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Topic: Double Helix Activity

Summary: Students will build a classroom size model of the double helix using paper.

Goals & Objectives: Students will be able to explain the structure of a nucleotide and DNA. Students will be able to explain complimentary base pairing. Students will be able to explain that the double helix is made of many nucleotides. Students will be able to explain how the strands of the double helix are complementary based upon the 5' prime 3' prime ends. Students will be able to devise a plan on how DNA replicates.

NGSS Standards: *HS-LS3-1* Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.

Time Length: 1-2 days

Materials:

- Construction Paper – 7 colors (regular paper works but not as well)
- Tape (glue works but not as well)
- Scissors

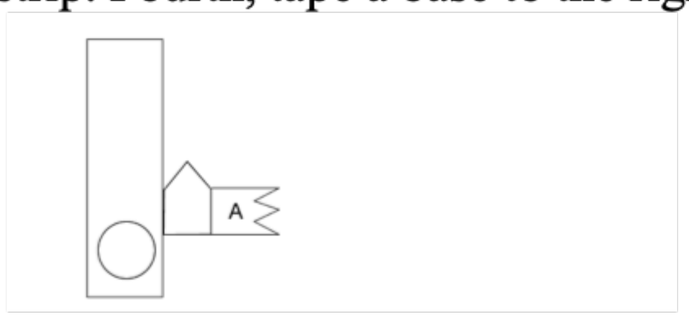
Set-Up:

- Photocopy each page with a different color.
- Place scissors, tape, and papers on a table.

Procedures:

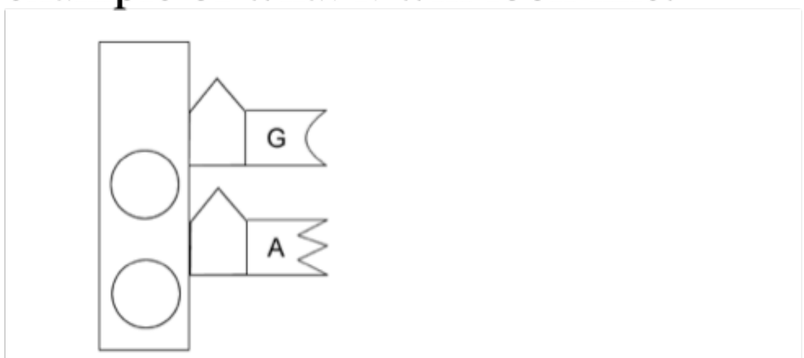
1. Introduce to them the different parts of a nucleotide, base pairing rules, 5' prime 3' prime ends, and super coiling. Then each student goes and gets the supplies. Two of the strips, 1 paper of circles, pentagons, and each base is a good amount of supplies to start with but students will need more as they progress.

3. Before the students start to cut out each part from the construction paper, demonstrate how to assemble the helix. First take the long strip (it is the bonds for the backbone). Second, the students tape the small circle (the phosphate group) on top of the strip. Third, to the upper right of the circle, tape a pentagon (the sugar) onto the side of the strip. Fourth, tape a base to the right of the sugar. Below is an example.

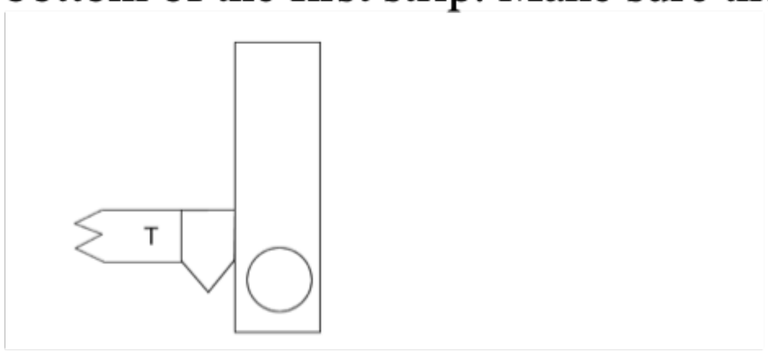


4. The students start to cut the parts from the construction paper and build a nucleotide. It is important that students follow the procedures that were demonstrated and not try to take a short cut. Make sure the students build it one nucleotide at a time and not tape several phosphates on the strip first then several sugars, and so forth.

