DAQRI

ELEMENTS 4D™

CHEMISTRY LESSON PLAN

HIGH SCHOOL (Grades 9-12)

4D in the Classroom: A Whole New Way of Learning

WHAT IS 4D?

4D combines augmented reality and other technologies to create a new communication medium. 4D doesn't just superimpose a digital image: it intersperses your view of the real world with seamless, spatially in-context imagery and information in real-time, wherever you are. 4D creates an interactive and digitally manipulable world. 4D creates whatever you can imagine.

To discover more about the world of 4D, visit DAQRI.com.

4D Empowers Classroom Learning

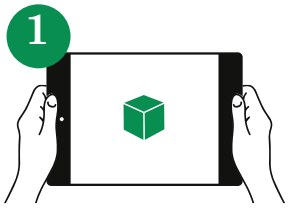
Educators have the opportunity to provide relevant, immersive learning experiences in 4D on just about every classroom topic and drive knowledge-transfer to their students. Thanks to its intuitive form and interactive functionality, 4D has massive potential to transform the way we learn, both inside and outside the classroom.

For example, Elements 4D is a 4D Experience™ supercharging the chemistry classroom. Elements 4D is a set of interactive blocks that help students learn the Periodic Table by showing how elements combine into new chemical substances, what the reactions look like, and the resulting chemical equation.

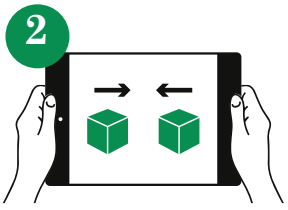
Similarly, students from grade school to grad school are able to explore the human body with Anatomy 4D, an app from DAQRI that enables interactive learning even beyond what's possible in a medical lab.

With 4D, students can interact with spatial, geometric models in math class, perform interactive dissections on a 3D model of a frog as though a real frog were sitting on the lab table in front of them and much more. Teachers and students can now create their own 4D Experience™, tailored to the classroom, with the help of DAQRI 4D Studio for Education.

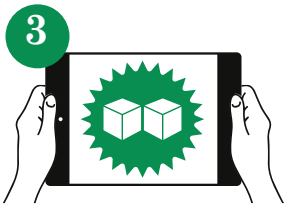
HOW ELEMENTS 4D WORKS



See the elements in 4D
Download and open the Elements 4D app and point your device at the block face illustrating the element you want to view.



Combine Two Elements
Next, introduce a second element. Move the two blocks together until they touch.



Marvel at the Reaction You've Created!
If nothing happens, those elements don't combine. Try another combination.

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ABOUT DAQRI

DAQRI is a global technology leader that is fundamentally transforming the way people deliver and interact with information through a powerful new medium, 4D. An innovator in computer vision, DAQRI's industry-leading software and hardware set the standard for the next generation in industrial, storytelling, and educational technologies.

DAQRI is headquartered in Los Angeles with an R&D center in Mountain View, California and sales offices in New York, Chicago, Boston, Detroit, Atlanta, San Antonio, and Minneapolis. For more information, visit DAQRI.com.

ACKNOWLEDGEMENTS

This lesson plan was made possible by the DAQRI Education team, as well as the thoughtful contributions of educators Courtney Pepe and Jessica Lupone. We thank them for lending us their stellar expertise!

Lessons align to Common Core State Standards and Next Generation Science Standards.

LESSON 1

Solid, Liquid, or Gas?

50 MIN

Learning Objectives

STUDENTS WILL BE ABLE TO:

Classify the elements on the Elements 4D blocks as a solid, liquid, or gas in their standard state.

Defend their position about whether the element is a solid, liquid, or gas in its standard state in a writing prompt.

Justify their position about whether the element is a solid, liquid, or gas in a think pair share.

Collaborate and create a screencast sharing their discoveries about the behavior of elements.

STANDARDS

Exercise 1 corresponds to the following Science & Technical Subjects Common Core State Standards:

CCSS.ELA-Literacy.RST.9-10.4
Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.

Exercise 2 corresponds to the following Science & Technical Subjects Common Core State Standards:

CCSS.ELA-Literacy.SL.9-10.5
Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.

Lesson 1 is also aligned with the following Next Generation Science Standards.

