

A Common Core State Anchor Standards &
Next Generation Science Standards-Aligned
Discussion/Activity Guide

The Kitchen Pantry Scientist

Chemistry for Kids:

Homemade Science
Experiments and Activities
Inspired by Awesome
Chemists, Past and Present

Written by Liz Lee Heinecke

Praise for *Chemistry for Kids*:

★ "Wondrous." – *School Library Journal*, starred review
2021 EUREKA! Nonfiction Children's Honor Book
2021 NSTA-CBC Outstanding Science Trade Book

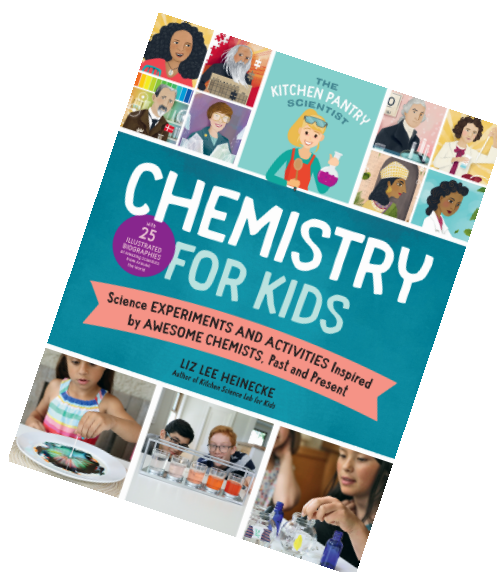
Replicate a chemical reaction similar to one Marie Curie used to purify radioactive elements! Distill perfume using a method created in ancient Mesopotamia by a woman named Tapputi! Aspiring chemists will discover these and more amazing role models and memorable experiments in Chemistry for Kids, the debut book of The Kitchen Pantry Scientist's Guides series.

Guide Created by
Debbie Gonzales, MFA



Table of Contents

Discussion Guided by the Scientific Method.....	3-5
The Scientific Method Template	6
Dropped Phrase Vocabulary Puzzle	7
Dropped Phrase Vocabulary Puzzle Answers	8
Historical Timeline.....	9
Timeline Grid.....	10-15
Timeline Labels.....	16-19
Biographical Timeline.....	20
Biographical Planner.....	21
Blank Timeline Grids.....	22-23
Blank Timeline Labels	24
Common Core State Anchor Standards Alignment:	
• English Language Arts Standards » Anchor Standards for Reading.....	25
• English Language Arts Standards » Anchor Standards for Writing.....	25
• English Language Arts Standards » Anchor Standards for Speaking & Listening	25
Next Generation Science Standards Alignment:	
• K-LS1: From Molecules to Organisms: Structures and Processes	26
• K-PS2-1: Motion and Stability: Forces and Interactions.....	26
• 2-PS1: Matter and Its Interactions	26
• 5-PS1: Matter and Its Interactions	26



Discussion Guided by the Scientific Method

The Scientific Method is a methodical and verifiable way of studying and learning about the scientific world. This method of research is founded a systematic, measurable, and replicable process of proving a hypothesis, also known as an “educated guess.” The Scientific Method consists of procedural six steps which are applicable to all fields of science.

The steps of the Scientific Method are listed below:

- Ask a Question
- Research
- Form a Hypothesis, which is a prediction of the outcome of the experiment
- Perform Experiment
- Analyze Data
- Formulate Conclusion, stating whether the hypothesis was proven or disproven

The chemists featured in *Chemistry for Kids* diligently applied this type of scientific reasoning while performing their systematic, measurable, and replicable experimentations. In the Discussion section of this guide, we will use the steps of the Scientific Method to guide inference and exploration of selected chemists featured in *Chemistry for Kids*.



Galen eventually became a physician to Roman emperors and began to write extensively about medicine (pg. 15).

- Galen, a Roman physician in 129 CE, is attributed for the invention of soap. As a scientist, consider what question might have inspired this research. What problem do you think he was attempting to solve in the experimentation process?
- Galen attended medical school and eventually became a physician to the gladiators. Predict how caring for wounded gladiators helped to guide Galen’s research.
- Predict what Galen’s hypothesis might have been. Determine what outcome he predicted would happen because of his experimentation.
- Galen believed that wounds were “windows to the body.” Consider how this belief might have influenced his methods of experimentation.
- Galen was a prolific writer and a philosopher. Consider the impact Galen’s experimental data had upon his writings.
- In conclusion, discuss how Galen’s interest in hygiene impacted history.

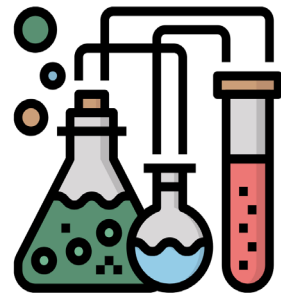
He set up a workspace in a garden shed and along with his brother and a friend, tested the dye and scaled its production (pg. 37).

- William Henry Perkin is attributed to the discovery of synthetic dyes, more specifically, the color purple. William was originally engaged in the experimentation process to discover a cure for malaria when he accidentally discovered the dye. Discuss how this “unexpected result” was influenced by his research, hypothesis, and experimentation process.
- The procedural steps of the Scientific Method assure that discoveries are replicable and scientifically sound. Predict how the changes in William’s focus would alter his research, hypothesis, experimentation, and data analysis.
- Note that William Henry Perkin was eighteen years old when he was awarded a patent for his discovery. Examine how William’s life as it prepared him for his contributions to the scientific world.
- Does age limit an individual’s ability to question and explore scientific questions? Explain your answer.



Life was not easy for Dmitri Mendeleev and his family, but his mother recognized his genius early on and made it possible for him to reach his full potential (pg. 41).

- Dmitri is credited for establishing and organizing chemical elements in a remarkable table categorized by atomic number, electron configuration, and recurring chemical properties. Consider the depths of scientific questioning and research required to accomplish this task.
- It is said that the organization of the Periodic Table appeared to Dmitri in a dream. Dreams are said to be expressions of the unconscious mind. Consider how working to prove endless hypotheses about chemical elements and recording of volumes of data might have prepared his subconscious mind to help Dmitri visualize the solution to his organizational puzzle.
- Not only did Dmitri contributed to other scientific fields such as hydrodynamics, meteorology, and petroleum chemistry, he volunteered to teach women who attended the Russian university for free. He did so at a time in history when women were not welcome in the scientific world. What does his willingness to encourage females to join in the world of scientific reasoning reveal about his character?
- Do you agree with Dmitri’s mother that her son was, in fact, a genius? How so?



