**Expert Pack: States of Matter**

Lexile Range: 1030-1160

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| **Topic/ Subject:** States of Matter |
| **Text/ Resources****Articles**1. “States of Matter”
2. “Hot Air Balloons; Gas and Go”
3. “Crystallization”
4. “Gravity-Driven Fluid Flow”

**Other media**1. “3 States of Matter for Kids”
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| **Rationale and Suggested Sequence for Reading**This text set begins with a video, 3 States of Matter for Kids”, that will introduce students to the states of matter and examples of each. They will then be prepared to read the informational text, “States of Matter,” which gives a basic overview of the 3 main states of matter, as well as a fourth state that is relatively recently discovered. One of the states of matter, gas, is explored further in “Hot Air Balloons; Gas and Go.” In “Crystallization,” students will explore what they know about matter by looking at how solids can be formed from liquids. Finally, students will learn more about liquids in “Gravity-Driven Fluid Flow.”  |
| **The Common Core Shifts for ELA/Literacy**1. Regular practice with *complex* text and its academic language
2. Reading, writing and speaking grounded in *evidence* from text, both literary and informational
3. Building *knowledge* through content-rich nonfiction
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| **College and Career Readiness Anchor Standards for Reading Literary and/or Informational Texts** 1. *Read closely to determine what the text says explicitly and to make logical inferences from it*; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.
2. *Determine central ideas or themes of a text* and analyze their development; summarize the key supporting details and ideas.
3. *Read and comprehend complex literary and informational texts independently and proficiently*
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| **Annotated Bibliography****N/A “3 States of Matter for Kids”**Author: Free SchoolGenre: VideoLength: 4:34 minutesSynopsis: This video introduces the three states of matter, how they are all matter and examples of them.Citation: 3 States of Matter for Kids. Free School. Retrieved from <https://www.youtube.com/watch?v=wclY8F-UoTE> Suggested Activities: Wonderings**1160L “States of Matter”**Author: NASAGenre: Nonfiction – Informational TextLength: 2 pagesSynopsis: There are 3 well-known states of matter known as solids, liquids, and gasses. Each has a set of physical properties that define them. Although these states of matter are the best-known, and define most things on earth, scientists have discovered other states of matter such as plasma.Citation: NASA. (n.d.) Retrieved on Dec. 19, 2016 from <https://spaceflightsystems.grc.nasa.gov/education/rocket/state.html>. NASA – Public Domain. United States. Suggested Activities: Quiz Maker**1030L** **“Hot Air Balloons; Gas and Go”** Author: Claudia VanderborghtGenre: ArticleLength: 2 pagesSynopsis: In this overview of the physics behind a hot air balloon, we learn about the need for gas inside the balloon to be less dense than the air surrounding it to allow it to take flight. This text also reviews several key components of a hot air balloon, and some of the dangers of hot air balloons as the physics behind how they work was being studied when they were a new invention.Citation: Vanderborght, C. (April 2002). Retrieved on Dec. 19, 2016 from <https://www.acs.org/content/dam/acsorg/education/resources/highschool/chemmatters/articlesbytopic/solidsliquidsgases/chemmatters-april2002-hot-air-balloons.pdf>. Chem Matters. American Chemistry Society. United States.Suggested Activities: A Picture of Knowledge**1140L “Crystallization”** Author: Microgravity — A Teacher’s Guide with Activities in Science, Mathematics, and TechnologyGenre: Nonfiction - Informational TextLength: Use only Pages 4-5, labeled pages 138-139 “Student Reader – 1, 2”Synopsis: Crystalline solids are substances whose atoms or molecules are arranged into a fixed pattern that repeats in three dimensions. Crystalline materials generally begin as a fluid of atoms or molecules in either the liquid or gaseous state.Citation: Microgravity — A Teacher’s Guide with Activities in Science, Mathematics, and Technology. (n.d.) Retried on Dec. 19, 2016 from <https://www.nasa.gov/pdf/315954main_Microgravity_Crystallization_Model.pdf>. NASA. United States.Suggested Activities: Wonderings**1080L “Gravity-Driven Fluid Flow”** Author: Microgravity — A Teacher’s Guide with Activities in Science, Mathematics, and TechnologyGenre: Nonfiction - Informational TextLength: Use only Page 3, labeled page 111 “Student Reader – 1”Synopsis: Fluids are more complex than just being in a state of matter; fluids that are hot become less dense, while those that are cold become denser. Scientists discover these changes because liquids create crystals at different densities, and those are important to study to create other things.Citation: Microgravity — A Teacher’s Guide with Activities in Science, Mathematics, and Technology. (n.d.) Retried on Dec. 19, 2016 from <https://www.nasa.gov/pdf/315955main_Microgravity_Gravity_Driven.pdf>. NASA. United States.Suggested Activities: Quiz Maker**1160L “Clouds (and Cloud in a Bottle)”**Author: Ann M. RosenthalGenre: Informational Text and DirectionsLength: 4 pagesSynopsis: This article explores all of the ways that clouds are formed, and the role that solids, liquids, and gasses have within the realm of clouds. This passage ends with a student-friendly experiment that shows students how they can make their own “cloud in a bottle.”Citation: Rosenthal, A. (October 2003). Retrieved on Dec. 19, 2016 from <https://www.acs.org/content/dam/acsorg/education/resources/highschool/chemmatters/articlesbytopic/solidsliquidsgases/chemmatters-oct2003-clouds.pdf>. Chem Matters. American Chemistry Society. United States.Suggested Activities: A Picture of Knowledge |

