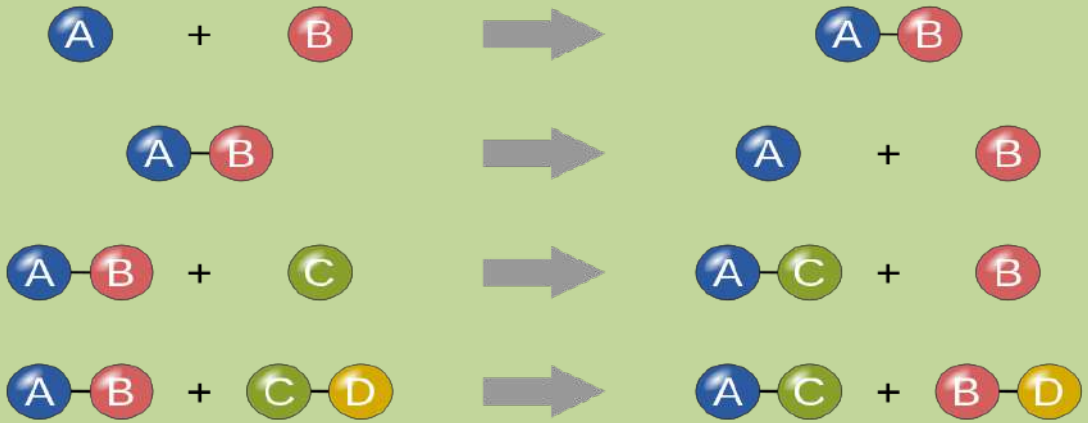
Science Unit 3 Plan
Grade 7

Chemical Reactions



Number of Days for Unit: 25 days

Unit 3: Chemical Reactions

Students provide molecular-level accounts of states of matters and changes between states, of how chemical reactions involve regrouping of atoms to form new substances, and of how atoms rearrange during chemical reactions. Students also apply their understanding of optimization design and process in engineering to chemical reaction systems. The crosscutting concept of *energy and matter* provides a framework for understanding the disciplinary core ideas. Students are expected to demonstrate proficiency in *developing and using models, analyzing and interpreting data, designing solutions*, and *obtaining, evaluating, and communicating information*. Students are also expected to use these science and engineering practices to demonstrate understanding of the disciplinary core ideas.

Student Learning Objectives

Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved. [Clarification Statement: Emphasis is on law of conservation of matter and on physical models or drawings, including digital forms, that represent atoms.] [Assessment Boundary: Assessment does not include the use of atomic masses, balancing symbolic equations, or intermolecular forces.] (MS-PS1-5)

Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.* [Clarification Statement: Emphasis is on the design, controlling the transfer of energy to the environment, and modification of a device using factors such as type and concentration of a substance. Examples of designs could involve chemical reactions such as dissolving ammonium chloride or calcium chloride.] [Assessment Boundary: Assessment is limited to the criteria of amount, time, and temperature of substance in testing the device.] (MS-PS1-6)

Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. (MS-ETS1-3)

Concepts

- Substances react chemically in characteristic ways.
- In a chemical process, the atoms that make up the original substances are regrouped into different molecules.
- New substances created in a chemical process have different properties from those of the reactants.
- The total number of each type of atom in a chemical process is conserved, and thus the mass does not change (the law of conservation of matter).
- Matter is conserved because atoms are conserved in physical and chemical processes.

The law of conservation of mass is a mathematical description of natural phenomena.

NGSS

Performance Expectations:

Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved. (MS-PS1-5)
Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.* (MS-PS1-6)
Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. (MS-ETS1-3)
This standard will be met when students do MS-PS1-6 if they follow the standard of designing a device and then work through the engineering process.