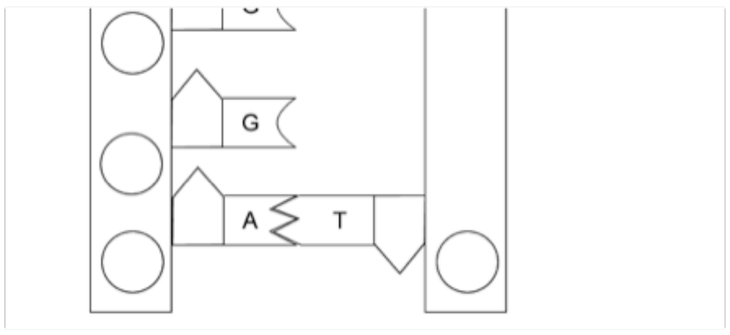
5. Once the student has done one nucleotide, the student continues to make more of the same helix. The student should fit about 5-6 phosphates per backbone strip. Below is an example of what it will look like.



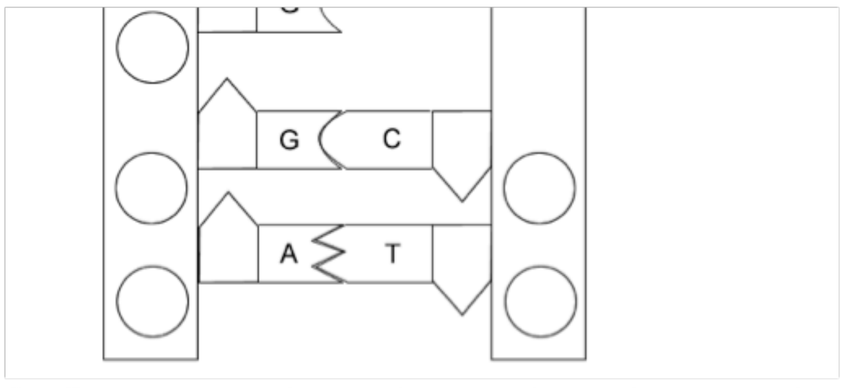
6. The student then takes another strip and does the exact opposite of the first strip. The student then needs to select to correct complimentary base to fit with the base at the bottom of the first strip. Make sure the sugar is pointing in the opposite direction.



7. Students then attach the two bases together.



8. Then the student continues to build the second helix one nucleotide at a time.



9. Once complete, the student then works on making the double helix longer. The longer the double helix, the easier it is for the super coiling.

Going Further: Optional Hydrogen Bonds and Phosphodiester Bonds Tape Colors

11. Students can also draw with a marker over the tape used to connect the phosphate and sugars for the phosphodiester bond. Students can use a different color marker to color over the tape holding together the two complimentary nitrogen bases demonstrating a hydrogen bond.

Going Further: Inquiry DNA Replication

12. Ask students to come up with a way to replicate their DNA. Give them the rules that only the hydrogen bonds can be broken and not the phosphodiester bonds. Have students make a model demonstrating the DNA replication.

Going Further: Coiling

13. With about 30 minutes left in class, have the student tape each helix together to make a super long double helix. Once completed, take the students outside to an open space. Tell the student to carry the double helix outside with out breaking any of the bonds/tape. The tape is very fragile.

14. Once to the open space, have the students examine their current positions. Are they in a long line? Taking up a lot of space? Without the students moving, ask them how hard it would be for them to fit in a tiny space and then stretch out the helix so it can be read. Ask for ideas, there can not be any knots in the helix.

15. Now stretch out the helix. Have one student in the middle wrap the helix around their self twice. The two students on the sides of him follow. The students near the ends walk the helix in, giving the students in the middle the extra length needed to coil it around themselves (histones).

Accommodations: Students who have difficulty using scissors must be provided pre-cut parts of the helix. Students who have difficulty walking may sit out and just watch the super coiling part of the activity.

