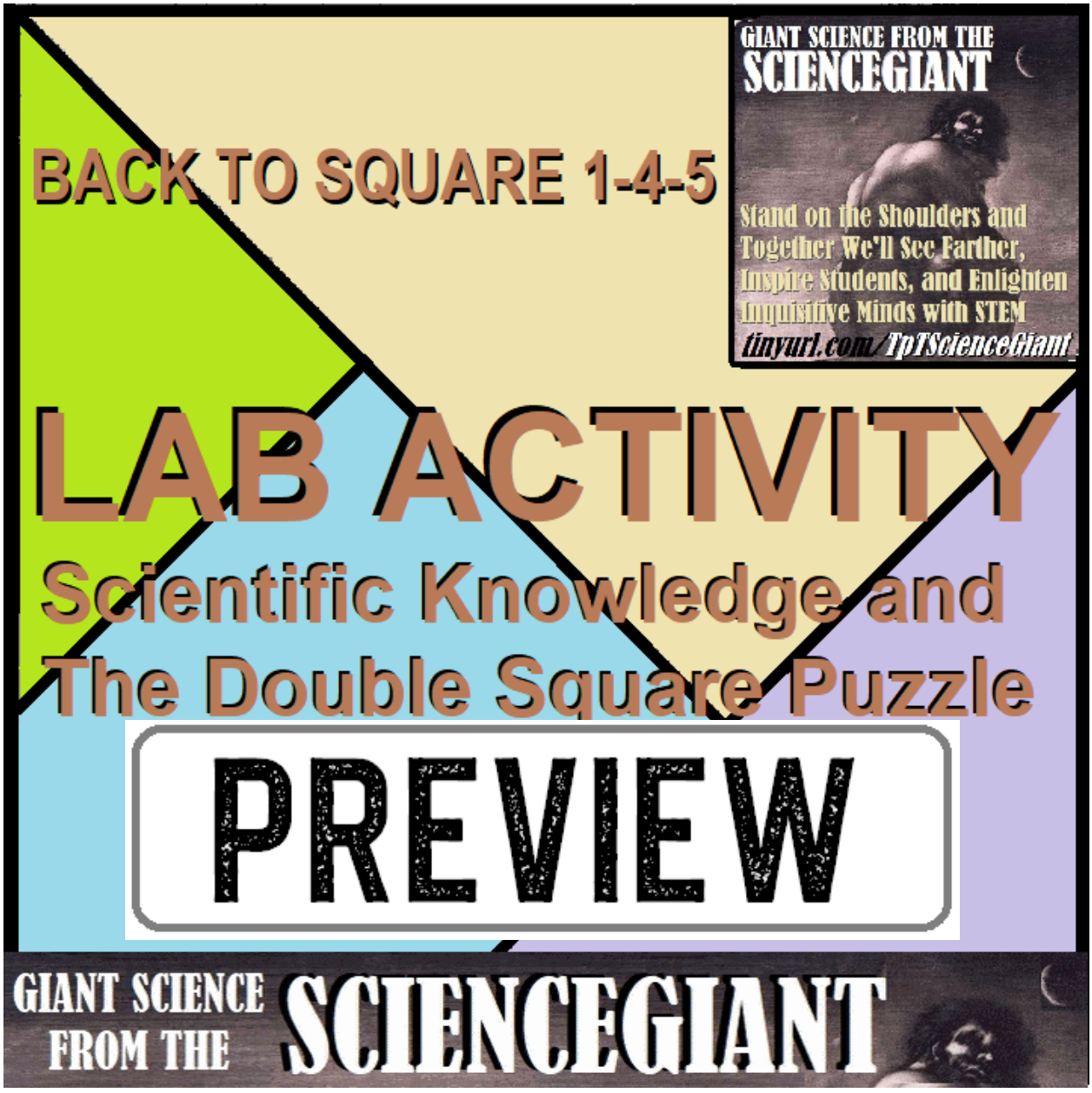
LAB ACTIVITY: BACK TO SQUARE 1 - 4 - 5
Scientific Knowledge and The Double Square Puzzle



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OBJECTIVE

The purpose of this activity is to get the students/student teams to think about the nature of science, and also, to show the importance of being an active participant in the learning process. Ss should realize that science is dynamic, and it changes as knowledge of a subject increases.