Science and Engineering Practices

Developing and Using Models

- Develop a model to describe unobservable mechanisms. (MS-PS1-5)

Constructing Explanations and Designing Solutions

- Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints. (MS-PS1-6)

Analyzing and Interpreting Data

- Analyze and interpret data to determine similarities and differences in findings. (MS-ETS1-3)

Disciplinary Core Ideas:

LS2.C: Ecosystem Dynamics, Functioning, and Resilience **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-PS1-5)
- The total number of each type of atom is conserved, and thus the mass does not change. (MS-PS1-5)
- Some chemical reactions release energy, others store energy. (MS-PS1-6)

ETS1.B: Developing Possible Solutions

- A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (*secondary to MS-PS1-6*)
- There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-3)
- Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors.

(MS-ETS1-3)

ETS1.C: Optimizing the Design Solution

- Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process - that is, some of the characteristics may be incorporated into the new design. (*secondary to MS-PS1-6*)
- The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (secondary to MS-PS1-6)

Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design. (MS-ETS1-3)

Cross Cutting Concepts

Energy and Matter

- Matter is conserved because atoms are conserved in physical and chemical processes. (MS-PS1-5)
- The transfer of energy can be tracked as energy flows through a designed or natural system. (MS-PS1-6)

Connections to Nature of Science

Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

- Laws are regularities or mathematical descriptions of natural phenomena. (MS-PS1-5)

Assessments

DE Assessments: Multiple Choice (40) and Constructed Response

Optional Activities
Chemical Reactions and Engineering Design
http://www.middleschoolchemistry.com/lessonplans/chapter6/lesson11 This lesson is an example of what the elaborate project could look like, but it has too many supports. It takes away all of the engineering and walks the students through the process.

District:
Notebook Investigation Entries

Student Observations
Anecdotal Notes
Homework
Readorium
Writing prompts
Summative Assessments: Pre-Assessment, Post Assessment

Discovery Education TechBook Unit Overview

Teachers will begin unit with a phenomenon/anchoring event. The anchoring event is a specific event and students need to explain the event. More information about anchoring events can be found here: goo.gl/ULVptn As students learn about populations they will take their learning and connect it back to their explanation of the anchoring event. groups are an effective method for working with explanatory models. More information about them can be found here: http://ambitiousscienceteaching.org/tools-face-to-face/#Smallgroup

After presenting students with the event, students will explore and learn about the topic. Listed below are high leverage resources teachers can use. Paired with the resources are links to instructional strategies that would be effective for implementation. Teachers are encouraged to have students work in a guided inquiry style lesson, but if student need additional structure the teacher should provide that. Additional detailed instructional ideas can be found at https://google.discoveryeducation.com/learn/techbook/units/389ed5b9-f41a-40ff-9cbf-582ed6ae1bf1/concepts/03ba39eb-e2dd-4d57-bbc7-1774e85894ca/lesson/sections/4310f912-d895-455b-bf64-093b382c7e51 these "model lessons" should not be implemented as is, but can be a valuable resource for teachers looking for strategies and suggestions as they craft their plan. The class should keep a summary table for all learning experiences. This table should be filled in after each learning activity or at the end of class. This could be part of an effective closing activity. More on summary tables with samples can be found at: http://ambitiousscienceteaching.org/tools-face-to-face/#Summtable

Students should document their learning and summarize their learning each day. Every few days, 2 or 3, students should revisit their original explanation and improve their explanation. The explanation should change. Strategies for working on and improving scientific explanations can be found here: http://ambitiousscienceteaching.org/tools-face-to-face/#Sticky

Students should finalize their explanation of the anchoring event. They should use a teacher created rubric to evaluate their explanation and include evidence to support their claim. The rubric listed in the explain tab of Discovery Education is a starting point for the rubric, and could be used, but the teacher may want to add specific details related to populations

and the changes in. Student's rough draft and work as they progress is a formative assessment, the final draft explanation should be the summative assessment. Students could submit this as an essay, a digital media project, or some other representation that allows them to communicate their claim, evidence, and reasoning.
https://google.discoveryeducation.com/learn/techbook/units/389ed5b9-f41a-40ff-9cbf-582ed6ae1bf1/concepts/03ba39eb-e2dd-4d57-bbc7-1774e85894ca/tabs/0df56444-5400-41eb-a6ce-de52b7efb950