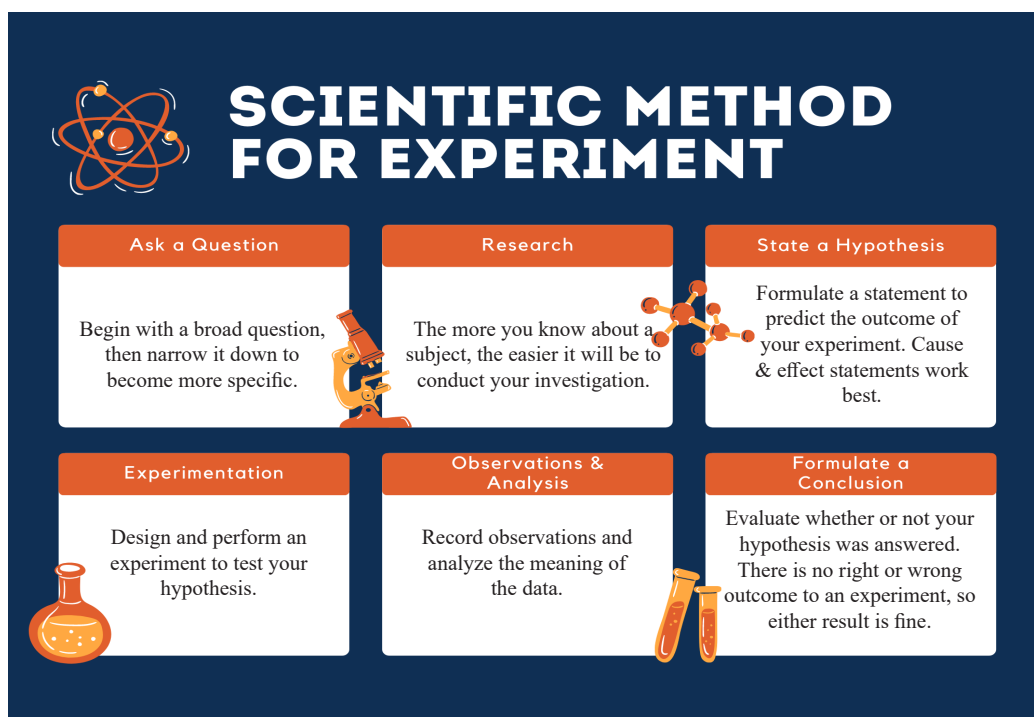
She became to believe that education was the only way to fight oppression (pg. 55).

- Marie Curie passion for chemistry and biology contributed to her love for math and physics. Discuss how her belief in the empowerment of education affected her life.
- Marie discovered radium while working with pitchblende, mining waste containing several other radioactive elements. Synonyms for the word discover are to uncover, detect, and reveal. Consider the importance of questioning, researching, and hypothesizing in developing the radium extraction process. Determine the importance of establishing a systematic, measurable, and replicable process for her discoveries.
- Note that, rather than seeking wealth through her discoveries, Marie "...freely shared her technique with the scientific community and industry (pg. 55)." Discuss how her willingness to share her discoveries reflected her belief in the empowerment of education.



When reading about the rest of incredible lives and contributions of the chemists featured in *Chemistry for Kids*, consider the importance following the steps of the Scientific Method in their discoveries. Follow the steps of the Scientific Method while performing the experiments depicted in the book. Test your findings by replicating the experiments repeatedly. Question your results. Connect with the same sense of wonder, inquiry, and investigation the chemists featured in *Chemistry for Kids* possessed. Who knows what you might find!

The Scientific Method



The Scientific Method Template

SCIENTIFIC METHOD FOR EXPERIMENT



Ask a Question

Research

State a Hypothesis



Experimentation

Observations &
Analysis

Formulate a
Conclusion



Dropped Phrase Vocabulary Puzzle

Using the Glossary as a reference, unscramble the words below. Match the numbers associated with the letters in the dropped phrase below. Answers to the puzzle are provided on the following page.

HISCYMYTER	15	2	34	61	19	31	22	18		
YOTHHISPE	42			16	1	23	28	37	33	39
MOCLUELE	5	51	5	17	32	58	12	43		
NOTROP										
	44	53	24	55	9					
TATREM	45	11	36	38	4	49				
GEEN	60	6	35	46						
LYMERPO										
	27	26	50	7	20	62				
TNRONUE	47	8	54	10		25				
GYEXON	40									
			29	3	59					
SIOMEOSRB	41	13	57	48	21	52	56	30	14	

1 2 3 4 5 6 7 8 9 10 11 12 D 13 14 15 16 V 17 18 19 20 21 22 23 11 24
 F 25 26 12 27 W 28 D 29 11 v 30 31 32 33 34 35 36 13 37 38 39 , F 40 41 10 42 43
 F 13 44 31 10 F 36 13 45 46 13 47 2 13 31 10 48 49 50 , 22 2 28 10 51 52 26 21
 24 53 v 33 21 54 11 26 13 Z 8 11 36 55 56 21 , 10 2 20 57 58 13 5 D 13 59 60
 24 5 27 15 K 21 16 F 61 11 22 22 34 62 (pg. 9).

Dropped Phrase Vocabulary Puzzle Answers

Using the Glossary as a reference, unscramble the words below. Match the numbers associated with the letters in the dropped phrase below. Answers to the puzzle are listed below.

HISCYMTER **C H E M I S T R Y**
15 2 34 61 19 31 22 18

YOTHHISPE **H Y P O T H E S I S**
42 16 1 23 28 37 33 39

MOCLUELE **M O L E C U L E**
5 51 5 17 32 58

NOTROP **P R O T O N**
44 53 24 55 9

TATREM **M A T T E R**
45 11 36 38 4 49

GEEN **G E N E**
60 6 35 46

LYMERPO **P O L Y M E R**
27 26 50 7 20 62

TNRONUE **N E U T R O N**
47 8 54 10 25

GYEXON **O X Y G E N**
40 29 3 59

SIOMEOSRB **R I B O S O M E S**
41 13 57 48 21 52 56 30 14

T H E **E L E M E N T A L** **D I S C O V E R I E S** **T H A T**
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 11 24

F O L L O W E D **G A V E** **S C I E N T I S T S** , **F O R** **T H E**
25 26 12 27 28 29 11 30 31 32 33 34 35 36 13 37 38 39 40 41 10 42 43

F I R S T **T I M E** **I N** **H I S T O R Y** , **T H E** **T O O L S**
13 44 31 10 36 13 45 46 13 47 2 13 31 10 48 49 50 22 2 28 10 51 52 26 21

T O **V I S U A L I Z E** **A T O M S** , **T H E** **B U I L D I N G**
24 53 33 21 54 11 26 13 8 11 36 55 56 21 10 2 20 57 58 13 5 13 59 60

B L O C K S **O F** **M A T T E R** . (pg. 9)
24 5 27 15 21 16 61 11 22 22 34 62

Chemistry For Kids: A Historical Timeline

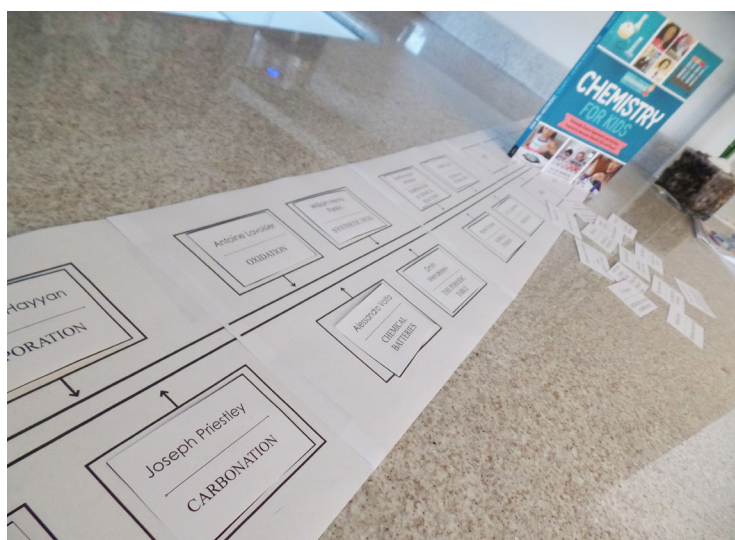
Objective: Integrate, interpret, and analyze historical information in a visual format.