This activity uses a puzzle which includes five interfitting pieces, four of which form a square and all five of which can be interfitted to collectively form a larger square.

NGSS STANDARD

Scientific Knowledge Is Open to Revision in Light of New Evidence

Primary School (K-2)	Elementary School (3-5)	Middle School (6-8)	High School (9-12)
Science knowledge can change when new information is found.	Science explanations can change based on new evidence	• Scientific explanations are subject to revision and improvement in light of new evidence. • The certainty and durability of science findings varies. • Science findings are frequently revised and/or reinterpreted based on new evidence.	• Scientific explanations can be probabilistic. • Most scientific knowledge is quite durable, but is, in principle, subject to change based on new evidence and/or reinterpretation of existing evidence. • Scientific argumentation is a mode of logical discourse used to clarify the strength of relationships between ideas and evidence that may result in revision of an explanation.

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

Primary School (K-2)	Elementary School (3-5)	Middle School (6-8)	High School (9-12)
Science uses drawings, sketches, and models as a way to communicate ideas.	Science theories are based on a body of evidence and many tests.	● Theories are explanations for observable phenomena. ● The term "theory" as used in science is very different from the common use outside of science.	● A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence. ● Models, mechanisms, and explanations collectively serve as tools in the development of a scientific theory.

MATERIALS

- Class set of ScienceGiant small squares in a separate bag
- Set of four polygon pieces of square puzzle in a separate bag, one per student/team
- Instruction card “Back to Square 1 - 4 - 5”, one per student/team
- “HINT” cards 1 - 3, one per student/team
- Notes and Reflections sheet. Worksheet can be distributed one sheet per student/team, or cut down the middle and distribute one half-sheet per student/team who pair up.
- Timer (optional)

PREPARATION

- ➔ Copy and cut out the Instruction card “Back to Square 1 - 4 - 5”
- ➔ Copy and cut out the HINT cards 1 - 3
- ➔ Copy and cut out the Square 1 - 4 - 5. An example with pastel colors, the ScienceGiant small s… and STEM (science, technology, engineering, and math) is shown. A blank templa… …ovided, Ts are encouraged to insert their own colors, clipart, and v…
- ➔ Sepa… …wo piles: a) the ScienceGiant small squ…
- ➔ Pla…
- ➔ One per s… …zzle into seperate bags.

NOTE

“The Five Block Puzzle” first appeared in the 1934 novelty cata… …nith at a cost of ten cents. The “Double Squares” version received patent number 453… …the US government in 1985. But its inventor David Eskima, of Moore, Oklahoma, allowed the patent to expire for failure to pay the maintenance fee.

COPY AND CUT OUT, ONE PER STUDENT/TEAM

BAC[illegible] TO SQUARE 1 - 4 - 5

1. [illegible] uare using the **1** [illegible] vation.
2. [illegible]
3. Merg[illegible] make a giant sq[illegible] **5** pieces. Do NOT fold, cu[illegible] rip, overlap, *etc*. pieces.

BACK TO SQUARE 1 - 4 - 5

1. Observe a square using the **1** piece. This is an *observation*.
2. Make a square using the [illegible] **4** pieces. Do NOT fold, [illegible] *etc*. pieces.
3. [illegible] ries and [illegible] uare using all [illegible] OT fold, cut, [illegible] c. pieces.

BACK TO SQUARE 1 - 4 - 5

1. Observe a square using the **1** piece. This is an *observation*.
2. Make a square using the other **4** pieces. Do NOT fold, cut, rip, overlap, *etc*. pieces.
3. Merge both theories and make a giant square using all **5** pieces. Do NOT fold, cut, rip, overlap, *etc*. pieces.

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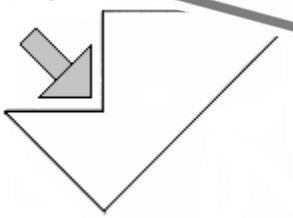
COPY AND CUT OUT, ONE PER STUDENT/TEAM ***ONLY IF NEEDED***

BACK TO SQUARE 1 - 4 - 5
HINT 1

The inside corner of this polygon piece can be filled with two pieces. But the 4-piece square has a different piece then the 5-piece square.