**Supports for Struggling Students**

By design, the **gradation of complexity** within each Expert Pack is a technique that provides struggling readers the opportunity to read more complex texts. Listed below are other measures of support that can be used when necessary.

* Provide a brief **student-friendly glossary** of some of the academic vocabulary (tier 2) and domain vocabulary (tier 3) essential to understanding the text
* Download the Wordsmyth widget to classroom computers/tablets for students to access student-friendly definitions for unknown words: <http://www.wordsmyth.net/?mode=widget>
* Provide brief **student-friendly explanations** of essential background knowledge not easily learned from the text
* Include **pictures or videos** related to the topic within and in addition to the set of resources in the pack
* Select a small number of texts to **read aloud** with some discussion about vocabulary work and background knowledge
* Provide **audio recordings** of the texts being read by a strong reader (teacher, parent, etc.)
* **Chunk the text** and provide brief questions for each chunk of text to be answered *before* students go on to the next chunk of text
* Pre-reading activities that focus on the **structure and graphic elements** of the text
* Provide **volunteer helpers** from the school community during independent reading time
* Use Expert Packs as the **resources for Guided Reading** with a small group of students

Why Text Sets Support English Language Learners

Those acquiring English as a second language have to learn many words in English to catch up with their English-only peers. Vocabulary builds at a much quicker pace when reading a set of connected texts. Text sets are an adaptable resource perfect for building knowledge and vocabulary. Student use of text sets can vary in terms of independence or teacher supports based on the individual needs of the students in the room. Activities found within the text set resources reflect several best practices for English Language Learner instruction including:

* Providing brief, engaging texts that provide a high volume of reading on a topic.
* Providing web-based resources and/or videos that are tied to the content of the texts students are reading.
* Providing opportunities for students to learn new vocabulary through the use of student-friendly definitions in resource-specific glossaries.
* Allowing for options to reinforce newly learned vocabulary and/or content through graphic organizers.
* Providing opportunities for students to reinforce new vocabulary through multi-modal activities including written work, group discussion, viewing visual content, and reading texts that feature the vocabulary.

Teachers of ELLs may use the protocols on the following pages to provide additional support to students who are struggling to access the content within text sets because they are new to English.

ELL Text Set Protocol Grades 3-12

The goal of text sets is to help students build knowledge through a volume of independent reading, and it is important that educators provide scaffolds to allow English Language Learners to be successful in engaging meaningfully with the texts, even as students are still developing English language skills. The protocol below can be used for teaching with text set resources as a full class. Students can also be trained on the protocol so that they can utilize text sets in small groups or partnerships as a resource for independent or reciprocal reading and study.

Please note that this protocol includes options for teachers. Individual decisions should be made considering the needs of the students and the demands of the content, keeping in mind that the goal of each scaffold is to allow students to meaningfully access the text and move toward independent, knowledge-building reading.

**Step one: Build knowledge and vocabulary.**

Introduce students to the overall topic/content of the text set, including knowledge demands needed to engage in the content, and domain-specific vocabulary necessary for comprehension. This should be done prior to engaging with the texts themselves; time allotted to this activity should reflect student needs (anywhere from 5 minutes prior to reading, to a full day’s lesson is appropriate).