Editable DOCX File and Answer Key:

Available at www.ngsslifescience.com

Backbone

Backbone

Backbone

Backbone

Backbone

Backbone

Phosphate	Phosphate	Phosphate	Phosphate	Phosphate
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Sugar Sugar Sugar Sugar Sugar Sugar

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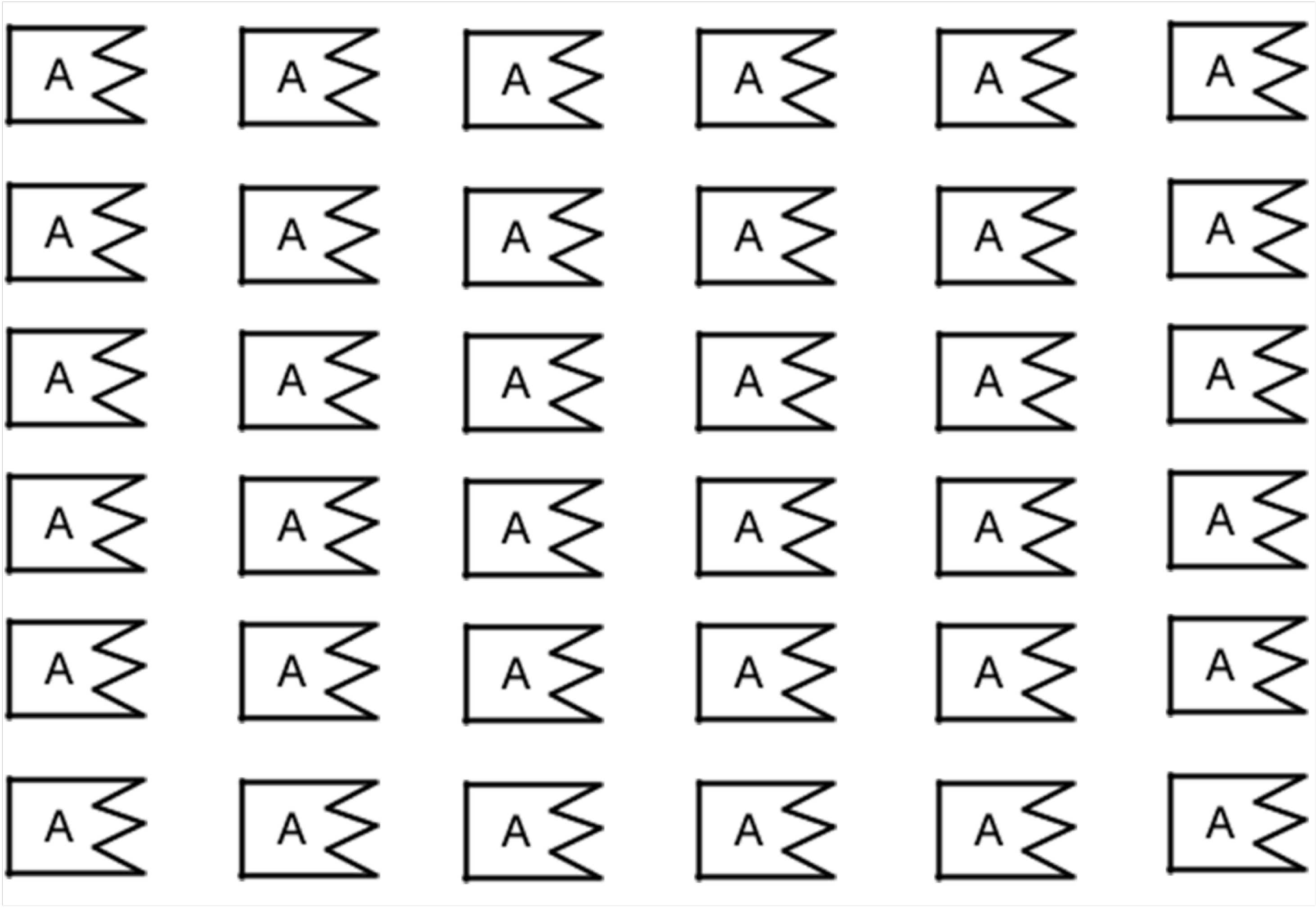
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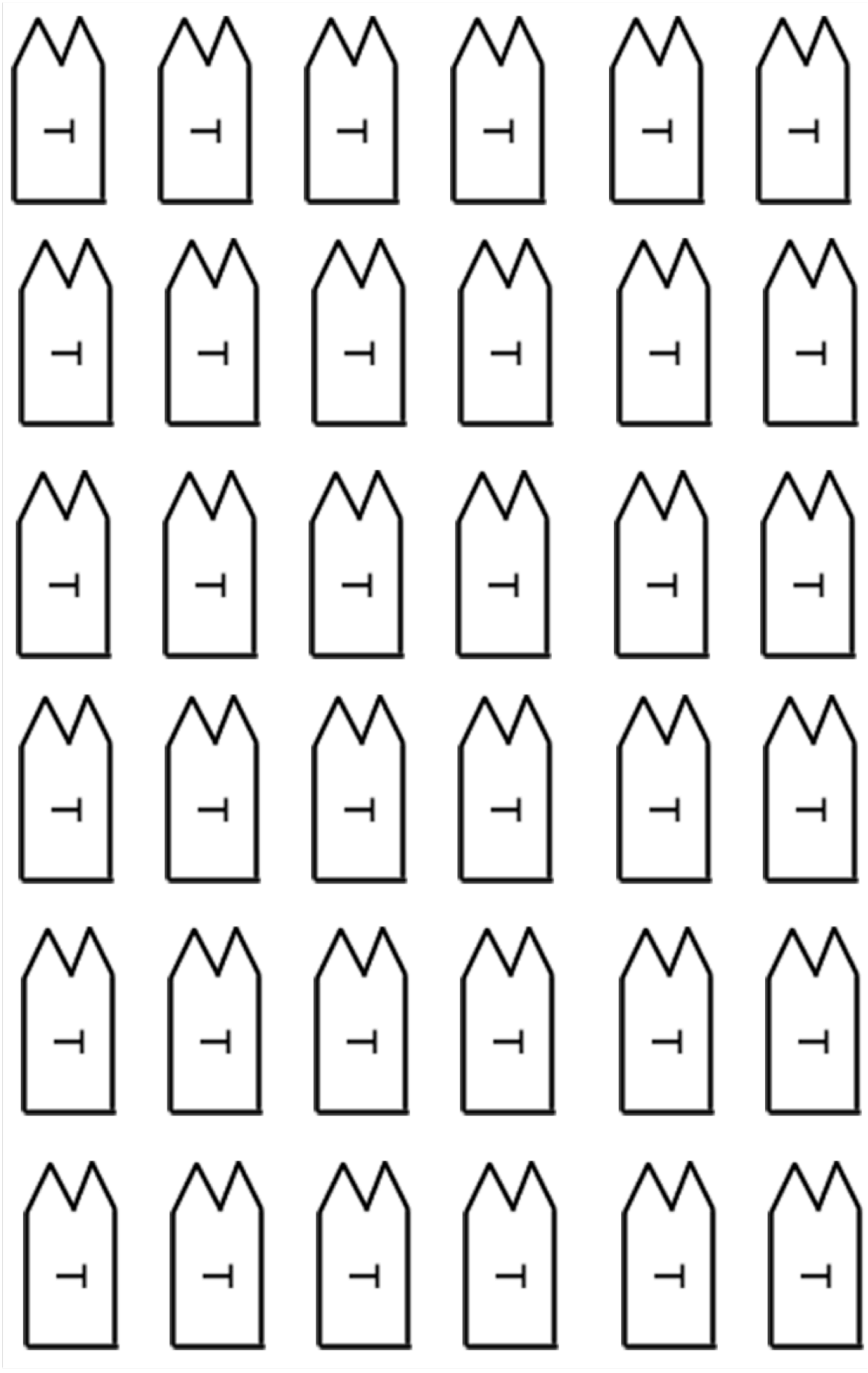