What students should understand: (To be shown in their scientific explanation)

Students develop a model in which they identify the relevant components for the chemical reaction including the types and number of molecules that make up the reactants and products. Each molecule in each of the reactants is made of the same type(s) and number of atoms. ($2H_2O$ is two molecules of water with two hydrogens and one oxygen) Each molecule on each side of the equation is made of the same type(s) and number of atoms. When a chemical reaction occurs, the atoms that make up the molecules of reactants reactance and form new molecules (products). Each type of atom has a specific mass, which is the same for all atoms of that type. Mass is conserved during chemical reactions because the number and types of atoms that are in the reactants equal the number and types of atoms that are in the products, and all atoms of the same type have the same mass regardless of the molecule in which they are found.

Students need to engineer a hot or cold pack to meet the second performance expectation. They can choose one or the other, but they must go through the engineering design process and create a product. It is ESSENTIAL that students design the solution. The materials list can be provided, but they need to research and test. They should get feedback on their first design and then go back and improve it. Otherwise this is not an engineering activity and it does not meet the expectation.

What students should understand: (To be shown as they build and defend their design)

General Topics

Course:
Matter and Energy

Unit:
Matter

Concepts

1. Combining and Separating
2. Chemical Reactions and Equations
3. Heat and Temperature (if not addressed in previous unit)

High Leverage Learning Experience

Engage

Session 1: Introduction of Anchoring Event/Engage/Opening:

Suggested ideas for an anchoring event:

Skunk smell and using cleaners or tomato juice to remove the smell. Ask students if they are familiar with the concept of a skunk spray, and how to get rid of it. The Mythbusters do a test to see if tomato juice will really get rid of the smell of a skunk. The video is 15 minutes long and explains some of the science behind the concept. You should not show the video, but you could show the introduction segment where they explain the myth. https://google.discoveryeducation.com/player/view/assetGuid/99457ab5-8f18-4c82-a7fd-7b683ef31d6d Or use an image of a skunk to help frame the conversation. Have the students work in small groups to explain why you can't just rinse off skunk spray. They should create an explanatory model as outlined in the unit overview. If you prefer, below are listed some other ideas for anchoring events that may be more relevant to students.

What happens to wood in a fire, where does it go?

The mass of clean vs. oxidized (rusted metal) Why does the mass increase?

Engage Text, which has prior knowledge assessment items:
https://google.discoveryeducation.com/learn/techbook/units/389ED5B9-F41A-40FF-9CBF-582ED6AE1BF1/concepts/03BA39EB-E2DD-4D57-BBC7-1774E85894CA

EXPLORE

Sessions Two Thru Ten

As students learn every two or three sessions they should revisit and revise their initial models from the first session.

Have the students create a vocabulary journal. As they read and learn over the next few weeks' students should record important, unclear, or unknown vocabulary in their journal. The journal should include the term, the definition, examples, and non-examples of the term. Students should include academic and content specific vocabulary, any words that they think are important. Their list of words should be their own decision, not a list of terms the teacher has shared with them. In their journal students should connect the vocabulary terms back to anchoring event and use them as part of their **evidence** for the **explanation**. As students **communicate information** about their learning, they need to use the

vocabulary from their journal. More about vocabulary journals can be found at:
https://goalbookapp.com/toolkit/strategy/vocabulary-journal

The teacher could create learning stations where the students conduct research using the Core Interactive Text and other digital resources. Looking at their initial scientific explanation of the anchoring event students should first **ask questions** about the phenomenon that they do not know. Have the students record their initial questions on sticky notes and attach to explanation. As students analyze the text and digital media they will **collect evidence or analyze and interpret data** and summarize their learning. As students read the text they should be **developing their explanatory model.** At the end of the stations lesson the stations should be summarized in a class SUMMARY CHART as mentioned in the overview above. The stations do not need to be done in order, but students should complete every station.