Materials:

- *Chemistry For Kids*, the book
- Historical Timeline Grid (Guide, pg. 10-15)
- Timeline Labels (Guide, pg. 16-19)
- Cardstock
- Tape
- Scissors
- Pencil

Procedure:

- Print Historical Timeline Grid sheets on computer paper. Tape sheets together in a sequential manner.
- Print Timeline Labels on cardstock. Use scissors to trim around the borders of the cards.
- Lay timeline out on the floor.
- Using *Chemistry For Kids*, the book, as a reference, match each Timeline Label to its corresponding place on the timeline.
- Analyze the connectivity between the chemists and their discoveries by answering the following questions:
 - Identify ways that the discoveries correspond with each other.
 - Which discoveries inspired subsequent inventions throughout time?
 - Determine how each discovery has impacted today's world.
- Instruct students to summarize their observations in a short essay.
- Encourage students to share their work with the class.



1200 BCE

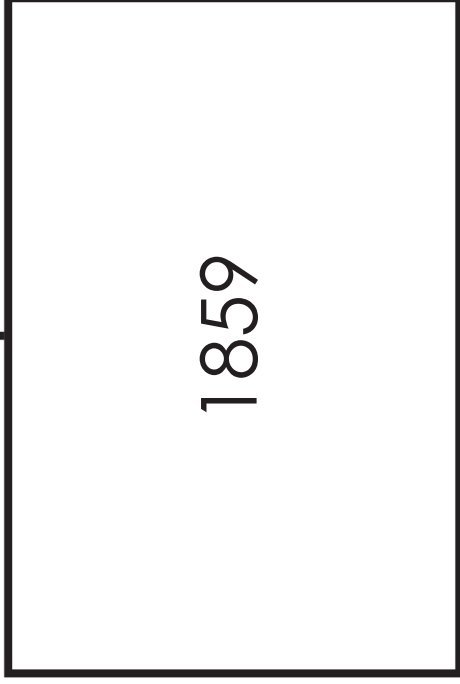
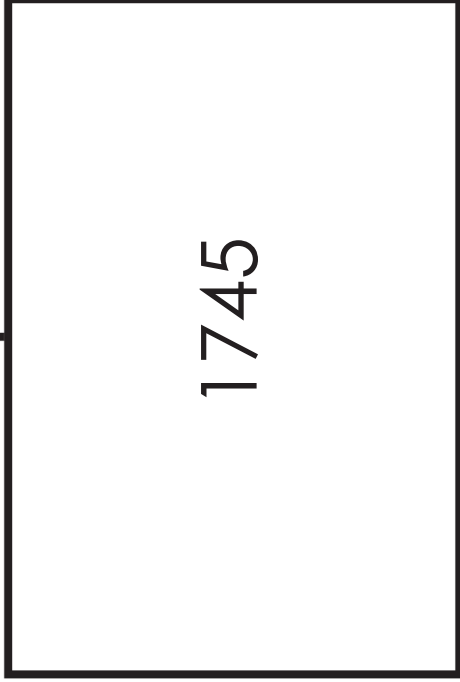
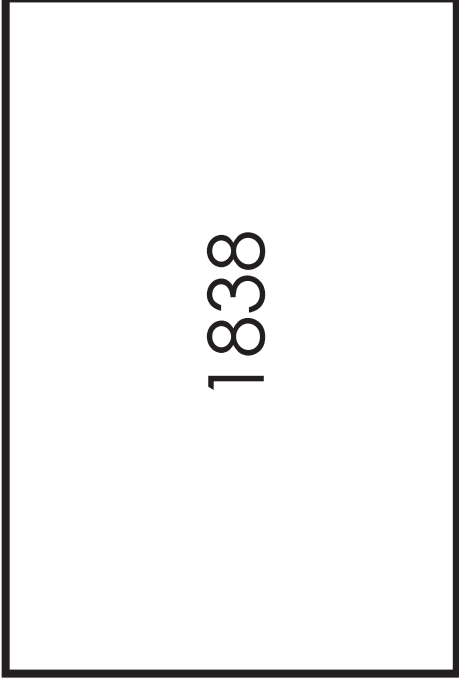
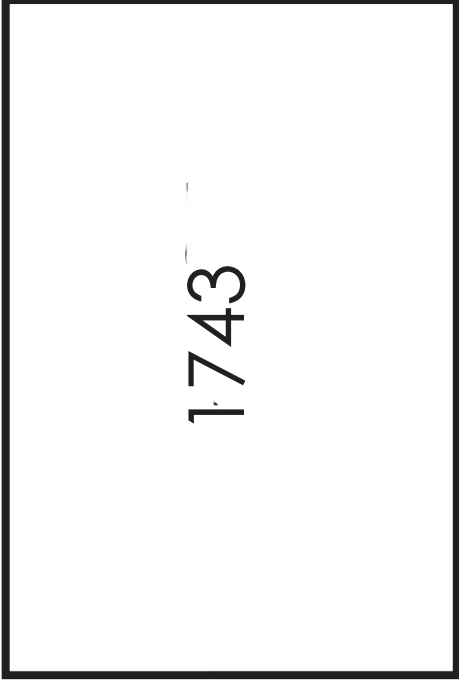
815 CE