HS-PS2-6 Motion and Stability: Forces and Interactions
Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.*

**The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.*

Exercise 1: Writing Assignment

STEP 1 Using their classroom textbook, technology resources, and any other available resources, students will research whether the thirty-six elements that are depicted on the six blocks can be classified as a solid, liquid, or gas in their standard state.

STEP 2 Citing evidence from the textbook, other available resources, and previous lessons, the students will make prediction statements about whether each element is a solid, liquid, or gas in its standard state. Students must be encouraged to support their answers with scientific and technical knowledge.

A writing sample might start like this:

> *I predict that helium will be a gas in its natural state because helium is what makes balloons get bigger.*
>
> *I predict that hydrogen is going to be a gas in its natural state because our teacher stated that in a lecture on the first day of school.*
>
> *On page 37 of the textbook, the author states that lithium is a solid in its natural state so I predict that lithium will be a solid.*
>
> *When we ate at McDonald's last night, the salt particles were solid so I predict that sodium will be a solid.*
>
> *The textbook shows a picture of a banana next to potassium so based upon the visual, I predict that potassium would be a solid in its natural state.*
>
> *Based upon my technical knowledge that gold is a type of jewelry and jewelry is solid, I predict that gold is going to be solid. My lab partner reminded me that lithium exists in batteries so I am predicting that lithium will be a solid in its natural state.*

**Opportunity for differentiation:*

Please note that if you choose to write about all thirty-six elements on the blocks, each student would write a total of six paragraphs, each of which contained six prediction statements. As the teacher, you can modify the number of elements that you want the students to write about based upon the ability level in your class. Certainly an AP or honors class would do the six-paragraph version of the assignment.

STEP 3 After the students complete their writing sample, they should get into groups of two and engage in a think pair share where they compare and contrast their answers about whether each element is a solid, liquid, or gas in its standard state. During this time, the teacher can get the app ready to show to the class.

STEP 4 **Infusion of twenty-first century skills into the lesson:** While the teacher is doing the hands on demonstration with the blocks, the students work in groups of four with the iPads. As the augmented reality technology begins to work, the students take screenshots of the blocks coming to life and showing whether each element is a solid, liquid, or gas in its standard state.

Exercise 2: Screencast Assignment

STEP 1

In groups of four, the students make a screencast about whether or not their predictions were correct. Recommended apps to be used to make a screencast on the iPad: Educreations, Explain Everything, or Screenchomp. In a classroom where the students have Chromebooks instead of iPads, the screencast activity could be completed with the following tools: Screencastify or Snagit for Chrome.

EXTENSION ACTIVITY

The student screencasts could be published on a school YouTube Channel or a Class Blog.

LESSON 2
Electron Behavior & Compound Formation

50 MIN

Learning Objectives

STUDENTS WILL BE ABLE TO:

Make predictions about electron behavior based upon Periodic Table geography.

Analyze which elements will react with one another to form compounds.

Academic Vocabulary to Review as Part of the Lesson: Electron configurations, ionic bonds, covalent bonds, groups, families, alkali metals, alkaline earth metals, transition metals, halogens, and noble gases

For this lesson, students should download the following Periodic Table or the teacher should print out a color version for the class: www.ptable.com

Don't have an iPad? The same activity could be completed as a poster. The modification of this portion of the assignment is at the discretion of the teacher.

STANDARDS

This lesson is aligned with the following Next Generation Science Standards.

HS-PS1-1.
Use the Periodic Table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.

HS-PS1-2.
Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the Periodic Table, and knowledge of the patterns of chemical properties.

The extension activity is aligned to the following Science & Technical Subjects Common Core State Standards:

CCSS.ELA-Literacy.RST.9-10.7:
Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.

CCSS.ELA-Literacy.RST.9-10.9
Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

Exercise 1

STEP 1 In groups of six, students should be given their own printouts of the Elements 4D blocks.

STEP 2 Since there are six different pages, each student should be given an individual page as well as scissors and glue so each student has the opportunity to build their own Elements 4D blocks.

STEP 3 Once the students have constructed the block, the students should take turns passing the blocks around their groups. Each student should locate the six elements on the block in front of them and circle or highlight those elements on the Periodic Table and pass the block to the student to the right. Once this has been done six times, every student should have thirty-six elements circled or highlighted on the Periodic Table.

