomb, and helium gas. We carry out an investigation to see if gas from the bath bomb rises or sinks. We argue from evidence (density and flammability data) that the gas from the bath bomb can be narrowed down to three candidate substances. We figure out that: • Density and flammability are properties. • In high concentrations, gases that are non-flammable will extinguish a flame. • Materials that are less dense float upward when surrounded by matter that is more dense; materials that are more dense sink downward when surrounded by matter that is less dense. • The gas from the bath bomb could be nitrogen, argon, or carbon dioxide.	Key Model Ideas • Gases, liquids, and solids are all matter. • Matter has mass and takes up space. • All matter is made of particles. • In a closed system, no matter can get in or out, so the mass stays the same ... even when changes happen to the matter (such as becoming a gas) • In an open system, matter can get in or out, so the mass can change if that happens. • Properties don't change for a substance. • Less dense gases (and liquids) float upward when surrounded by denser gases (and liquids) • Denser gases (and liquids) sink downward when surrounded by less dense gases (and liquids).

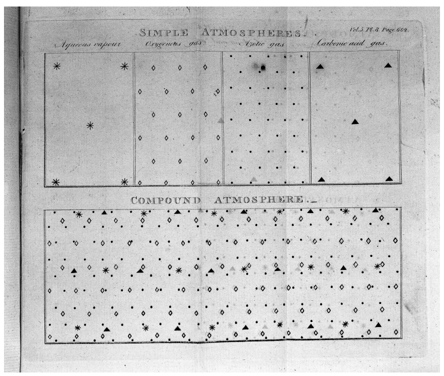
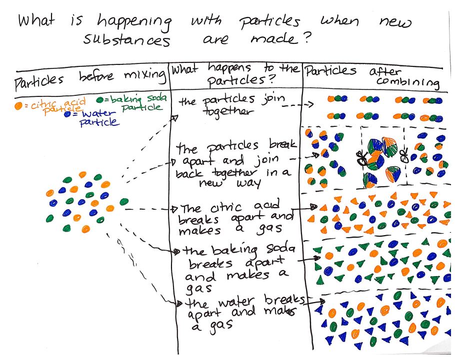
⇓ **Navigation to Next Lesson:** We want to see if we can explain a related phenomena using what we have figured out so far about property data. We want to see if we can explain a related phenomena using what we have figured out so far about property data.

Lesson Question	Phenomena or Design Problem	What we do and figure out	How we represent it
LESSON 6 1 day **How can we explain another phenomenon where gas bubbles appear from combining different substances together?** Putting Pieces Together	 *When different substances are combined (potassium chloride and hydrogen peroxide), they interact and produce a gas.*	We apply what we have figured out about properties to explain a related phenomena (elephant's toothpaste). We revisit our DQB and reflect on what other related phenomena we might explain using the same key model ideas. We figure out that: • The mass of a partially open system where potassium iodide and hydrogen peroxide are combined decreases because a gas is formed and some of it escapes the system. • The gas makes a glowing ember burst into flame and an already burning flame glow brighter. • Flammability data can help identify the types of gases that aren't being produced. • Testing the melting/freezing point, density, and/or comparing the results of the flammability test to results from controls could help identify additional gases that aren't being produced in this process.	

⇓ **Navigation to Next Lesson:** We know that the possible candidate substances that are in the gas from those bubbles are a different substance(s) that wasn't there to start with. Therefore, we wanted to try to develop a model at a particle level to explain how it is possible that a new substance that wasn't there before was produced from different substances we started with.

Lesson Question	Phenomena or Design Problem	What we do and figure out	How we represent it
LESSON 7 1 day **How can we revise our model to represent the differences in the matter that goes into and comes out of the bath bomb system?** Putting Pieces Together	 *No new phenomena are introduced in this lesson. We put the pieces together for all phenomena previously explored in Lessons 1 through 5.*	We work as a class to summarize and review all of the science ideas we have figured out through the investigations we have done so far in order to put all the pieces together. We develop a new way to represent what we figured out, using an input/output table. We identify an unanswered question about where the particles that make up the substance(s) of the gas came from and individually develop a model to try to explain this.We figure out that: • The same substance is made of the same type of particles throughout. • Different substances are made of different materials throughout. • The particles that make up the substances in the gas bubbles from a bath bomb must be a different type of particle than any of those in the substances that were combined together to make it (water, baking soda, and citric acid).	