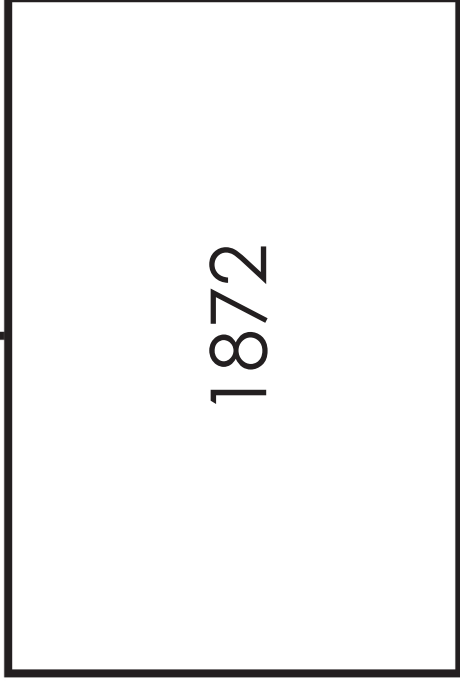
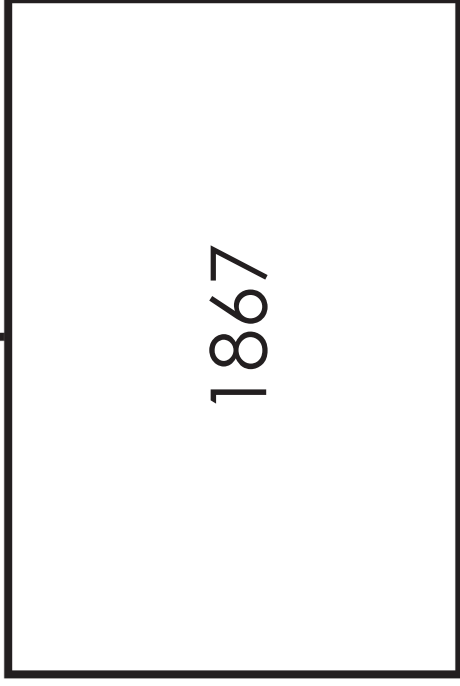
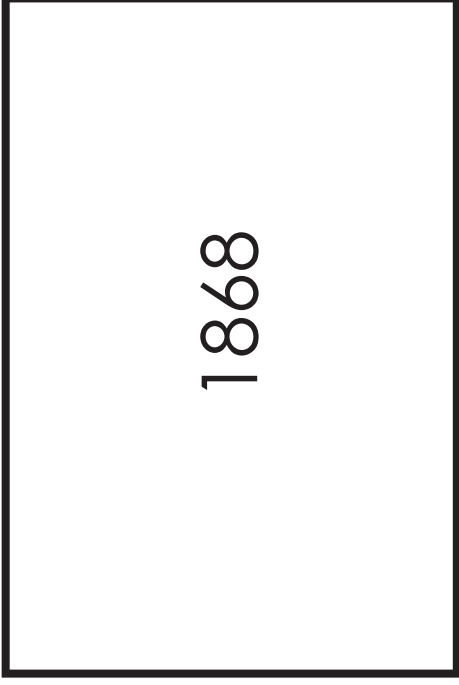
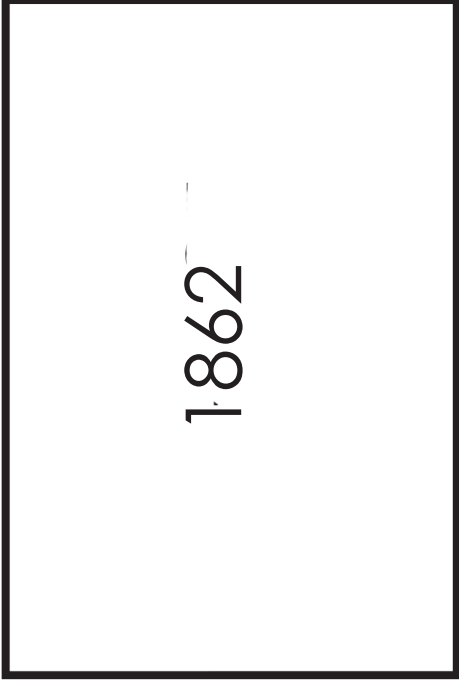


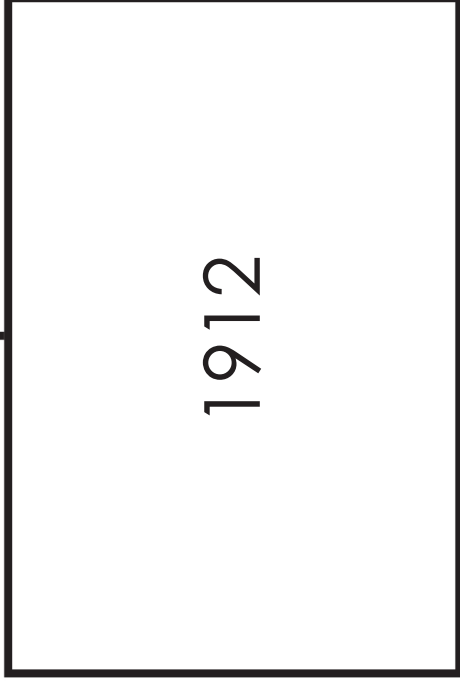
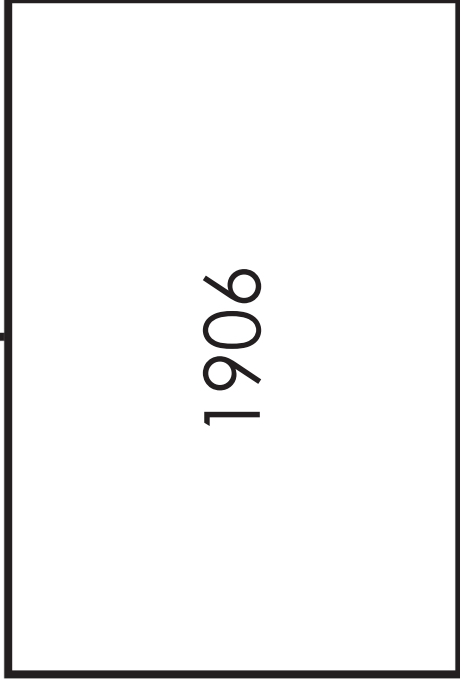
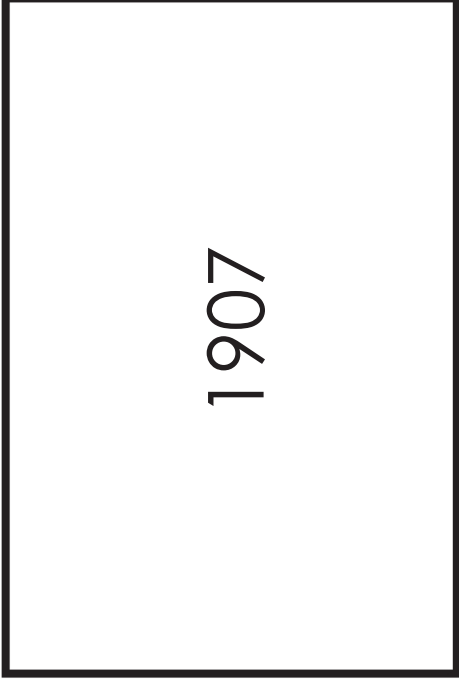
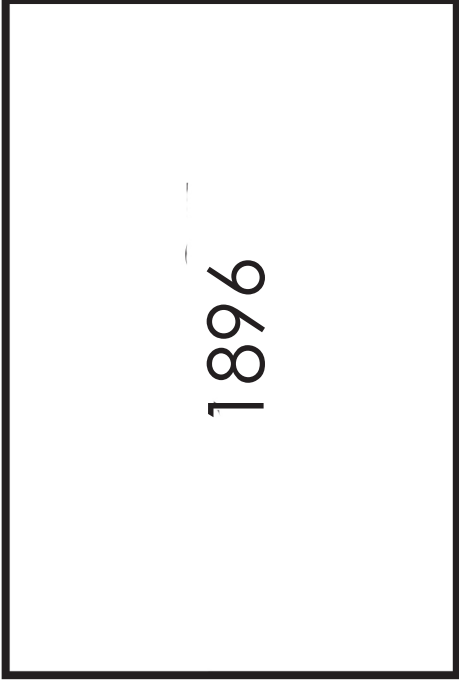
129 CE