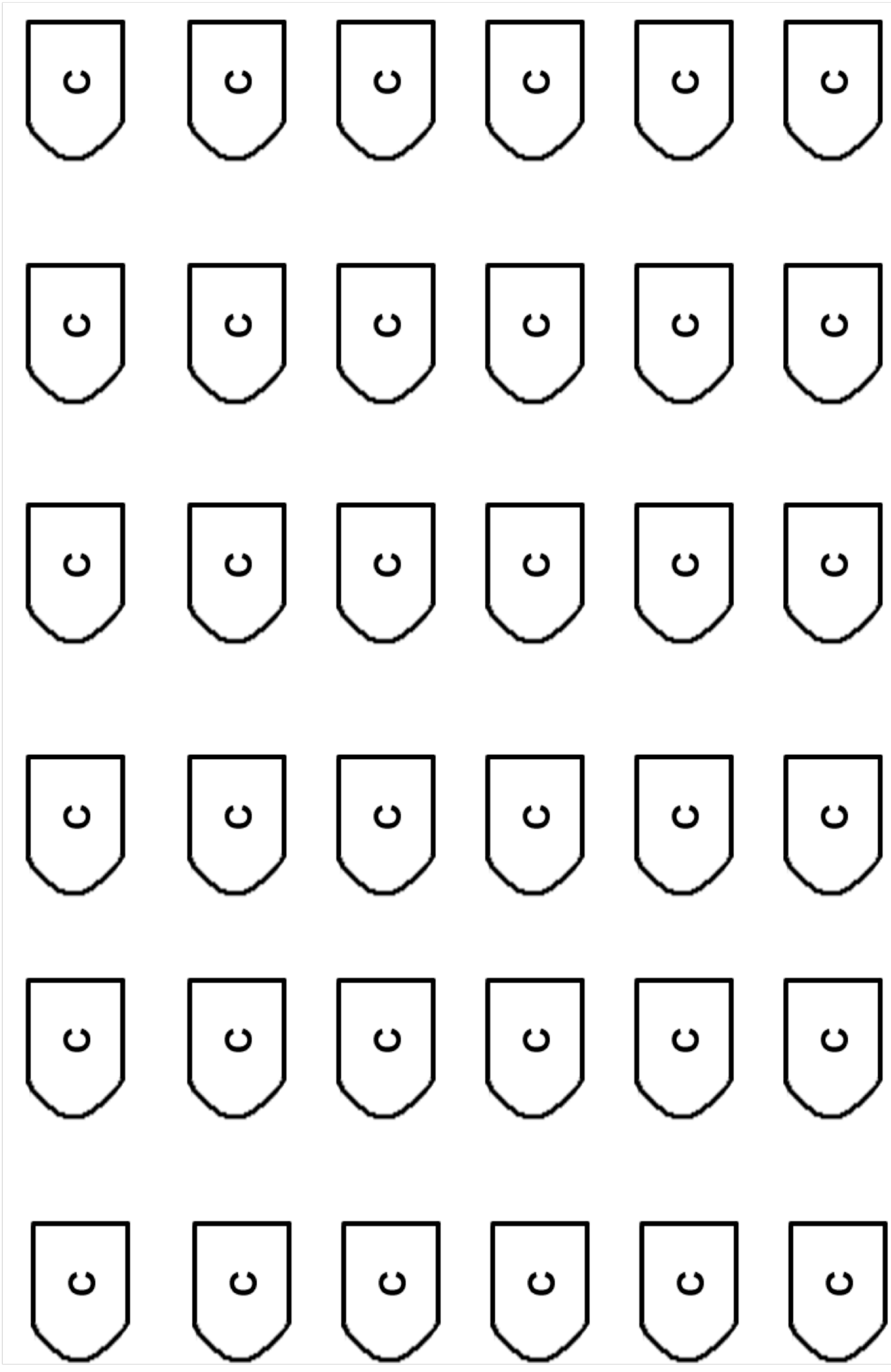
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