*Options for this step include:*

* Engage students in reading and discussing auxiliary texts (of lesser complexity) and resources (illustrations, photographs, video clips) on the topic of the text set.
* Pre-teach a few key content-specific terms prior to students engaging with a text set. (Ideas for text-focused vocabulary instruction can be found [here](https://achievethecore.org/content/upload/Selecting%20and%20Using%20Academic%20Vocabulary%20in%20Instruction.pdf).)
* Provide the student-friendly glossary included in the text set prior to reading each text.
* When possible, allow students to read texts in their home language about the topic under study.

**Step two: Read text orally.**

Focusing on one resource at a time, allow students to listen to a fluent read of the resource, while following along with their own copy of the text.

*Options for this step include:*

* Have a fluent reader model the first read of a text or resource.
* Have students engage in a buddy/partner read.
* Use recordings of the text to provide additional opportunities to hear expert reading.

**Step three: Engage in group discussion about the content.**

Allow students time in partnerships or small groups to discuss the content of the resource.

*Options for this step include:*

* + Allow for discussion/conversation (in the students’ home language if possible) with a small group of students reading the same text set prior to writing or provide heterogeneous language groupings to talk about content and discuss what students are learning.
	+ Have students refer to the student-friendly glossary included with each text set to identify meanings for new vocabulary necessary for comprehension.

**Step four: Write about what was read.**

*Options for this step include:*

* Use the “Rolling Knowledge Journal” and/or “Rolling Vocabulary Journal” as a shared writing routine/ graphic organizer to help to scaffold the writing process and capture student knowledge over time.
* Provide students with several supports to help students engage in writing/drawing about what they read:
	+ Use mentor texts about which students can pattern their writing.
	+ Allow them to write collaboratively.
	+ Show students visual resources as prompts, etc.
	+ Provide language supports such as strategically chosen sentence starters.

## Repeat steps one through four with each resource in the text set as appropriate.

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| **Learning Worth Remembering** **Cumulative Activities –** The following activities should be completed and updated after reading each resource in the set. The purpose of these activities is to capture knowledge building from one resource to the next, and to provide a holistic snapshot of central ideas of the content c**overed in the expert pack. *It is recommended that students are required to complete*** *one of the Cumulative Activities (Rolling Knowledge Journal or Rolling Vocabulary) for this Expert Pack.* |

**1. Rolling Knowledge Journal**

* Read each selection in the set, one at a time.
* After you read each resource, stop and think what the big learning was. What did you learn that was new and important about the topic from this resource? Write or list what you learned from the text.
* Then write or list how this new resource added to what you learned from the last resource(s).

**Sample Response:**

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| **Title** | **Write or List** |
| **New and important learning about the topic** | **How does this resource add to what I learned already?** |
| “3 States of Matter for Kids” | Introduces the 3 states of matter: solids, liquids and gas. Also explains how they can all be matter even though they look different.  |  |
| “States of Matter” | They are different because the molecules that they are made of are in different states. There is also a fourth state called plasma. | Introduces plasma as a fourth state of matter. |
| “Hot Air Balloons; Gas and Go”  | The gas inside the balloon must be less dense than the air surrounding it to allow it to take flight. If the air inside the balloon is not hot, or a gas that is lighter than air, it will not take off. | Using gasses that are lighter than air can be dangerous because they are often flammable. |
| “Crystallization” | Crystalline solids are substances whose atoms or molecules are arranged into a fixed pattern that repeats in three dimensions. Crystalline materials generally begin as a fluid or gas, but then become solid. | Snowflakes are an interesting example of a crystallization because they are formed when in the gaseous state, but instead of the precipitation coming down as a liquid, they are solid because of the temperature of the formation of atoms. |
| “Gravity-Driven Fluid Flow” | Fluids are more complex than just being in a state of matter; fluids that are hot become less dense, while those that are cold become denser.  | Scientists discover these changes because liquids create crystals at different densities, and those are important to study to create other things. |
| “Clouds (and Cloud in a Bottle)” | This article explores all of the ways that clouds are formed, and the role that solids, liquids, and gasses have within the realm of clouds.  | Even though we might think of some things as fixed in their state of being, a cloud is a good example of how solids, liquids, and gasses can all exist in the same thing. |

**2. Rolling Vocabulary: “Fabulous Five”**

1. Read each resource then determine the (up to) 5 words from each text that most exemplify the central idea of the text.
2. Next use your 5 words to write about the most important idea of the text. You should have as many sentences as you do words.
3. Continue this activity with EACH selection in the Expert Pack.
4. After reading all the selections in the Expert Pack, go back and review your words.
5. Now select the “Fabulous Five” words from ALL the word lists.
6. Use the “Fabulous Five” words to summarize the most important learning from this Expert Pack