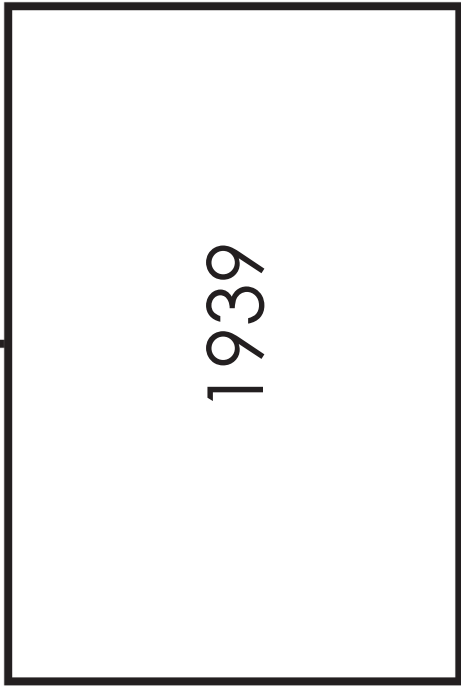
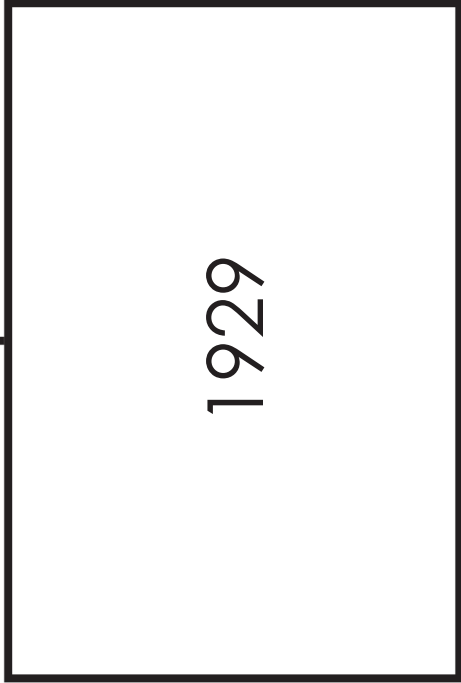
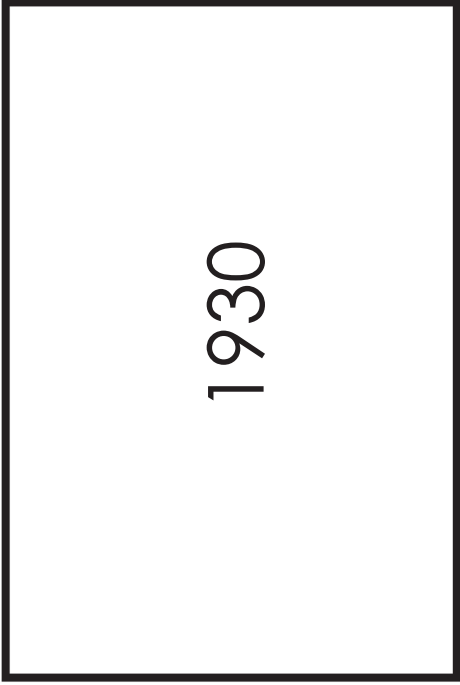
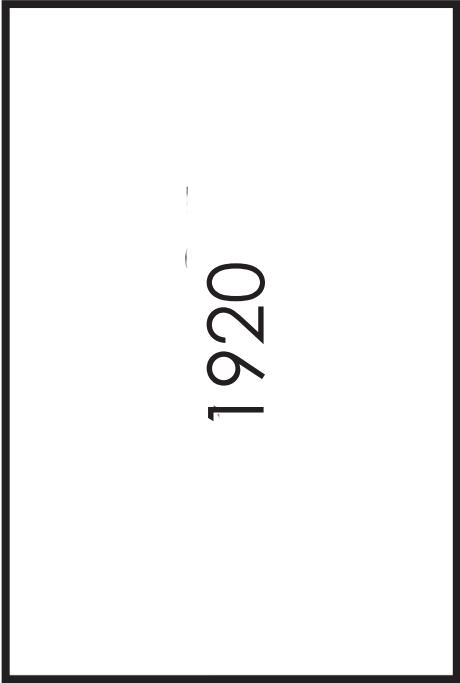


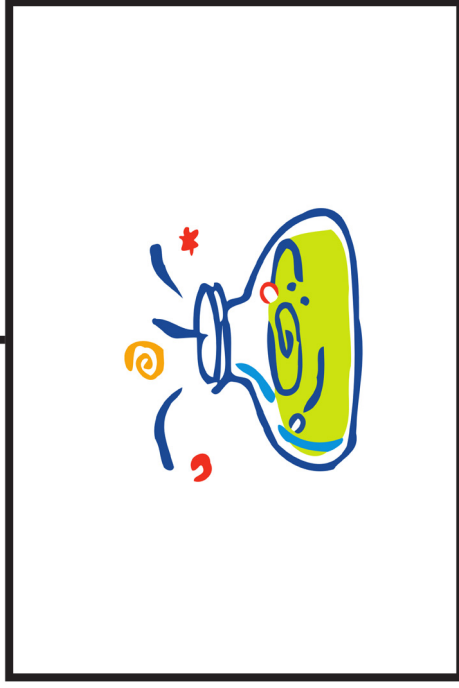
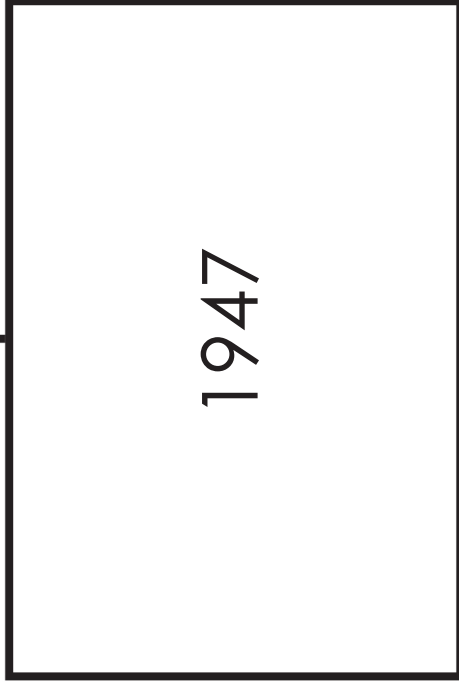
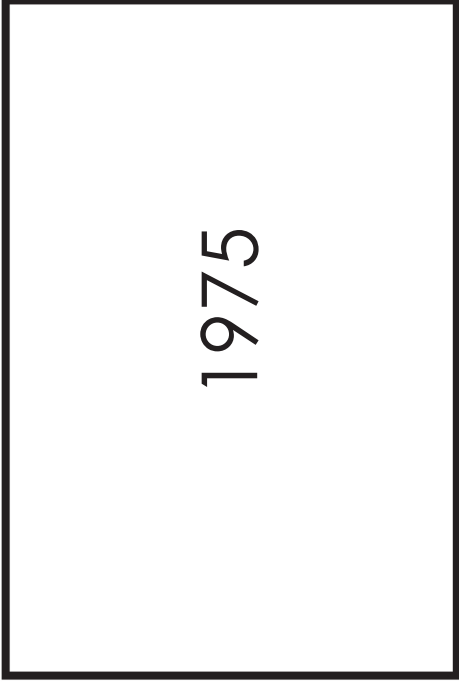
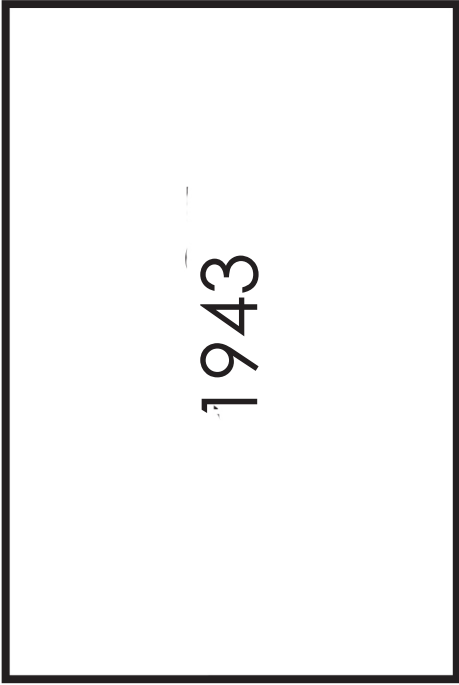
1733











