What do you plan to research for your project?

<u>Problem:</u> I'm going to build a puzzle flipper that will be able to flip puzzles over easily to put puzzle glue on the back.

<u>Topics related to the problem:</u>

1) What are puzzle pieces made of?

2) *What different types of plastic are there?*

3) *How many different ways are there to flip a completed puzzle over?*

4) *What type of woods are used the most, and how heavy are they?*

5) How light is a 20x27/1000-piece completed puzzle?

Star three topics you will research during research time

ONE MAIN IDEA I SHOULD RESEARCH IS… What different types of plastic are there?
1-Pet-Plastics that belong to group number one are made out of polyethylene terephthalate or PET. It holds the number one spot because of its widespread utility. It is mostly used for food and drink packaging purposes due to its strong ability to prevent oxygen from getting in and spoiling the product inside. 2-HDPE-Technical name **- High-Density Polyethylene –** it's an incredible resistant resin used for grocery bags, milk jugs, recycling bins, agricultural pipe, but also playground equipment, lids, and shampoo bottles among others. Because it's made with long unbranched polymer chains it's much stronger and thicker than PET. Also, it is relatively hard and resistant to impact and can be subjected to temperatures of up to 120 °C without being affected. As far as its disposal is concerned, HDPE is accepted at most recycling centers in the world, as it is **one of the easiest plastic polymers to recycle.** 3-PVC-**Polyvinyl chloride** is the world's third-most widely produced synthetic plastic polymer. It comes in two basic forms: **rigid and flexible**. In its rigid form, PVC is largely used in the building and construction industry to produce **door and window profiles and pipes** (drinking and wastewater). When mixed with other substances, It can be made softer and more flexible and applied to plumbing, wiring, and electrical cable insulation and flooring.

Thanks to its versatile properties, such as lightness, durability, and easiness of processability, PVC is now replacing traditional **building materials** like wood, metal, concrete, rubber, ceramics, etc. in various applications.

Despite its many advantages and efforts made by the plastic industry to increase its reusability, PVC is still hardly recyclable and should therefore be avoided, whenever possible.

4-LDPE-Contrary to HDPE, **LDPE** is characterized by low-density molecules, giving this resin a thinner and more flexible design. It has the simplest structure of all the plastics, making it easy and cheap to produce. Used in plastic bags, six-pack rings, various containers, dispensing bottles, and most famously for plastic wraps, **is not often recycled** through curbside programs.
5-PP-**Polypropylene** is the second-most widely produced commodity plastic and its market is forecasted to grow even more in the following years. Hard and sturdy, it can withstand high temperatures and is found in tupperwares, car parts, thermal vests, yogurt containers, and even disposable diapers.

Fun fact: because it is **VERY** resistant to fatigue, PP is usually used for living hinges (the thin piece of plastic that allows a part of a product to fold or bend from 1 to 180 degrees).

6-PS-**Polystyrene is the sixth type of plastic on the list** and it can be solid or foamed. It is a very inexpensive resin per unit weight and easy to create, for these reasons it can be found everywhere: from beverage cups, insulation, packing materials to egg cartons and disposable dinnerware. Perhaps better known by its commercial name – Styrofoam – it's highly inflammable and dangerous as it can leach harmful chemicals, especially when heated (which often happens because, as it's found in disposable take-out containers, people often microwave it to heat up the food inside it).

Environmentally-speaking it's **among the worst types of plastic**: first, it is regarded as not biodegradable. Second, polystyrene foam blows in the wind and floats on water, due to its low specific gravity. Animals do not recognize it as artificial and may mistake it for food causing serious effects on the health of birds or marine animals that might swallow it.

In addition, polystyrene **is not accepted in curbside collection recycling programs** and is not separated and recycled where it is accepted. To sum up, **it's a no-go**.

7-Other plastic-If plastic cannot be identified in the six types above-mentioned, then it will be included in group number 7. The best-known plastics of this group are **polycarbonates** (**PC**) used to build strong, tough products. Polycarbonates are commonly used for eye protection in the creation of lenses for sunglasses, sport and safety goggles. But they can also be found on mobile phones and, more frequently, in compact-discs (CD).