**Sample Response**

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| **Title:** | **Five Words & Sentences** |
| “States of Matter” | Words: solid, liquid, gas, plasma, physical changes1. A solid holds its shape and the volume of a solid is fixed by the shape of the solid.
2. A liquid will take the shape of its container with a free surface in a gravitational field.
3. A gas fills its container, taking both the shape and the volume of the container.
4. Plasma is an interesting state of matter that was only discovered recently and it is known best for making TV’s better.
5. A physical change is a reversible change in the physical properties of a substance.
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| “Hot Air Balloons; Gas and Go” | Words: pilot, nylon, ascent, descent, plunging1. Most hot air balloons are made from nylon material that is lightweight, but allows some heated air to escape.
2. The ascent in a hot air balloon needs to be carefully calculated as it goes into the air.
3. A pilot is the person that ensures that the balloon doesn’t go too high.
4. A hot air balloon pilot needs to carefully control the descent in order for the balloon to land carefully.
5. Controlling the descent is important so balloon doesn’t go plunging into a dangerous situation before it lands safely.
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| “Crystallization” | Words: ideal, crystalline, structure, defects, enhance 1. Crystalline solids are substances whose atoms or molecules are arranged into a fixed pattern.
2. The structure in the fixed pattern is one that repeats in three dimensions.
3. All crystalline materials have varying degrees of defects. Defects can take many forms.
4. Gem-quality diamonds sometimes have small inclusions of carbon that reduce their value, making the gem not ideal.
5. In other crystalline materials, defects may actually enhance and increase value.
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| “Gravity-Driven Fluid Flow” | Words: consequently, defects, density, microgravity, deposited1. Consequently, the solution that held the molecule becomes a little less salty than it was a moment ago.
2. The density of the solution is a little bit less than it was.
3. Flaws, called defects, are produced that can alter the way those crystals perform in various applications.
4. In the crystal growth process, the ions that make up the salt come out of solution and are deposited on the crystal to make it larger.
5. Microgravity virtually eliminates gravity-driven fluid flows and often produces crystals of superior quality to those grown on Earth.
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| “Clouds (and Cloud in a Bottle)” | Words: abundant, condenses, dew point, vapor, supersaturation/saturation1. One of earth’s most abundant resources is water.
2. Water condenses and turns into gas when temperatures rise and then cool.
3. When the temperature of the air cools down at night that’s often when it reaches its dew point temperature.
4. If more and more water vapor enters the air, for example by evaporation from a mountain lake, the air may become saturated, causing the gas to become a liquid.
5. As the air cools, it may reach supersaturation, an overloaded state.
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| **Fabulous Five** | Words: solid, liquid, gas, physical change, vaporThere are three commonly known states of matter: **solid**, **liquid**, and **gas**. In a **solid** the molecules are closely bound to one another by molecular forces. A solid holds its shape and the volume of a solid is fixed by the shape of the solid.In a **liquid** the molecular forces are weaker than in a solid. A liquid will take the shape of its container with a free surface in a gravitational field. In microgravity, a liquid forms a ball inside a free surface. Regardless of gravity, a liquid has a fixed volume.In a **gas** the molecular forces are very weak. A gas fills its container, taking both the shape and the volume of the container.States of matter are not fixed;a **physical change** is a reversible change in the physical properties of a substance; for example, turning a liquid into a solid by freezing it or turning a liquid into a gas by heating it are both considered **physical changes.** Another example might be if lots of water **vapor** enters the air by evaporation from a mountain lake, the air may become saturated, causing the gas to become a liquid. |

**Student Copy**

**1. Rolling Knowledge Journal**

* Read each selection in the set, one at a time.
* After you read *each* resource, stop and think what the big learning was. What did you learn that was new *and important* about the topic from *this* resource? Write or list what you learned from the text.
* Then write or list how this new resource added to what you learned from the last resource(s).

**Sample Response**

|  |  |
| --- | --- |
| **Title** | **Write or List** |
| **New and important learning about the topic** | **How does this resource add to what I learned already?** |
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**2. Rolling Vocabulary: “Fabulous Five”**

* Read each resource then determine the 5 words from each text that most exemplify the central idea of the text.
* Next use your 5 words to write about the most important idea of the text. You should have as many sentences as you do words.
* Continue this activity with EACH selection in the Expert Pack.
* After reading all the selections in the Expert Pack, go back and review your words.
* Now select the “Fabulous Five” words from ALL the word lists.
* Use the “Fabulous Five” words to summarize the most important learning from this Expert Pack.