Timeline Labels

Tapputi-Belatikallim

FRAGRANCE
DISTILLATION

Antoine Lavoisier

OXIDATION

Galen

SOAP

William Henry
Perkin

SYNTHETIC DYES

Jabir ibn Hayyan

EVAPORATION

Dmitri
Mendeleev

THE PERIODIC
TABLE

Joseph Priestley

CARBONATION

Svante August
Arrhenius

TEMPERATURE
& CHEMICAL
REACTIONS

Agnes Pockels

SURFACE
TENSION

Alice Ball

ORGANIC OIL
EXTRACTION

Marie Curie

ELEMENTAL
EXTRACTION

Gerty Cori

THE CORI CYCLE

S. P. L. Sorensen

THE PH SCALE

Maria
Goeppert-Mayer

THE NUCLEAR
SHELL MODEL

Mikhail Tsvet

CHROMATOGRAPHY

Rachel Carson

DISPERSION OF
ENVIRONMENTAL
CONTAMINANTS

Anna Jane
Harrison

ORGANIC
COMPOUNDS AND
ULTRAVIOLET
LIGHT

Ada Yonath

RIBOSOME
STRUCTURE

Rosalind Franklin

DNA
STRUCTURE

Margaret
Cairns Etter

CRYSTALLOGRAPHY

Edith Flanigen

MOLECULAR
SIEVES

Linda Buck

OLFACTORY
CHEMISTRY

Tu Youyou

MEDICINAL PLANT
COMPOUNDS

Raychelle Burks

COLORMETRIC
SENSORS

Alessandro Volta

CHEMICAL BATTERIES

THE PERIODIC TABLE

1 IA	2 IIA																	18 VIII A
1 H Hydrogen 1.00794	2 He Helium 4.002602																	18 VIII A
3 Li Lithium 6.941	4 Be Beryllium 9.012182																	18 VIII A
11 Na Sodium 22.98976928	12 Mg Magnesium 24.305																	18 VIII A
19 K Potassium 39.0983	20 Ca Calcium 40.078	21 Sc Scandium 44.9559	22 Ti Titanium 47.867	23 V Vanadium 50.9415	24 Cr Chromium 51.9961	25 Mn Manganese 54.938045	26 Fe Iron 55.845	27 Co Cobalt 58.933195	28 Ni Nickel 58.6934	29 Cu Copper 63.546	30 Zn Zinc 65.38	31 Ga Gallium 69.723	32 Ge Germanium 72.64	33 As Arsenic 74.9216	34 Se Selenium 78.96	35 Br Bromine 79.904	36 Kr Krypton 83.798	18 VIII A
37 Rb Rubidium 85.4678	38 Sr Strontium 87.62	39 Y Yttrium 88.90585	40 Zr Zirconium 91.224	41 Nb Niobium 92.9063	42 Mo Molybdenum 95.96	43 Tc Technetium [98]	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.9055	46 Pd Palladium 106.42	47 Ag Silver 107.8682	48 Cd Cadmium 112.411	49 In Indium 114.818	50 Sn Tin 118.71	51 Sb Antimony 121.76	52 Te Tellurium 127.6	53 I Iodine 126.90447	54 Xe Xenon 131.293	18 VIII A
55 Cs Cesium 132.9054519	56 Ba Barium 137.327																	18 VIII A
87 Fr Francium [223]	88 Ra Radium [226]																	18 VIII A

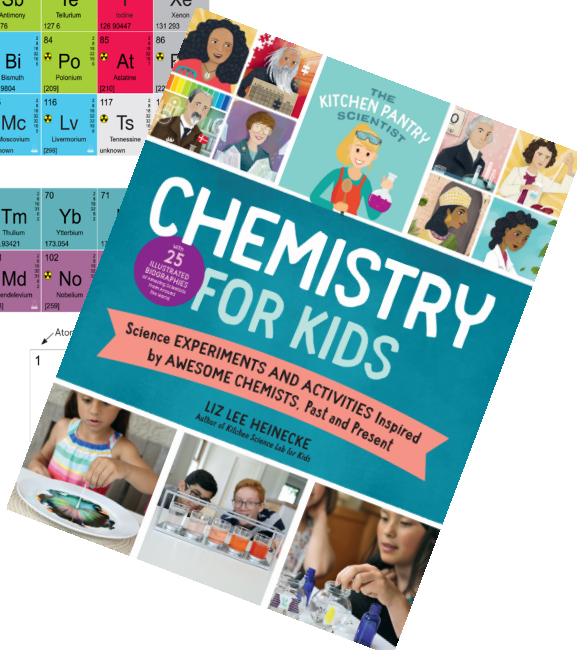
Lanthanoids	57 La Lanthanum 138.90547	58 Ce Cerium 140.116	59 Pr Praseodymium 140.90765	60 Nd Neodymium 144.242	61 Pm Promethium [145]	62 Sm Samarium 150.36	63 Eu Europium 151.964
Actinoids	89 Ac Actinium [227]	90 Th Thorium 232.0377	91 Pa Protactinium 231.03688	92 U Uranium 238.02891	93 Np Neptunium [237]	94 Pu Plutonium [244]	95 Am Americium [243]

Matter is made up of invisible building blocks called atoms. The atoms of any given element are identical, and consist of three basic particles: protons, electrons, and neutrons. A nucleus, found at the center of each atom, contains the positively charged protons and the neutrons, which carry no charge. The outermost regions of the atom, which contain negatively charged electrons, are called electron shells.

Study the Periodic Table above. See how many elements you recognize. Find the atomic number in the upper left-hand corner of each element. This number tells you how many protons the element has in its nucleus. At the bottom of each square, you'll find the element's atomic mass, which is not a whole number, because the number of neutrons might vary. The number you see is an average and you can round it to the nearest whole number. To calculate how many neutrons are in an element, subtract the atomic number from the atomic mass.