These instructional ideas could be presented in a different strategy, and the teacher will need to modify the activities based on student needs. Students should work on these activities in their small groups, the same groups as the scientific explanation.

STATIONS

Station One Resources: (Linguistic Intelligence, Reading and Writing)
Reading Passage: "How do Scientists Represent Chemicals"
The students should read the CIT, using the highlight and annotate feature, students should read the text to gather evidence to support their explanation of the anchoring event. Students should highlight the text yellow for evidence that supports or helps to explain the text, pink for sections that they have questions about or they need clarification, green for sections that connect to previous learning, and blue for information that they think might connect to their model but they are unsure. Students should use the annotate feature to record their questions in the techbook, as well as summarize their learning in the digital notebook. If they are using print versions of the CIT then they should write their questions directly on the paper and summarize their learning in their science journals. Students should be adding to their vocabulary journal as the read.
Core Interactive Text: https://google.discoveryeducation.com/learn/techbook/units/389ed5b9-f41a-40ff-9cbf-582ed6ae1bf1/concepts/03ba39eb-e2dd-4d57-bbc7-1774e85894ca/tabs/759da9a7-2edf-4cde-9515-7081ca990764/pages/64ae5408-400e-4b5d-a408-43045569ad84

Station Two Resources (Linguistic Intelligence, Speaking and Listening):
Video Segment: "Introduction to Chemical Reactions"

Students should watch the video "Introduction to Chemical Reactions" at: https://google.discoveryeducation.com/player/view/assetGuid/77eedc7b-ca93-43b6-b44a-fc7424d60546 As they watch the video they should summarize their learning using the instructional strategy "That Sums It Up" which can be found at https://google.discoveryeducation.com/player/view/assetGuid/47e8de91-8318-4e1f-b6f4-3b26b2eb7f0e They will need to watch the video several times to complete the task. After students watch the video and complete the learning task they should analyze their notes and summary for evidence to support their **explanatory model**.

Station Three Resources (Bodily-Kinesthetic, Logical Mathematical):
Common Lab

Students will conduct a *lab* in which they will need to establish if a reaction has occurred, and then prove that the matter is conserved. Using their **questions** from the anchoring event, they should decide or **create an appropriate question** to investigate. Students should then **design the investigation** to answer their question using the resources provided. Students should conduct the investigation to test their hypothesis, and then **analyze their data** to determine if the hypothesis is correct. The students should **communicate their findings** from the investigation though a conclusion, then connect that conclusion back to **their scientific explanation of the anchoring event.** The teacher can use the hands-on activity at: https://google.discoveryeducation.com/player/view/assetGuid/07ba2863-ac44-458e-9474-64c3cb68f7b8 as a guide, but students need to create their own procedure based on their own question.

Station Four Resources (Musical-Rhythmic, Visual-Spatial)
Song: "Don't Change"
Students will listen to the song https://google.discoveryeducation.com/player/view/assetGuid/06c43676-5bd2-49dc-b132-f48c989ddee1 and read along with the lyrics. Students should use a highlighter as they read to highlight the text as they would in station one. Students should highlight the text yellow for evidence that supports or helps to explain the text, pink for sections that they have questions about or they need clarification, green for sections that connect to previous learning, and blue for information that they think might connect to their model but they are unsure.

Virtual Lab: "The Bonds that Bind:
Students should examine the exploration Compounds: The Bonds That Bind: **Virtual Lab**
https://google.discoveryeducation.com/player/view/assetGuid/dc26c0f8-fe25-4d90-991e-690efbf9c95e Using the exploration, students should create a table to represent the evidence presented. They should use a yellow highlighter to highlight any data in their table that connects back to the anchoring event.