STEP 4 Once students have circled the thirty-six elements displayed on the Elements 4D blocks, they should fill in **Table 1**. This will help them make predictions about which elements will form compounds with one another based upon their electron configuration and geographic location on the Periodic Table:

STEP 5 **The Power of Student Observation—4D Senses:** After students fill out the chart, they will use the set of the paper blocks to test their hypothesis about which elements will lose, gain, or share electrons to form a compound with another element. They will then fill out **Table 2** for at least ten different compounds that were formed as a result of trying to match up different elements.

NAME: _____ **TABLE 1** DATE: _____

Name of Element	Element Symbol	Atomic Number	This Element Belongs to Which Family	Number of Electrons in the Outer Shell	Will be Likely to Bond With
Chlorine	Cl	17	Halogens	7	Sodium
Fluorine					
Oxygen					
Carbon					
Mercury					
Sulfur					
Hydrogen					
Lithium					
Helium					
Sodium					
Gold					
Potassium					
Cesium					
Xenon					
Gallium					
Iodine					
Silicon					
Tin					
Beryllium					
Calcium					
Bromine					
Titanium					
Rubidium					
Magnesium					
Iron					
Chromium					
Aluminium					
Cobalt					
Copper					
Nitrogen					
Plutonium					
Phosphorus					
Platinum					
Zinc					
Uranium					
Bismuth					

NAME: _____

TABLE 2

DATE: _____

Element 1	What did it look like in 4D?	Element 2	What did it look like in 4D?	Compound Formed	What did it look like in 4D?	Describe the behavior of the electrons...
Calcium	It looked like a big chunk of ice or a block of frozen milk	Oxygen	It looked translucent and invisible	Lime Calcium Oxide	White powdery substance	Calcium loses two electrons while oxygen gains those same two electrons to form a stable octet

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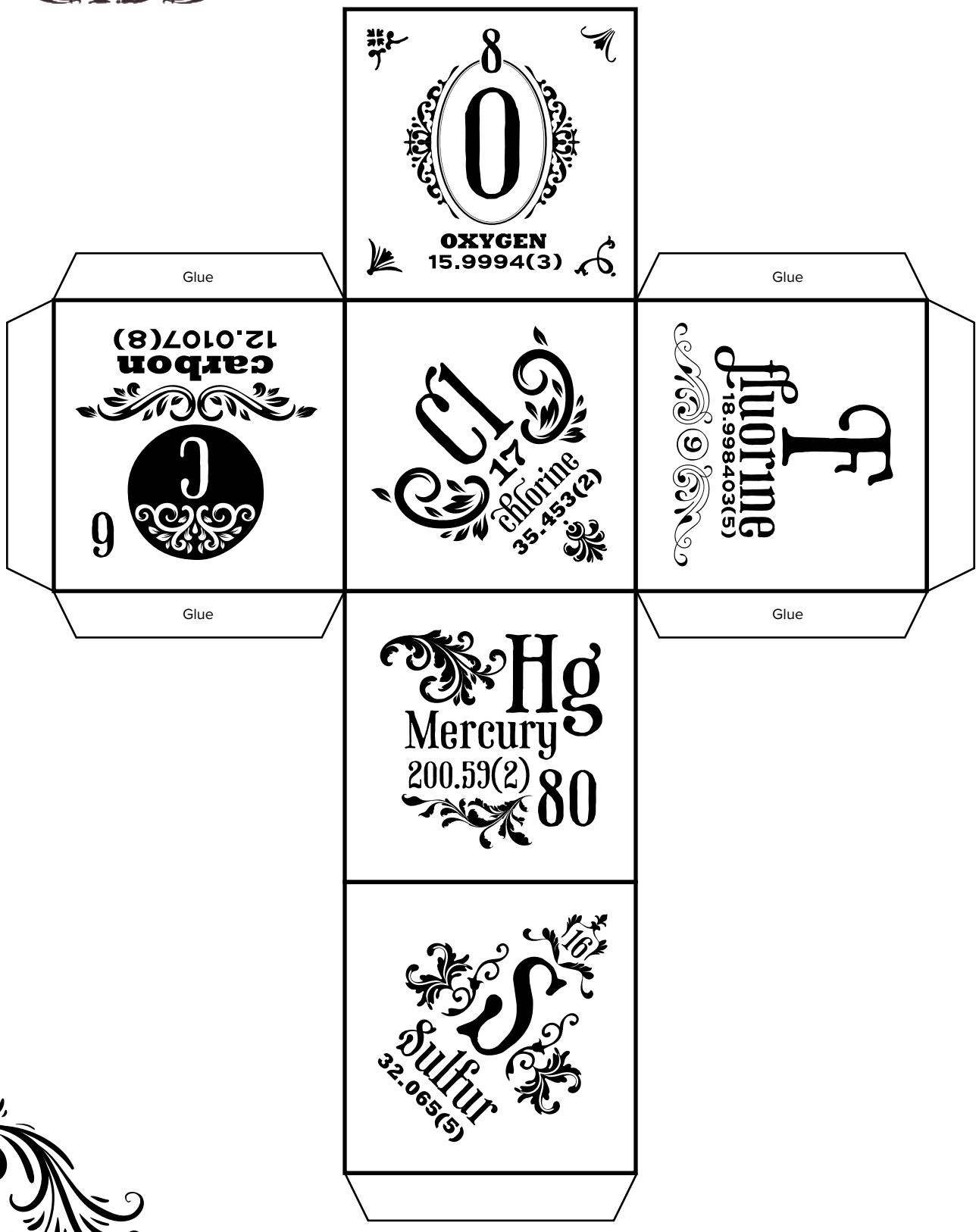
ELEMENTS 4D