**Sample Response**

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| --- | --- |
| **Title:** | **Five Vocabulary Words & Sentences** |
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| **Fabulous Five** | Words:  |

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| **Learning Worth Remembering****Singular Activities** – the following activities can be assigned for each resource in the set. The purpose of these activities is to check for understanding, capture knowledge gained, and provide variety of ways for students to interact with each individual resource. Students may complete some or none of the suggested singular activities for each text. Singular activities should be assigned at the discretion of the teacher. |

**1. Quiz Maker** (Recommended for “States of Matter” and “Gravity-Driven Fluid Flow”)

* Make a list of questions that would make sure that another student understood the information.
* Your classmates should be able to find the answer to the question from the resource.
* Include answers for each question.
* Include where you can find the answer in the resource.

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| **Question**  | **Answer** |
| 1. |  |
| 2.  |  |
| 3. |  |
| 4. |  |

**2. A Picture of Knowledge** (Recommended for “Hot Air Balloons; Gas and Go” and “Clouds (and Cloud in a Bottle)”)

(see graphic on next page)

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**3. Wonderings (**Recommended for “3 States of Matter for Kids” and “Crystallization”)

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| **I’m a little confused about:** | **This made me wonder:** |
| On the left, track things you don’t understand from the video and the article. **I am confused about or do not understand….** | On the right side, list some things you still wonder (or wonder now) about this topic.**I wonder or would like to learn more about….** |

**Expert Pack: States of Matter**

Expert Pack Glossary

**“3 States of Matter”**

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| *Word* | *Student-Friendly Definition* |
| matter | Something that takes up space |
| atoms | Tiny particles that makes up matter |
| state | A condition of the way something looks like |
| property | A way that something is that we can measure, like shape, mass and volume |
| mass | The amount of matter in an object |
| volume | How much space an object occupies |
| evaporate | To cause to pass off from liquid to vapor |

**“States of Matter”**

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| --- | --- |
| *Word* | *Student-Friendly Definition* |
| atom | The most basic unit of a chemical element; all things are made of atoms |
| fixed volume | When the amount of space an object occupies does not change |
| gas | The state of matter without a set shape or volume |
| liquid | The state of matter with a set volume but no set shape |
| plasma | A plasma is a fluid, like a liquid or gas, but because of the charged particles it responds to and generates electro-magnetic forces.  |
| solid | The state of matter with a set volume and a set shape |
| volume | The amount of space an object occupies |

**“Hot Air Balloons; Gas and Go”**

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| *Word* | *Student-Friendly Definition* |
| altimeter  | A device that measures the distance from the ground |
| apex | The top, or highest part of something |
| helium | The chemical element of atomic number 2, an inert gas that is the lightest member of the noble gas series |
| hydrogen | A colorless, odorless, highly flammable gas, the chemical element of atomic number 1 |
| montogolfieres | French term for hot air balloon |
| undulate | To move with a smooth wave-like motion |
| variometerpropane | A device that measures the rate or ascent and descent in a hot-air-balloon |

**“Crystallization”**

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| --- | --- |
| *Word* | *Student-Friendly Definition* |
| amorphous | Not having a clearly defined shape |
| crystal | A material in which the atoms are arranged in a rigid state that is marked by geometry and symmetry |
| crystallization | The slow precipitation of crystals from a solution |
| defects | Something that is lacking or imperfect |

**“Gravity-Driven Fluid Flow”**

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| *Word* | *Student-Friendly Definition* |
| buoyant | Things that stay afloat or rise to the top of a liquid or gas |
| dense | Heavy or closely compacted |
| gravity | A force that attracts things toward the center of the earth, or downwards |

**“Clouds (and Cloud in a Bottle)”**

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| --- | --- |
| *Word* | *Student-Friendly Definition* |
| cloud seeding | A method for coaxing more rain or snow from clouds by dusting them with tiny particles |
| condensation nuclei | The result of all this gathering and ordering is liquid water. Or if it’s really cold, solid ice crystals or snowflakes form, |
| dew-point | Temperature below which water droplets begin to condense and dew can form |
| hygroscopic | Water-attracting |
| meteorologist | An expert in weather forecasting |
| nuclei | Sea salts are a major source of nuclei |
| particles | A small part of matter |

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