13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18 VIII A
5 B Boron 10.811	6 C Carbon 12.0107	7 N Nitrogen 14.0067	8 O Oxygen 15.9994	9 F Fluorine 18.9984032	10 Ne Neon 20.1797
13 Al Aluminum 26.9815386	14 Si Silicon 28.0855	15 P Phosphorus 30.973762	16 S Sulfur 32.065	17 Cl Chlorine 35.453	18 Ar Argon 39.948
29 Cu Copper 63.546	30 Zn Zinc 65.38	31 Ga Gallium 69.723	32 Ge Germanium 72.64	33 As Arsenic 74.9216	34 Se Selenium 78.96
47 Ag Silver 107.8682	48 Cd Cadmium 112.411	49 In Indium 114.818	50 Sn Tin 118.71	51 Sb Antimony 121.76	52 Te Tellurium 127.6
79 Pt Platinum 195.084	80 Au Gold 196.966569	81 Hg Mercury 200.59	82 Tl Thallium 204.3833	83 Pb Lead 207.2	84 Bi Bismuth 208.9804
110 Ds Darmstadtium [281]	111 Rg Roentgenium [280]	112 Cn Copernicium [285]	113 Nh Nihonium [286]	114 Fl Flerovium [289]	115 Mc Moscovium [290]
64 Gd Gadolinium 157.25	65 Tb Terbium 158.9253	66 Dy Dysprosium 162.5	67 Ho Holmium 164.93032	68 Er Erbium 167.259	69 Tm Thulium 168.93421
96 Cm Curium [247]	97 Bk Berkelium [247]	98 Cf Californium [251]	99 Es Einsteinium [252]	100 Fm Fermium [257]	101 Md Mendelevium [258]

Atoms always have the same number of protons and electrons. Simply look at the atomic number to see how many electrons an element has. On the right side of each square, some periodic tables show you how the electrons are arranged in their shells, with the number on top representing the number of electrons in the shell closest to the nucleus.



A Biographical Timeline

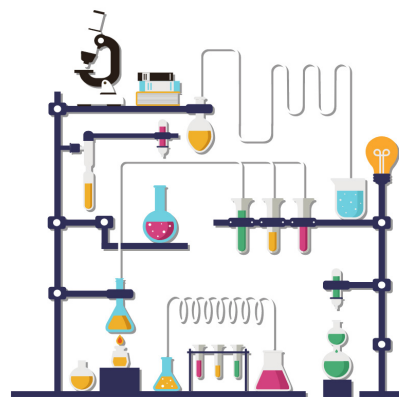
Objective: Integrate and create content presented in diverse media and formats.

Materials:

- *Chemistry For Kids*, the book
- A Biographical Timeline Planner (Guide, pg. 21)
- Blank Timeline Grids (Guide, pg. 22-23)
- Blank Timeline Labels (Guide, pg. 24)
- The Scientific Method Template (Guide, pg. 6)
- Research materials
- Tape
- Scissors
- Pencil
- Markers

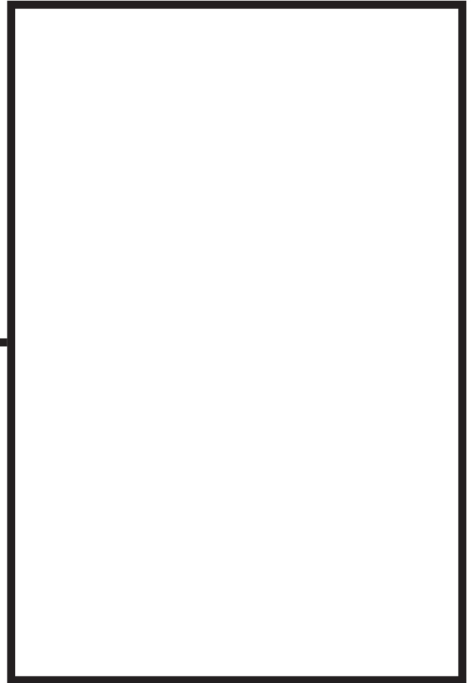
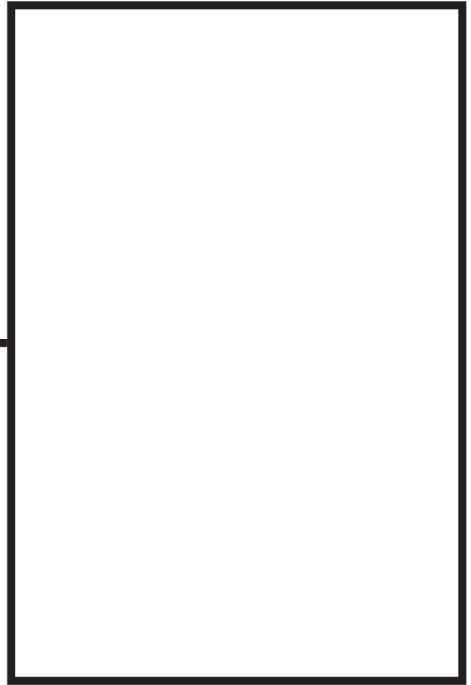
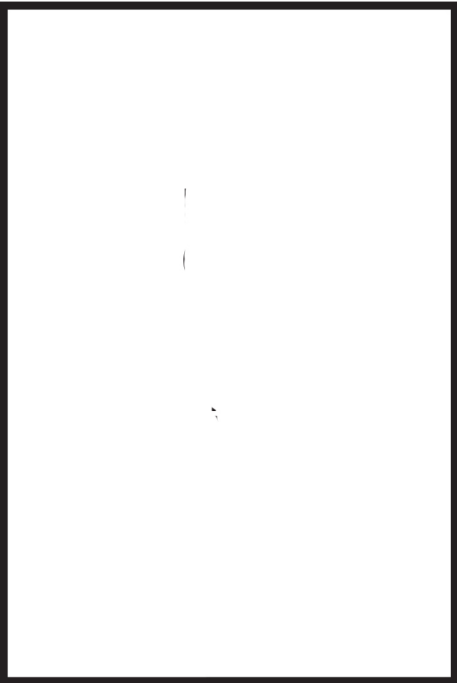
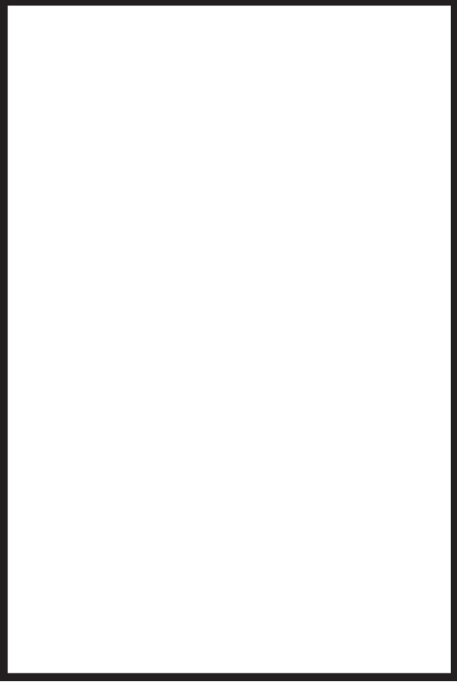
Procedure:

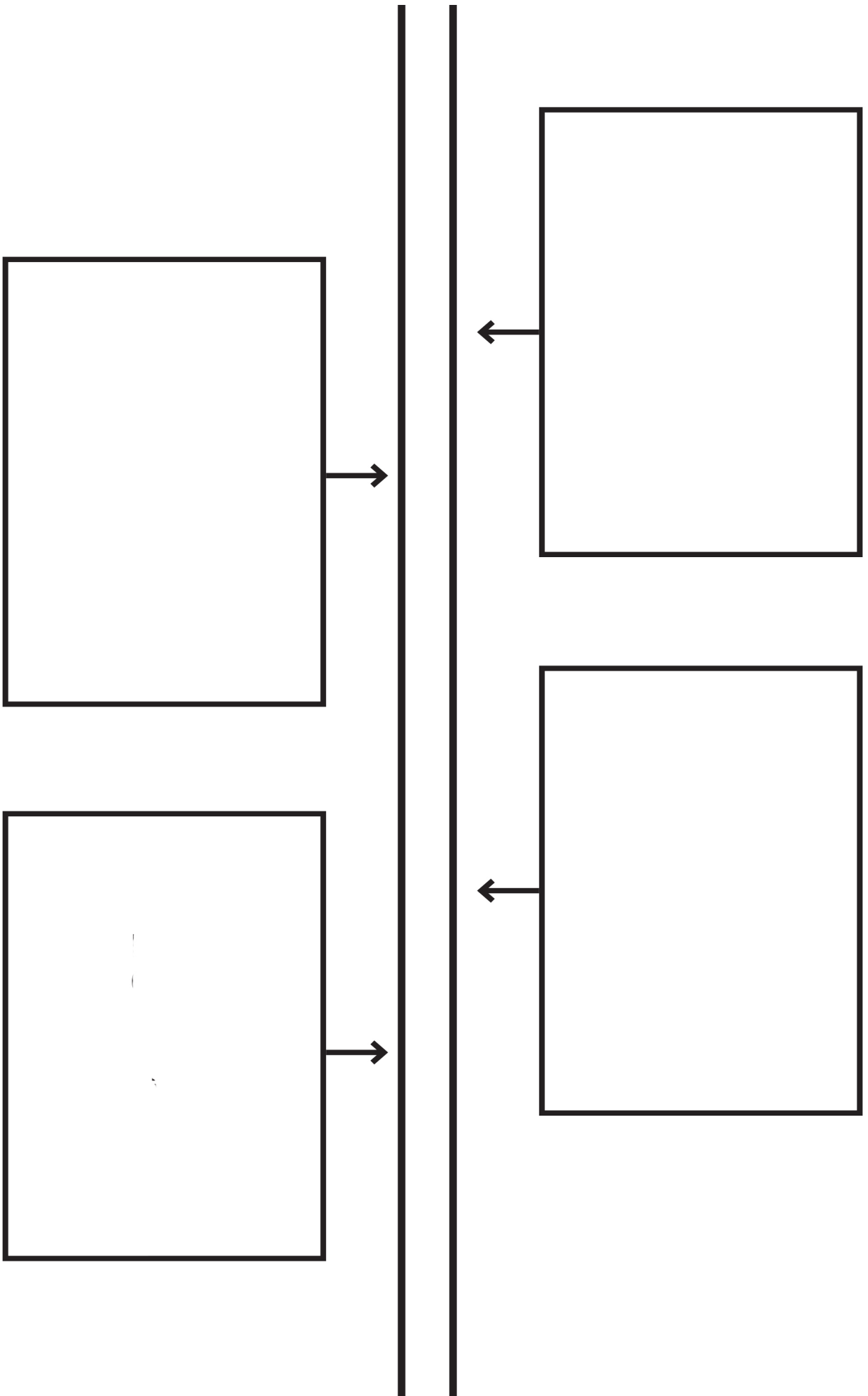
- Instruct students to choose a chemist featured in *Chemistry For Kids* to research.
- Using the Biographical Timeline Planner as guide, tell students to discover or infer the following information about their chosen chemist:
 - Date and place they were born.
 - Dated information about their childhood experiences.
 - Dated information about their educational background.
 - Dated information about their scientific contributions.
 - Dated information about their death.
 - Dated information regarding the legacy their work has left behind. Report on how their scientific contributions have impacted the modern world.
- Record dates on Blank Timeline Grid in a sequential manner.
- Tape pages of the Timeline Grid together
- Write and illustrate researched corresponding facts on Blank Timeline Labels.
- Use scissors to trim around the borders of Blank Timeline Labels.
- Match Timeline Labels to corresponding spaces on the Timeline Grid.
- Analyze how moments in their chemist's life served to prepare them for their scientific contributions, their legacy, and their impact on today's world.
- Use the Scientific Method Template as a guide to perform the experiment associated with their chemist.
- Write an essay making a connection between biographical facts discovered in their timeline research and the experiment associated with their chemist.
- Encourage students to share their work with the class.



A Biographical Timeline Planner

Chemist's Name	
Birth:	Childhood:
Education:	Scientific Contributions:
Death:	Legacy:





Common Core State Anchor Standards

		Discussion	Dropped Phrase Puzzle	Timeline	Biographical Timeline
English Language Arts Standards » Anchor Standards for Reading					
CCSS.ELA-LITERACY.CCRA.R.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.	•	•	•	•
CCSS.ELA-LITERACY.CCRA.R.2	Determine central ideas or themes of a text and analyze their development; summarize the key supporting details and ideas.	•	•	•	•
CCSS.ELA-LITERACY.CCRA.R.4	Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone.	•	•		
CCSS.ELA-LITERACY.CCRA.R.7	Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.	•	•	•	•
CCSS.ELA-LITERACY.CCRA.R.10	Read and comprehend complex literary and informational texts independently and proficiently.	•	•	•	•
English Language Arts Standards » Anchor Standards for Writing					
CCSS.ELA-LITERACY.CCRA.W.2	Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.			•	•
CCSS.ELA-LITERACY.CCRA.W.4	Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.			•	•
CCSS.ELA-LITERACY.CCRA.W.7	Conduct short as well as more sustained research projects based on focused questions, demonstrating understanding of the subject under investigation.				•
CCSS.ELA-LITERACY.CCRA.W.9	Draw evidence from literary or informational texts to support analysis, reflection, and research.	•	•	•	•
English Language Arts Standards » Anchor Standards for Speaking and Listening					
CCSS.ELA-LITERACY.CCRA.SL.1	Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.	•	•	•	•
CCSS.ELA-LITERACY.CCRA.SL.2	Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.	•		•	•
CCSS.ELA-LITERACY.CCRA.SL.4	Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.			•	•
CCSS.ELA-LITERACY.CCRA.SL.5	Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations.			•	•
CCSS.ELA-LITERACY.CCRA.SL.6	Adapt speech to a variety of contexts and communicative tasks, demonstrating command of formal English when indicated or appropriate.	•	•	•	•

Next Generation Science Standards

		Discussion	Dropped Phrase Puzzle	Timeline	Biographical Timeline
K-LS1 From Molecules to Organisms: Structures and Processes					
	Scientific Knowledge is Based on Empirical Evidence - Scientists look for patterns and order when making observations about the world.				•
K-PS2-1 Motion and Stability: Forces and Interactions					
	Planning and Carrying Out Investigations - Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.				•
	With guidance, plan and conduct an investigation in collaboration with peers.				•
	Scientific Investigations Use a Variety of Methods - Scientists use different ways to study the world.				•
2-PS1 Matter and Its Interactions					
	Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.				•
	Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question.				•
	Cause and Effect - Events have causes that generate observable patterns.				•
	Energy and Matter - Objects may break into smaller pieces and be put together into larger pieces, or change shapes.				•
5-PS1 Matter and Its Interactions					
	Developing and Using Models - Use models to describe phenomena.				•
	Planning and Carrying Out Investigations - Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.				•
	Make observations and measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon.				•