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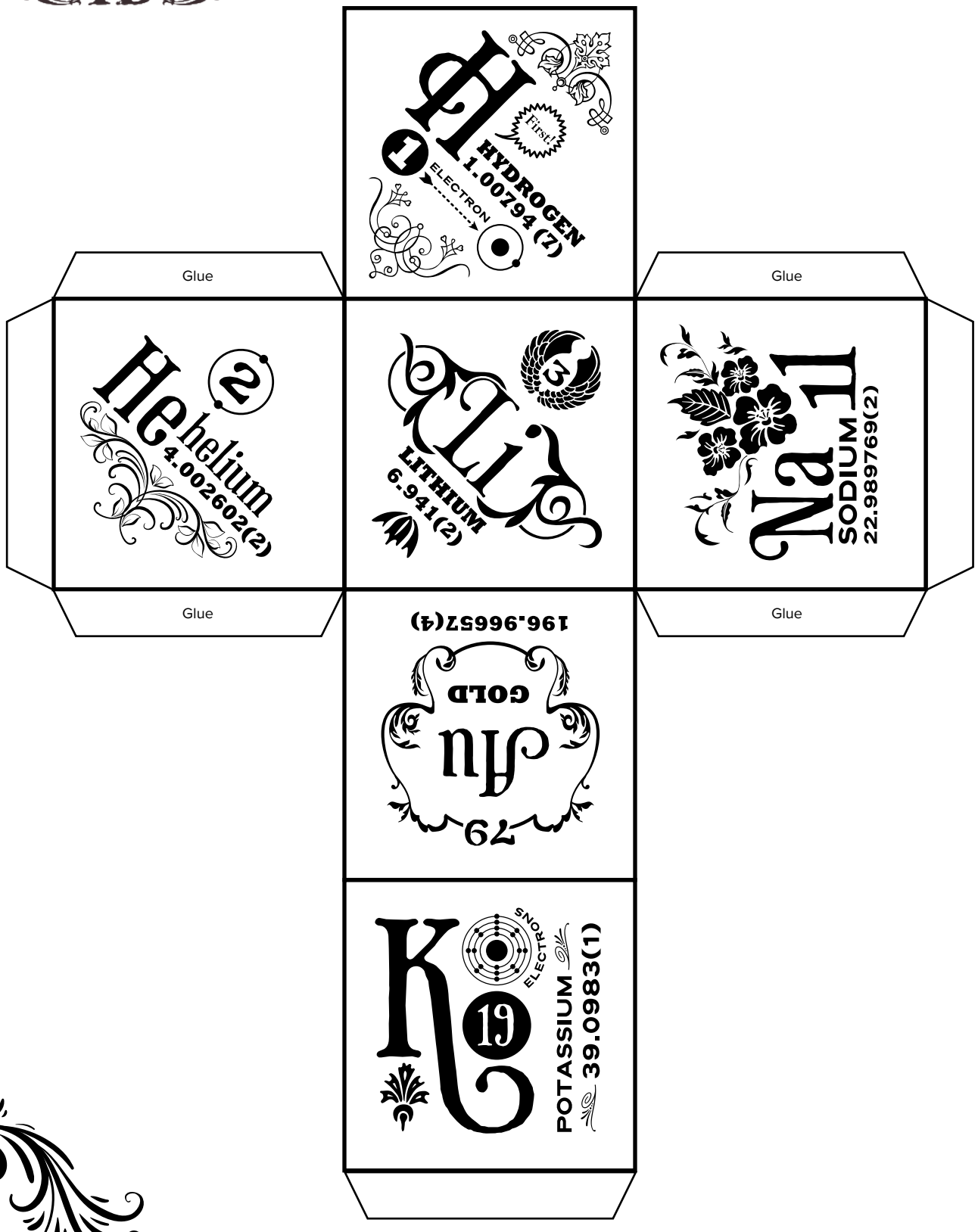