Station Five Resources (Linguistic, Visual-Spatial)
Reading Passage: "How is it Determined a Chemical Reaction has Occurred"
As students read and **analyze evidence** from the core interactive text to support their **scientific explanation**, they should use a learning process called, sketchnoting, (or some other method of visual note taking that integrates drawings). This is a visual method of taking notes with drawings. The text is set up in a top-down linear progression. Before students read the text, they should scroll through taking note of the structure and use that as a cue about the setup for their sketchnoting. More information about sketchnoting is here: http://www.jetpens.com/blog/sketchnotes-a-guide-to-visual-note-taking/pt/892 and http://www.verbaltovisualclassroom.com/course-info/ Link to the next page of the CIT: ***https://google.discoveryeducation.com/learn/techbook/units/389ed5b9-f41a-40ff-9cbf-582ed6ae1bf1/concepts/03ba39eb-e2dd-4d57-bbc7-1774e85894ca/tabs/759da9a7-2edf-4cde-9515-7081ca990764/pages/95b9e01f-e6fd-44a4-b403-9f159a9c7a79***

Station Six Resources (Logical-Mathematical, Visual-Spatial)
Common Lab
Students will use manipulatives to **create a functions like model** of chemical reactions. The detailed instructions for this activity are located under the teachers resources at:
https://google.discoveryeducation.com/player/view/assetGuid/d4f0af3c-70b3-4ed2-8013-d8cc8b0ddd3c but teachers would be better served by asking students to **create a functions like model** using the resources listed based on a set of constraints. Students are presented with different chemical equations that are properly balanced at first, to help establish the model. Then should be presented with unbalanced equations to test their model and find the mistakes. Students should create charts to show their thinking, record evidence, and then relate their learning back to their **scientific explanatory model** for the anchoring event.

Station Seven Resources (Linguistic, Interpersonal)
Reading Passage: "How are Chemicals Equations Written to Show that Mass is Conserved"
https://google.discoveryeducation.com/learn/techbook/units/389ed5b9-f41a-40ff-9cbf-582ed6ae1bf1/concepts/03ba39eb-e2dd-4d57-bbc7-1774e85894ca/tabs/759da9a7-2edf-4cde-9515-7081ca990764/pages/12f38582-3738-4d0e-8fcd-f883eb26e553
Students will analyze the resources, **ask questions, use evidence, and engage in arguments based on the evidence** as they complete a reciprocal teaching learning experience. More about reciprocal teaching can be found here: http://www.readingrockets.org/strategies/reciprocal_teaching As students read a section of the text they will each assume one of the four roles. After each section or resource the students should switch roles. Students do not need to look at the hands-on activity that is embedded in the text, as that is station six, or the reading passage, as that in in station eight.

Station Eight Resources (Linguistic, Intrapersonal)
Reading Passages: see below
Students will jigsaw the following reading passages. Students will choose two of the passages to **analyze for connections** to the anchoring event and their **explanatory model**. After students finish reading the two passages they should pause and write a short reflection to the question, "How does the evidence and information in these two articles connect to my own life?" In their reflection they should cite specific details from the article as they connect the content to some moment or event in their own personal experience. Literacy strategy jigsaw: http://www.readingrockets.org/strategies/jigsaw

The list of articles:
Rust As A Chemical Reaction:
https://google.discoveryeducation.com/player/view/assetGuid/8ac9fd3c-45cd-4001-bffc-4a6d186833a7
Chemical Equations:
https://google.discoveryeducation.com/player/view/assetGuid/18401f08-bf46-48e9-ad5f-fad1ea3adff7
The Father of Modern Chemistry:
https://google.discoveryeducation.com/player/view/assetGuid/14e41cb6-3d6e-4aa0-9deb-d2651f1f3f6b
Chemical Reactions:
https://google.discoveryeducation.com/player/view/assetGuid/d0b688db-d447-493e-96be-6157f631531f

Station Nine Resources (Linguistic, Visual-Spatial, Logical-Mathematical)