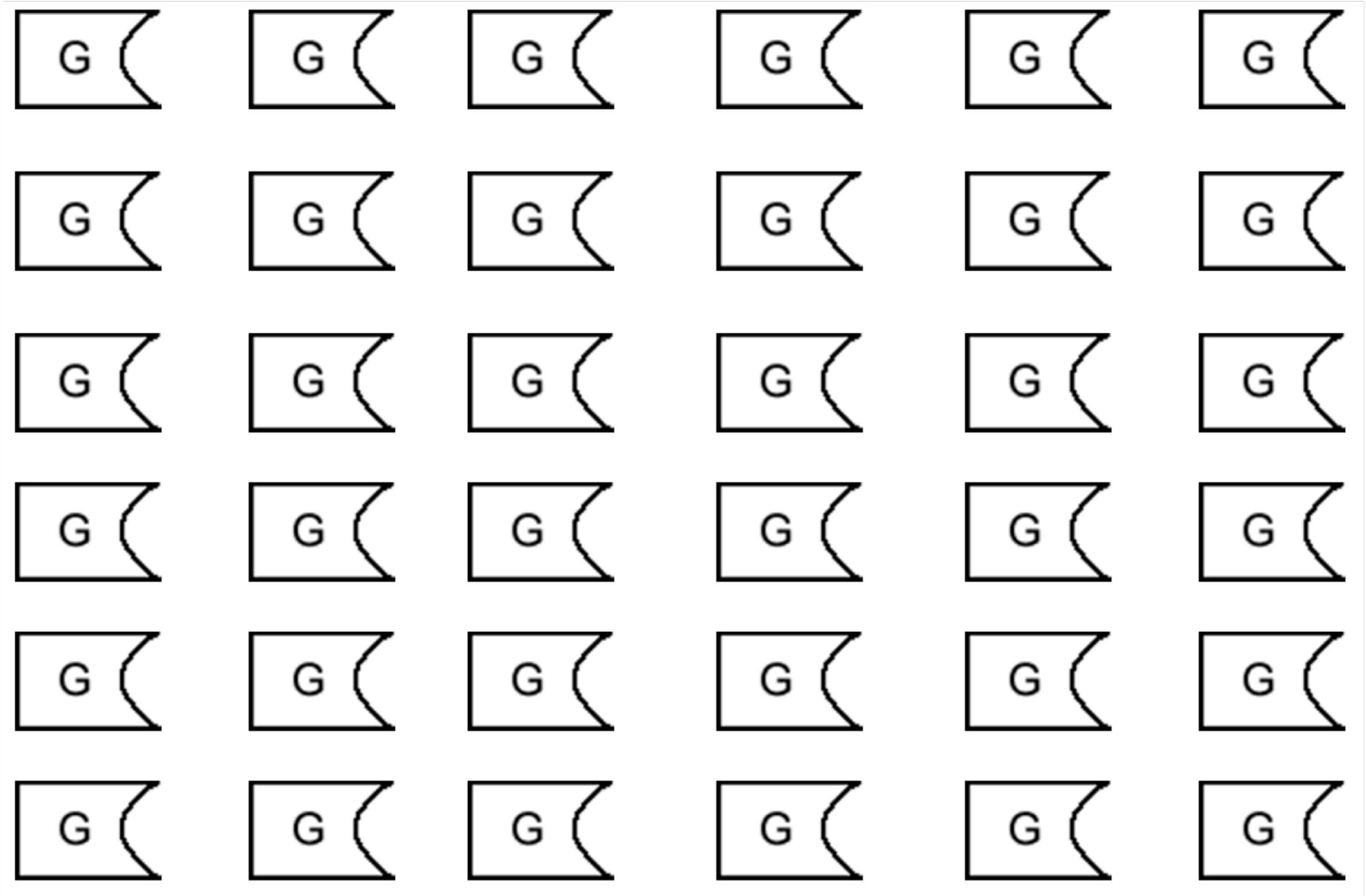
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