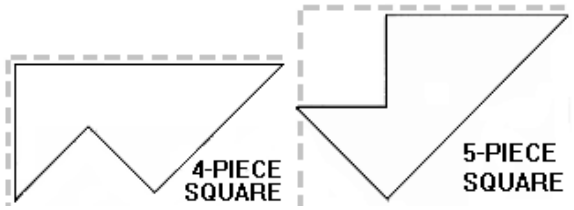


BACK TO SQUARE 1 - 4 - 5
HINT 1

The inside corner of this polygon piece can be filled with two pieces. But the 4-piece square has a different piece then the 5-piece square.

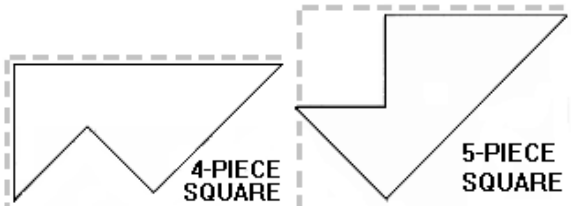
BACK TO SQUARE 1 - 4 - 5
HINT 2

It helps to be able to identify the corners. But the size of the 4-piece square has a smaller area than the 5-piece square.



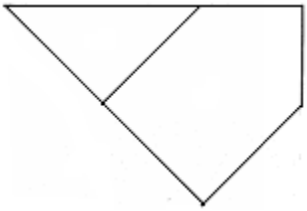
BACK TO SQUARE 1 - 4 - 5
HINT 2

It helps to be able to identify the corners. But the size of the 4-piece square has a smaller area than the 5-piece square.



BACK TO SQUARE 1 - 4 - 5
HINT 3

It helps to be able to identify the corners. These two polygons are adjacent in both the 4-piece square and the 5-piece square.



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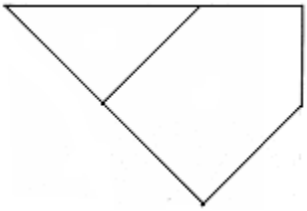