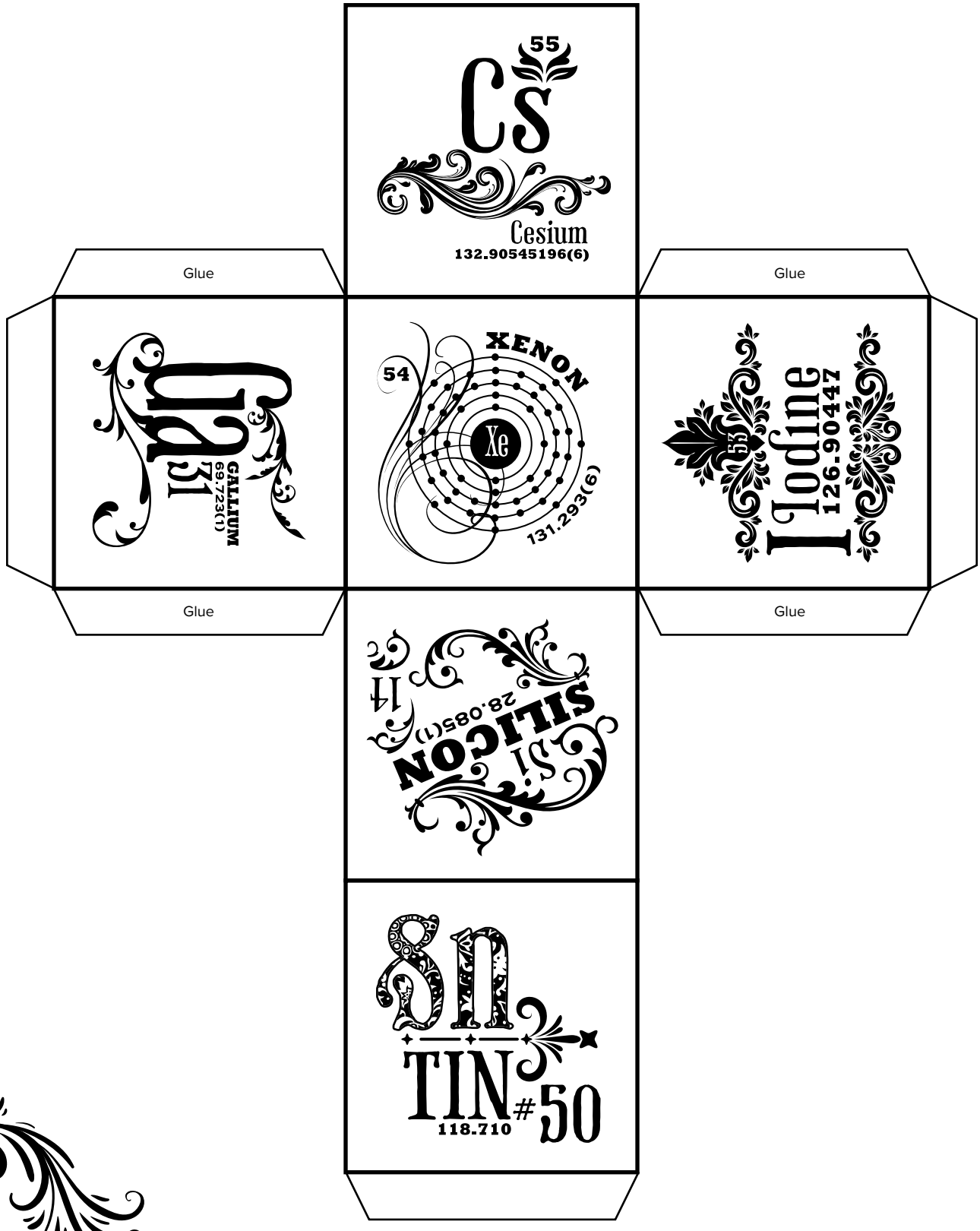