⇓ **Navigation to Next Lesson:** Since the only way there can be a new substance formed is if new particles were formed, we want to see if it is really possible to make new types of particles (and therefore new substances) out of something that we think is made of only one kind of particle.

Lesson Question	Phenomena or Design Problem	What we do and figure out	How we represent it
LESSON 8 1 day **How can particles of a new substance be formed out of the particles of an old substance?** Problematizing	 *Alternate models can help explain how to make new particles from old particles*	We develop alternate models for how new particles might be made from old particles using manipulatives (printed colored circles). We formulate questions we have about how we could figure out what happens when new substances are made from old. We read about what Dalton and other scientists did to see if adding energy to water could form new particles. We figure out that: • When new substances form from old substances, the particles of the old substances might break apart and/or stick together to form new combinations of particles. • We have a new line of investigations to pursue to see if new substances are formed when energy is added to a single substance (water).	

⇓ **Navigation to Next Lesson:** We came up with some initial predictions about what substances are in the gas bubbles that form when you add energy to water. We have ideas of some property tests we can try to see if our predictions are right and we want to do some of those next.

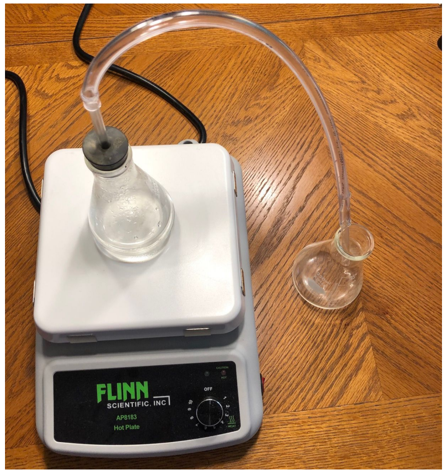
Lesson Question	Phenomena or Design Problem	What we do and figure out	How we represent it

LESSON 9

2 days

Does heating liquid water produce a new substance in the gas bubbles that appear?

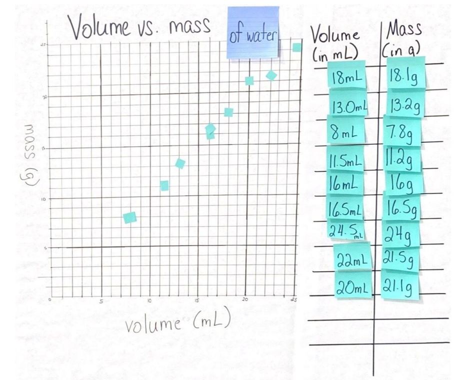
Investigation



Gas from heated water extinguishes a flame. Clear liquid collected when gas cools has a mass to volume ratio of 1 for any size sample.

We carry out an investigation to test the flammability of the gas produced by heating water. We collect data on the mass and volume of different samples of the water we started with and two other clear liquids and compare the mass and volume of each to the substance we collected from the gas produced by heating the water. We analyze graphs of the data and determine that the ratio of mass to volume for a substance is constant and that this is a property (density). We argue that the property data indicates that the gas we collected is made of the same particles that were in the water we started with. We figure out that:

- Density is calculated as a ratio of mass to volume (a unit rate). It is constant (a property) for any sample of a substance, regardless of size.
- The gas produced by the heated water is made of the same type of particles as those in the water that we started with.