In recent years, the use of these resins has been controversial: the basis of this controversy is their leaching that, occurring at high temperature, releases bisphenol A, **a compound that is on the list of potential environmental hazardous chemicals**. Moreover, the decomposition of BPA in landfills does not occur meaning that this chemical will be persistent in the ground and will eventually find its way into water bodies contributing to aquatic pollution. On top of this, plastics number 7 is almost never recycled.

Website Address (copy exactly):
https://www.plasticsforchange.org/blog/different-types-of-plastic

A SECOND MAIN IDEA I SHOULD RESEARCH IS… How many different ways are there to flip a completed puzzle over?

FLIPSI PUZZLING BOARD-Designed to make it easier for puzzlers to flip their puzzles over, this durable, gorgeous-to-touch board is excellent to puzzle on and perfect for storing a Flipsi Puzzle away in between sessions
Place one sturdy piece of paper/object underneath the puzzle (Object/paper should be bigger than the puzzle), put another piece of paper/object on top or hold it with your hands, flip the puzzle over, take off paper/objects, and put glue on the back. Tape two pieces of sturdy paper together, place it underneath the long puzzle, flip the tables bench over on top of the puzzle, tape the paper tightly to the bench, flip bench over, untape, and glue the puzzle together.

Website Address (copy exactly):
https://www.flipsipuzzles.com/products/flipsi-puzzling-board?srsltid=AfmBOoq7lulruqzOoxgy-NTGgFyOwMDjq6_32it4_42awcsbXYmAhjrJ
Tucson, Arizona (My dad taught me that and I couldn't find any website about it that i could use)

A THIRD MAIN IDEA I SHOULD RESEARCH IS…What type of wood are used the most, and how heavy are they?

Light colored wood like hard(Sugar) maple, white oak, birch, pine(white), ash(White), and beech offer an incredible range of options for enhancing your home and furniture.
Average dry weight-Specie Name
48 lbs/ft^3 (770)-White Oak
44 lbs/ft^3 (710)-Birch
Species-Weight per cubic ft
Maple, Sugar-56 lbs/ft^3
Pine, White-36 lbs/ft^3
Beech-54 lbs/ft^3
Ash, White-48 lbs/ft^3

Website Address (copy exactly):
https://k-timbers.com/top-7-light-colored-wood-types-properties-uses/
https://www.bellforestproducts.com/info/popups/average-dry-weight/?srsltid=AfmBOoqnKYRn5n9NCu3Sapnx1Rgi0ylkC1cRVdOHp7ST0hCfGfxsnLpE
https://sherrilltree.com/content/legacypdf/Log_WeightChart.pdf?srsltid=AfmBOooQIoBbNTHjvI41oTs_XbXErJ3zk3JMH2bcTQetIqaVy0aJhYxN

FIVE WORDS I NEED TO KNOW FROM MY RESEARCH ARE…
1)Word: Puzzle Definition: noun-a situation that is difficult to understand
Website Address (copy URL from definition website exactly – No 'Google Search'):https://dictionary.cambridge.org/us/dictionary/english/puzzle#google_vignette
2)Word: Flip Definition: If you flip something, you turn it over quickly one or more times, and if something flips, it turns over quickly
Website Address (copy URL from definition website exactly – No 'Google Search'): https://dictionary.cambridge.org/us/dictionary/english/flip
3)Word: Wood Definition: a hard substance that forms the branches and trunks of trees and can be used as a building material, for making things, or as a fuel
Website Address (copy URL from definition website exactly – No 'Google Search'): https://dictionary.cambridge.org/us/dictionary/english/wood
4)Word: Plastic Definition: **an artificial substance that can be shaped when soft into many different forms and has many different uses**
Website Address (copy URL from definition website exactly – No 'Google Search'): **https://dictionary.cambridge.org/us/dictionary/english/plastic?q=Plastic#google_vignette**
5)Word: Build Definition: **to make something by putting bricks or other materials together**
Website Address (copy URL from definition website exactly – No 'Google Search'): **https://dictionary.cambridge.org/us/dictionary/english/build?q=Build**

When puzzles are put together, there might be a reason to put puzzle glue on the back. In this case, the puzzle would have to be flipped over. Doing so is a difficult task since the puzzle pieces would fall apart easily.