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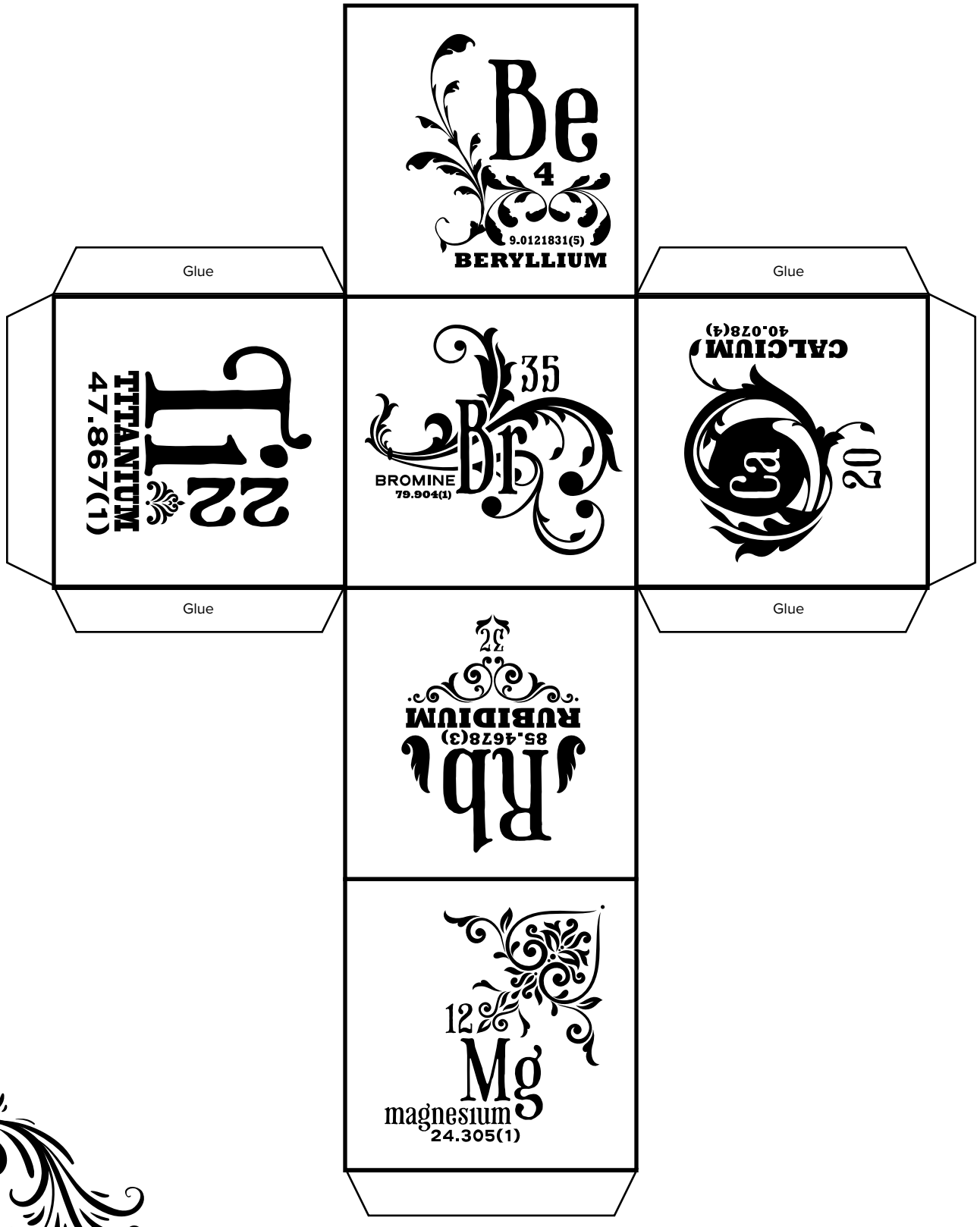