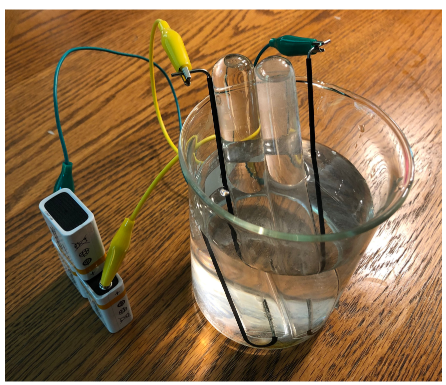
⇓ **Navigation to Next Lesson:** Now that we know that adding energy to water by heating it to make a gas doesn't produce any new substances, and therefore no new types of particles, we want to see if adding energy to water using electricity might create new substances.

LESSON 10

1 day

When energy from a battery was added to water, were the gases produced made of the same particles as were produced from heating the water?

Investigation



When energy from a battery is added to water, two streams of gas bubbles are produced. When a lit match is put into trapped gas from these two sources, one pops and the other glows brighter.

We will carry out an investigation to test the flammability of gases produced by providing energy to water with electricity. We will construct an explanation for whether the gas(es) produced from water using energy from a battery were made of the same particles as those produced from heating the water. We figure out that:

- Two different gases with different properties are produced from adding energy from a battery to water.
- The particles that make up these different gases must be different from each other; they must also be different than the ones that were produced from heating water.
- The matter that makes up all of the substances must come from matter that made up some of the original water particles.

⇓ **Navigation to Next Lesson:** We want to return to our poster "What is happening with particles when new substances are made?" and evaluate those ideas in light of the explanations we developed.

Lesson Question	Phenomena or Design Problem	What we do and figure out	How we represent it

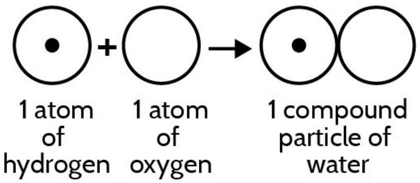
LESSON 11

2 days

How do Dalton's models of the particles that change in a reaction compare to the ones we developed?

Investigation

Phenomena or Design Problem:



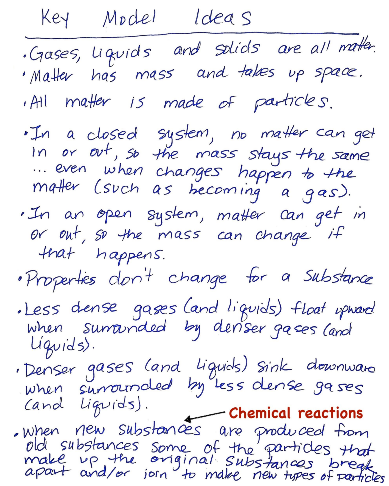
There are many different ways (symbols, shapes, letters, numbers, and physical manipulatives) to represent the number, type, and arrangement of the atoms that make up the molecules of different substances.

What we do and figure out:

We gather and summarize information from a reading on investigations that Dalton and other scientists did and molecular models they developed for atoms, compound particles, chemical reactions, and substances. We will individually use those models to predict and explain what gas is produced in the bath bomb reaction and what is happening to the particles in the system. We figure out that:

- Molecules are made of atoms and all the substances in our world are made of very few types of atoms.
- A substance is made of the same type of molecules (or atoms throughout). The number, type, and arrangement of atoms in the molecules that make up a substance are unique to that substance.
- In a chemical reaction, the particles that make up old substances can be broken apart and the atoms that make them up can be rearranged to form new molecules to make new substances.

How we represent it:



⇓ **Navigation to Next Lesson:** We are ready to take stock of all that we have learned, revise our final model, and use it to explain the chemical reaction that takes place when a bath bomb is placed in water.

LESSON 12

2 days

How can a new substance (a gas) be produced and the total mass of the closed system not change?

Putting Pieces Together

Phenomena or Design Problem:

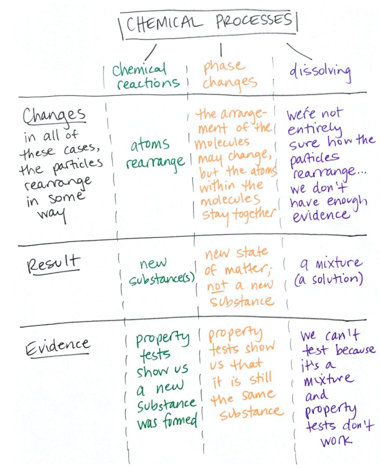
The mass of water captured in a container after a bath bomb reacts in it is greater than was initially in the container before the bath bomb was put in it. A white substance, with a different density and different solubility than any of the substances in the bath bomb is found in this container after the water is boiled off.