That is why Puzzle Flippers were made, to help in making flipping over puzzles easier. So determining which kinds of wood are the easiest to handle, aren't very heavy, and are common enough they won't cost a lot, is what would be needed to make one of these puzzle flippers.

According to K-timbers.com, certain light colored woods, such as Sugar maple, white oak, birch, white pine, white ash, and beech, can help improve certain objects (Furniture, etc.) in a house. This can help figure out what wood would be the lightest to make a puzzle flipper out, so the flipper isn't too heavy. The lightest wood by square foot out of these is White pine, according to sherriltree.com. White pine being at 36 lbs per square foot (average dry weight), compared to the heaviest wood, according to sherriltree.com, sugar maple is weighing at 56 lbs per square foot (average dry weight). This shows what wood to use to make the flipper not as heavy as it would be if the heavier wood, sugar maple, were used instead of the lighter wood, white pine. Using the other woods wouldn't be bad also, since, according to both sherriltree.com and bellforestproducts.com, white ash and white oak both share the dry weight of 48 lbs per square foot; the next heaviest would be Beech wood, according to sherriltree.com, with Beech weighing at 54 lbs per square foot. The next lightest, according to bellforestproducts.com, would be Birch wood, weighing at 44 lbs per square foot. This shows that even if the white pine isn't available, there are still other woods that are lighter than sugar maple that could be used to make a light puzzle flipper.

According to FlipsiPuzzles.com, their product of a puzzle flipper, is an easy way to flip a puzzle over and easily apply the glue on the back using a foldable board and 2 clips. This is important to show what can be made better and differently so the puzzle flipper isn't the same as the one by FlipsiPuzzles.com. According to Kyle Wheatley in Tucson, Arizona, another way to flip a puzzle over is by putting one piece of sturdy paper that's bigger than the puzzle underneath the puzzle, putting your hand on top of it, and flipping it over. This can be shown to make a puzzle flipper that is more efficient and easier to use than this method. Once again, according to Kyle Wheatley, one way to flip a long but skinny puzzle over is to tape two pieces of sturdy paper together, place it underneath the puzzle, flip the table's bench over onto the puzzle, tape the paper very tightly to the bench, flip the bench rightside up, carefully take the paper off of the puzzle, and glue the puzzle together. This can be shown to make sure that the puzzle flipper is a lot easier to use and only requires one person to flip the puzzle instead of 2-3 people. There are more ways to flip a puzzle over; however, these are three ways that really work.

According to plasticsforachange.org, there are 6 main types of plastic and 1 other category that's for any plastic that doesn't fit into the main 6. The six main types of plastic are PET, HDPE, PVC, LDPE, PP, PS, and the last one, with the plastic that doesn't fit into the other categories. This is important because it shows how many different types of plastic there are, so when building, these plastics are known to be helpful. Once again, according to plasticsforachange.org, Pet plastic is are made out of polyethylene terephthalate or PET, and PET plastic holds the Number one spot because of all of the different ways it can be used, PET plastic is mostly used to seal food or drink in containers since it has a strong ability to prevent oxygen from getting in, HDPE plastic is short for High-Density Polyethylene, It's useful to make Grocery bags, milk cartons, recycling bins, it can also be used to make playground equipment, lids, shampoo bottles, and more, HDPE plastic is also stronger and thicker than PET plastic, It also has a big resistance to impact and can survive temperatures up to 120 °C without being damaged or affected, HDPE is one of the easiest plastics to recycle, PVC plastic is also known as Polyvinyl chloride, and is the third most widely produced plastic in the world, PVC can be used in the building and construction ideustry, as it is helpful to make door and window frames aswell as pipes (Drinking, and Wastewater), it can be mized with other materials to be soft enough and more flexible to be applied to Plumbing, Wires, insulation for electrical work and flooring, PVC plastic is starting to "Replace Materials like wood, metal, concrete, etc, for building materials, PVC plastic is hardly recyclable, so if it can be avoided, avoid it whenever possible, LDPE plastic is thinner and more flexible than HDPE plastic, LDPE plastic is easy and