This station is about physical vs. chemical changes. It is the only station on the subject, but has three different types of learning resources. Students should analyze the resources to collect evidence and organize their thoughts using a concept map. This mind map should not just be a bunch of terms with lines connecting them, but a logical map that shows how these concepts are connected to each other including notes/text that explains the connections. Information about concept maps: http://www.readingrockets.org/strategies/concept_maps

Video passage: "How Can Matter Change"
Video is on changing matter, does not discuss physical vs. chemical changes, but highlights how matter can change:
https://google.discoveryeducation.com/player/view/assetGuid/db9b6ad8-a8f6-4bf3-a532-9fb3b985e359

Reading passage, reviews chemical vs. physical change:
https://google.discoveryeducation.com/player/view/assetGuid/2a253f28-c428-440c-9c3d-676cdd134796

Exploration, "All Mixed Up" Reviews the concepts of suspensions, solutions, and colloids:

https://google.discoveryeducation.com/player/view/assetGuid/2d7d102d-9cbd-4e80-907f-d8e723e01fad

After each learning experience students should summarize their learning and highlight evidence to support their explanatory model. They can write their thoughts of what to add on sticky notes and add them to their current model. When they refine their model at the end of the process, they may incorporate what is recorded on their sticky notes, or they may not.

Depending on how the learning experiences are structured the teacher may want to have the small groups keep individual summary tables, or may want to have a class summary table that is filled out after the seven stations are completed, or do both.

Explain

Sessions Eleven Thru Thirteen

After conducting research about chemical reactions, students should take their evidence and use it finalize their model and explanation. Use the rubric for scientific explanations as a starting point, but be sure to include elements specific to conservation of mass. The rubric can be found here:
https://google.discoveryeducation.com/learn/techbook/units/389ed5b9-f41a-40ff-9cbf-582ed6ae1bf1/concepts/03ba39eb-e2dd-4d57-bbc7-1774e85894ca/tabs/0df56444-5400-41eb-a6ce-de52b7efb950

At the start of session eleven the class should come together to discuss the rubric and the "gotta-haves" list for the explanatory model. More information about the "gotta-haves" list can be found at
http://ambitiousscienceteaching.org/tools-face-to-face/#Gottahave

Students will have two sessions to work on finalizing their explanatory model. They should use the notes they have taken as they went through the learning activities to create their **scientific explanatory model based on evidence.** As they work on their model they should be prepared to **defend their explanatory model.** Students need to clearly **communicate their ideas using different forms,** including textual and visual. Their model should include theoretical elements as well as directly observable elements. You may want to review the materials above about scientific modeling and explanatory models. Students should refer back to the class summary table to help recall evidence.

Evaluate

Students will then present their model to the teacher and the class. One potential **strategy** for this is the "one stay, rest stray" model where one student stays with their model to explain and answer questions, and the others rotate around the room to the other models to listen, ask questions, and give feedback to improve the model. After the "one stay, rest stray" the students revisit their model, make final modifications, and submit their work on day thirteen.

If time allows, a good review activity or alternative assessment is asking students to analyze the burning of a candle as to following the conservation of mass. This activity is an alternative event that can be explained by the same scientific principles as the anchoring events. A detailed explanation can be found at https://google.discoveryeducation.com/learn/techbook/units/389ed5b9-f41a-40ff-9cbf-582ed6ae1bf1/concepts/03ba39eb-e2dd-4d57-bbc7-1774e85894ca/tabs/054d49d8-d8f5-4203-b276-19e25b56cc5f/pages/03911698-7bd9-4eed-b734-92901ea4dac9

While the explanatory model is a summative assessment, students could take an exam summative assessment on day fourteen that is like the expectations of the state assessment. The process of finalizing their model is also an opportunity for students to review for the assessment.