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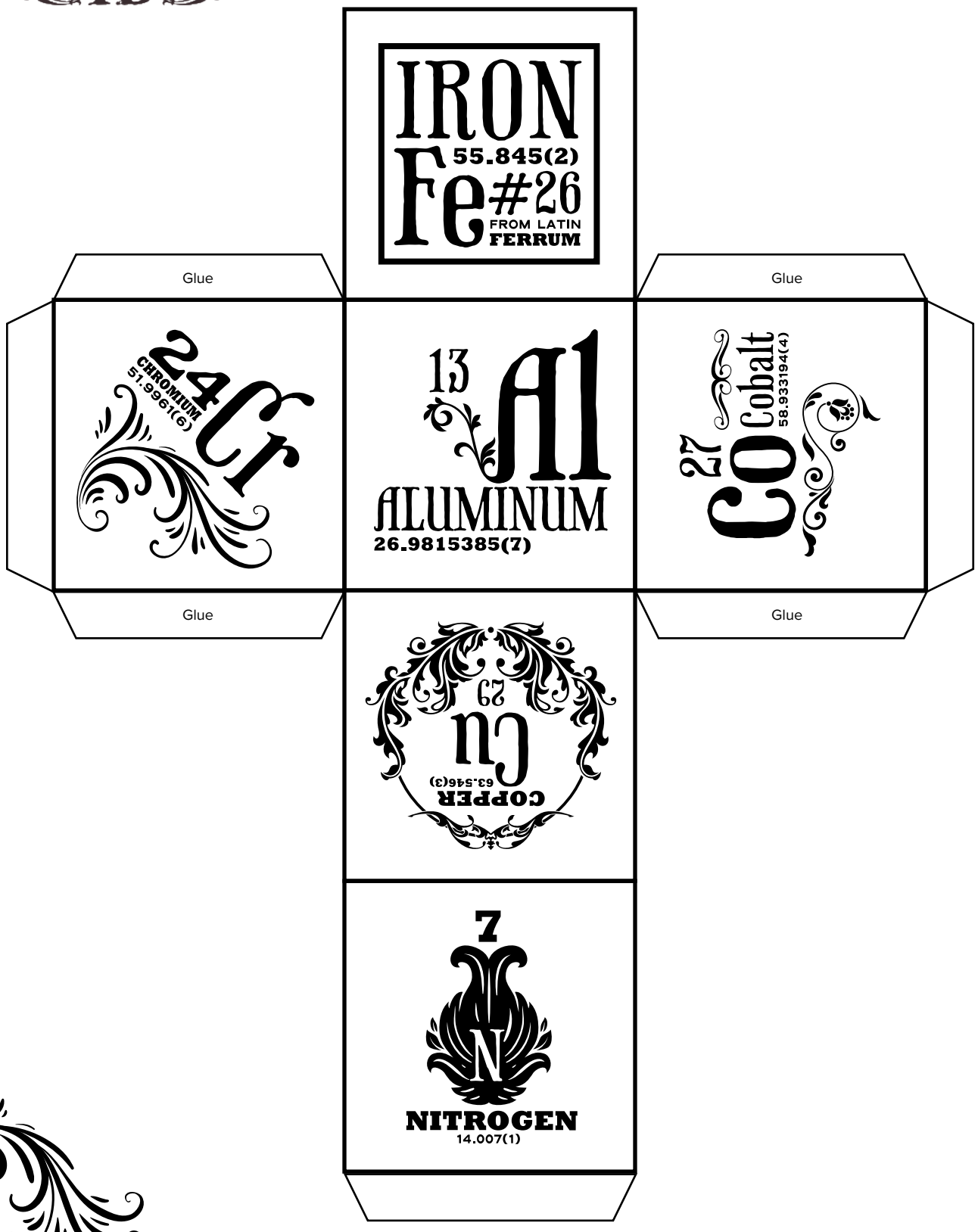

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