What we do and figure out:

We revise our consensus model with the molecules of the reactants and the gas produced from the bath bomb. We explain why it could be possible that water is also a product in this chemical reaction. Using property data and molecular models, we argue whether one the solids found in the container after the water has been boiled off is a new substance. We develop a model to represent what is happening to particles in three different chemical processes. We revisit the DQB and identify which questions we have made progress on. We figure out that:

- In a chemical reaction, the amount of matter at the beginning (in the reactants) is the same amount of matter at the end of the reaction (in the products). This is because all of the atoms we started with are still there. No new atoms can appear that weren't there to start with.
- Chemical reactions, phase changes, and dissolving are all chemical processes that involve rearrangement of the particles that make up the matter in the system.

How we represent it:



⇓ **Navigation to Next Lesson:** We identified one line of questions that we made only a small bit of progress on related to odors. We have some ideas about how we might investigate this line of questions further.

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<tr><th>Lesson Question</th><th>Phenomena or Design Problem</th><th>What we do and figure out</th><th>How we represent it</th></tr>
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LESSON 13

1 day

Why do different substances have different odors and how do we detect them?

Putting Pieces Together

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Some substances can be identified by their odor and each substance has a unique molecular structure. These odors are received by the receptors in our nose and signals are sent to our brain so we can recognize what the substance is.

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We carry out an investigation about the scents of different substances to see if we can identify these substances by their odors. We gather information from a reading about how sensory receptors in our nose work. We use what we figure out from the odor lab and the reading to write an explanation about why different substances have different odors and how we detect them. We figure out that:

Odor is a property of a substance that is determined by the number, type, and arrangement of atoms that make up that substance.
Molecules of substances must travel into our nose for us to detect an odor.
Our nose has many different cells that each have different structures (sensory receptors for odor) that different shaped molecules can fit into, which will cause that cell to send a signal to other nerve cells that relay that signal to our brain.
The perception of different scents is the result of a combination of signals that the brain receives from different nerve cells.

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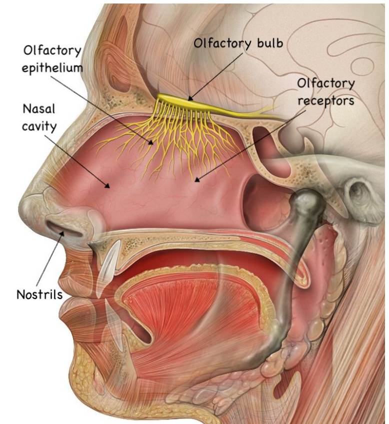

Patrick J. Lynch, medical illustrator; C. Carl Jaffe, MD, cardiologist. CCBY 2.5 Generic.

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<tr><td colspan="4">⇓ Navigation to Next Lesson: We want to apply everything we figure out to another phenomenon in the world.</td></tr>
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LESSON 14

2 days

What is happening to the Taj Mahal?

Putting Pieces Together

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The marble of the Taj Mahal is crumbling and falling apart.

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We apply what we have figured out about properties to explain a related phenomena (pollution and erosion on marble). We carry out an investigation to collect data about what happens when different substances in the air interact with marble. We identify what other evidence we would want to collect in terms of property data to be able to argue whether a chemical reaction occurs. We figure out:

Two pollutants in the air around the Taj Mahal are interacting with the surface causing a chemical reaction to occur and change the surface to a new substance.
Algae that is on the surface of the Taj Mahal secretes different acids that cause a chemical reaction to occur with the (calcium carbonate) marble surface.
The algae and pollutants in the air around the Taj Mahal are causing it to crumble due to chemical reactions that are occurring.

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LESSONS 1-14

25 days total