Elaborate with STEM:
Sessions Fifteen Thru Twenty Five

Begin by presenting students with the story of Kevlar. https://google.discoveryeducation.com/player/view/assetGuid/5b4f570d-909d-4290-b174-4d2a43f22b21 As the students watch the video they should complete a GIST summary. In a GIST summary student identify key details and information from a piece of information, then summarize that information. More information explaining the strategy can be found at: http://www.readwritethink.org/classroom-resources/lesson-plans/gist-summarizing-strategy-content-290.html A template for the summary is found here: http://www.readwritethink.org/files/resources/lesson_images/lesson290/Template.pdf

Students will be presented with their task, they will be engineers like Stephanie Kwolek. They will be tasked with creating a hot or cold pack. Below is a link to the techbook page with the video about Stephanie and information about setting the stage.

https://google.discoveryeducation.com/learn/techbook/units/389ed5b9-f41a-40ff-9cbf-582ed6ae1bf1/concepts/03ba39eb-e2dd-4d57-bbc7-1774e85894ca/tabs/054d49d8-d8f5-4203-b276-19e25b56cc5f

Students will need to **define the problem** of creating the device, including limits and constraints. Limits include cost, amount of materials, length of time that it must function, and size. Students will need to **engineer and test** their design, make modifications, improve and retest. The teacher should use the two links below to guide their thinking as they set the stage for students. As a class the students should set the constraints and decide on the ideal. After students complete their design the teacher should provide a system for evaluating the best design, and students should **defend their design** vs. other student designs. A good idea would be for students to create a marketing plan for their invention including a commercial and magazine/online ad.

Hot Pack
https://google.discoveryeducation.com/player/view/assetGuid/1d010651-d9f8-46e4-8046-bda4e9350403

Cold Pack
https://google.discoveryeducation.com/learn/techbook/units/389ed5b9-f41a-40ff-9cbf-582ed6ae1bf1/concepts/03ba39eb-e2dd-4d57-bbc7-1774e85894ca/tabs/054d49d8-d8f5-4203-b276-19e25b56cc5f/pages/D3BE1020-7026-4ACF-A74D-CD155D89CDD4

Common Labs and Activities

Balloon-Filling Bottle -Common lab
Conservation of Mass in Chemical Reactions

Materials:

For Common Lab:
Balloon-Filling Bottle
Per student:

- Safety goggles
- Safety gloves
- Laboratory Aprons
- Science journal or notebook

Per student pair:

- Balance, electronic
- Soda bottle, small, plastic, with a narrow neck

- *Vinegar, ½ cup (118 mL)
- *Baking soda, 2-3 tbsp. (28.6-42.9 g)
- Balloon, 16-inch (40.6 cm) Funnel, plastic or one made with paper and tape

* teacher supplied

Conservation of Mass in Chemical Reactions

Per group:

colored attachable beads in the following suggested colors and numbers:

- black, 12 (carbon)
- white, 24 (hydrogen)
- red, 36 (oxygen)
- orange, 4 (nitrogen)
- blue, 4 (magnesium)
- green, 4 (iron)
- blank sheet of paper, 1pen, pencil, or marker

21st Century Teaching and Student Strategies

- Project Based Learning. ...
- Ownership and Engagement. ...
- Collaborative Teaching and Cooperative Learning. ...
- Citizenship, Leadership, and Personal Responsibility. ...
- Mastery of Curriculum and Higher Order Thinking Skills. ...
- Technology and 21st Century Skills

Special Education and ELL Strategies and Resources

Special Education

In the Techbook, complex content is presented using supportive hyperlinks to definitions of key vocabulary and concepts. The Interactive Glossary provides a multimodal, scaffolded experience that enables students with a variety of learning styles/strengths to access grade level content. An inquiry approach using the 5E instructional model (Engage, Explore, Explain, Elaborate, and Evaluate) is an important tool for helping students to understand the scientific process and develop critical thinking skills. In many cases, the skills needed for successful inquiry will require additional support for students with learning disabilities.