COPY AND CUT OUT, ONE PER STUDENT/TEAM AS PER INSTRUCTIONS

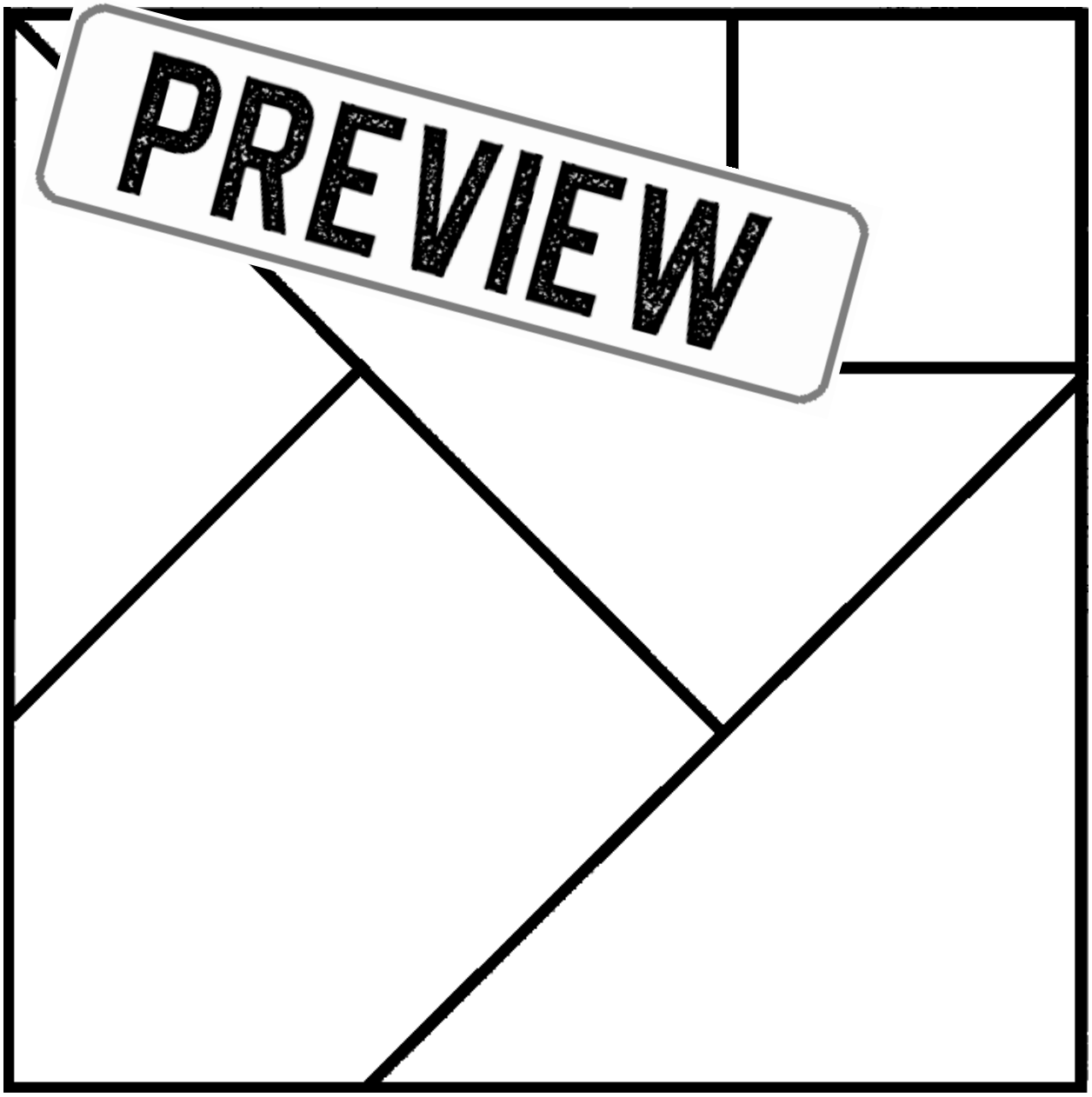
SOLUTION TO 4-PIECE PUZZLE

SOLUTION TO 5-PIECE PUZZLE

SOLUTION TO 5-PIECE PUZZLE

THIS TEMPLATE DELIBERATELY LEFT BLANK.

Ts ARE ENCOURAGED TO INSERT THEIR OWN COLORS, CLIPART AND WORDS.



ENGAGE

Hand out the ScienceGiant small square. This piece represents an observation of current scientific data. Ask Ss to complete the first challenge on the Back to Square 1 - 4 - 5 *Challenge 1. Observe a square using the 1 piece. This is an observation*.

EXPLAIN

In modern science, a scientific theory is a tested and expanded hypothesis that explains many experiments. It fits ideas together in a framework. If anyone finds a case where all or part of a scientific theory is false, then that theory is either changed or thrown out.

EXPLORE

Present students/ ith the four polygon pieces. Explain that these four are like pieces of evidence. Each p bservation of current scientific data, so all four must fit together. Ask Ss e on the Back to Square 1 - 4 - 5.
Challenge 2. M OT fold, cut, rip, overlap, etc. pieces

Encourage st If the frustration level rises, “cheating” and peeking at other arrangement, cover up the answer and set a lution.

ELABORATE

Once all or most of the Ss have arranged the pieces correctly, ask them to br on the “Notes and Reflections.” Students/Teams should be prepared to think-pair-share how this activity is similar to doing science.

Some similarities to guide the discussion include:
1) Assume that the pieces fit together. Nature is a puzzle that we are trying to solve.
2) Trial and error is an essential ingredient to science.
3) New information may require the old theory to be modified or discarded;
4) Our current information may be incomplete and therefore, our theories incorrect.
5) Sometimes, we get lucky and find the right answer.
6) Collaboration may be helpful.
7) Once we arrive at the answer, it makes obvious, even elegant sense.

EVALUATE

Discovering an exception to a scientific theory is a major event, and a scientist can become famous by discovering an exception to a rule. Einstein became famous for his theory of relativity, which found an exception to Isaac Newton's laws of motion. Newton's theory, which had been accepted for hundreds of years, had to be changed, and has been changed.

Ask students to complete the third and greatest challenge on the Back to Square 1 - 4 - 5.
Challenge 3. Merge both theories and make a giant square using all 5 pieces. Do NOT fold, cut, rip, overlap, etc. pieces.

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NOTES AND REFLECTIONS **NOTES AND REFLECTIONS**

DEBRIEF: ROLES, REASONS, RESULTS

When did I realize that I had come up with my final best solution?

How do I feel my solution relates to situations and problems?

How did I help others during this process?

DEBRIEF: ROADBLOCKS, REWARDS

What most got in the way of my progress, if anything?

How well did I and my team real-world communicate overall?

What went right and why?