Strategies or Tips

- Utilize Assignment Builder to provide a directed inquiry approach for specific students in which they are provided

with a detailed procedure or specific set of questions to answer as they proceed to exploration.

- Provide graphic organizers such as spider maps, tables, or cause–and effect charts as appropriate to guide students in note-taking as they explore resources. Model for students how to take notes while watching a video or working through a reading passage. Show students how they can stop, start, and repeat a video clip so they can view materials as many times as necessary or stop to take notes. Allow students to explore the different buttons and links in an interactive or Virtual Lab for several minutes before actually starting the activity. Set a stopwatch or timer and tell students they have x minutes to click through the activity before they actually begin.
- Provide a Main Ideas and Details graphic organizer for students to use to summarize all of their notes. Model for students how to find the overall main ideas by looking for concepts that repeat in their notes (i.e., concepts covered in multiple resources). Take full advantage of the online medium by allowing students to rewatch videos, re-read passages, or redo activities multiple times. The variety of multimodal Discovery Education resources available makes it possible for students who learn differently to approach the content in the ways they learn best. Provide sentence starters and frames to support students in describing what they learned.
- Add linking questions to student worksheets to fill in more tightly any potential logic gaps. Linking questions should lead students through each thought process required, tying one idea directly to another. Allow students to choose from the various project ideas in order to better suit their learning styles.
- Allow students to type reports or answers to questions rather than writing them out. Allow students to use sketches and diagrams to explain their thinking. Allow students to collaborate with peers on Brief Constructed Responses (BCRs), either discussing their ideas beforehand or writing responses in pairs or small groups. Provide sentence starters, sentence frames, and word banks to support students in demonstrating what they have learned.

ELL's

General Strategies for Supporting ELLs in the Classroom Given the ever-increasing number of English Language Learners in general education, it is in the best interest of school personnel to be aware of ways to support and help students at any English acquisition level. Self-contained classroom teachers as well as content teachers can use these tips to engage and invest ELLs.

- Do not assume background knowledge or experience.
- Do not assume accessibility to resources outside of school.
- Be aware of and respectful of cultural behaviors and restrictions.
- Teach vocabulary through direct instruction.
- Connect vocabulary to the curriculum.
- Provide context-based experiences.
- Access students' prior knowledge, allowing use of L1.
- Tie curriculum to students' life experiences.

- Tie new objectives to past lessons, allowing use of L1.
- Engage in conversational as well as instructional language.
- Integrate reading and writing early on.
- Model correct language.
- Expand student responses.
- Use multicultural materials.
- Identify objectives appropriate to each student's current knowledge base.
- Familiarize students with the writing process.

For Beginners:

- Use visual aids, especially the "real thing" (realia).
- Model the process and outcome.
- Enunciate clearly; speak slowly in short sentences, in the active voice (not "The trees were consumed by the fire that raged through the forest," but "The fire burned down all the trees.")
- Repeat and restate. Use facial expressions and body language.
- Allow students to demonstrate learning non-verbally.
- Front-load, post/provide, and demonstrate key vocabulary.
- Avoid idioms, colloquialisms, word play, jokes, and words with multiple meanings.
- Ask questions with single word answers, and repeat the answers in short sentences.
- Use cloze exercises.
- Pair students with English speaking partners.
- Reduce workload, especially research and home-based projects.

Intermediates:

- Use visuals (photos, objects).
- Model procedures and products.
- Frontload and reinforce content vocabulary.
- Maintain a posted list of specific science vocabulary.
- Give clear, explicit directions in short sentences.
- Provide assignments commensurate with ELL productive language skills.
- Offer students answer choices and/or provide verbal cueing – say the sentence frame(s) for the answer(s) or start the answer sentence. For example, "What is at the center of an atom? Is it a proton or a nucleus?" or "What is at the center of an atom?
- The center of an atom…." Allow reduced workload/output, extra time, and/or differentiated product.
- Allow English-speaking partners as needed. Provide multisensory input with closed captions and audio text, as in the

Techbook.