cheap to produce since it has the simplest built structure of all the plastics, LDPE plastic can be used in plastic bags,rings that hold six-pack drinks, reusable bottles, plastic wrap, and certain containers, LDPE plastic is hardly recycled, however it is still recyclable, PP plastic, Also known as Polypropylene, is the second most widely produced plastic, and is foretold to grow even more the following years, PP plastic is hard and sturdy and can withstand high temperatures, it can be found to be used in, tupperware, car parts, yogurt containers, disposable diapers, and even thermal vests, and it is recyclable depending on your local recycling center, PS Plastic, also known as Polystyrene, PS plastic cAn be solid or foamed, PS plastic is a very cheap plastic due to its lightweight and it is easy to create, because of these factors, it can be found almost anywhere, such as, cups to hold a drink, packing material, to egg cartons and and disposable dinnerware(plates,utensils,etc),it is mostly known to be called Styrofoam, it is a highly inflammable and can be very dangerous, since bringHarmful chemicals, especially when heated, PS plastic is one of the worst types of plastics when it comes to the environment, since it has a low specific gravity and can easily float in the air and on top of water, it is also not biodegradable, it is recyclable,however it is not always separated, recycled, or accepted at most recycling plants. This is important because it shows which plastics are safe and easy to use when making a puzzle flipper, so the plastic won't be expensive when purchasing materials for a puzzle flipper. Based on the information at plasticforachange.org, the recyclable Plastics are PET, HDPE, LDPE (although this plastic should not be recycled), PP (although it is expensive to recycle), and the Plastics that aren’t recyclable are PVC (in normal collections), and PS is NEVER recycled, and neither is plastic category 7. This is important because it shows which types of plastics can be reused if used to build something and which plastics to recycle, and what not to recycle after using certain plastics.

There are many things to learn throughout this paper; however, the most important ones are the different types of plastic, the different types of wood most commonly used and how much the Average dry weight, and how many different ways to flip a puzzle there are. The different types of plastic, PET, HDPE, LDPE, PVC, PP, PS, and all the plastic that doesn't fit into the other 6 categories. The different types of wood are sugar maple, white oak, birch, white pine, white ash, and beech. Average dry weight, Sugar maple-56 lbs/ft^3, white oak-48 lbs/ft^3, birch-44 lbs/ft^3, white pine-36 lbs/ft^3, white ash-48 lbs/ft^3, and beech-54 lbs/ft^3. Different way to flip a puzzle over, Flipsi puzzling board, (put a sturdy paper underneath the puzzle, put hand on top of the puzzle, flip the puzzle over, put the puzzle glue on the back of the puzzle}, {Put two pieces of sturdy pieces of paper taped together underneath the puzzle, flip bench on top of the puzzle, tape the paper tightly to the bench, flip the bench over, untape the paper, put puzzle glue on the back of the puzzle}.

Sources

1. **“Average Dry Weight.” *Bellforestproducts.com*, 2025,**

   www.bellforestproducts.com/info/popups/average-dry-

weight/?srsltid=AfmBOoqnKYRn5n9NCu3Sapnx1Rgi0ylkC1cRVdOHp7ST0hCfGfxsnLpE. Accessed 17 Sept. 2025.

2. **"FLIPSI PUZZLING BOARD."** ***Flipsi Puzzles*****, 2025, www.flipsipuzzles.com/products/flipsi-puzzling-board?srsltid=AfmBOoq7lulruqzOoxgy-NTGgFyOwMDjq6_32it4_42awcsbXYmAhjrJ. Accessed 17 Sept. 2025.**
3. ***Log Weight Chart WEIGHT of a ONE-FOOT SECTION (BASED on AVERAGE DIAMETER) SPECIES*****. 1960.**
4. **Plastics for Change. "The 7 Different Types of Plastic."** ***Plastics for Change*****, 6 Apr. 2021, www.plasticsforchange.org/blog/different-types-of-plastic.**
5. **"Top 7 Light Colored Wood – Best for Woodworking – K-Timber."** ***K-Timbers.com*****, 28 May 2024, k-timbers.com/top-7-light-colored-wood-types-properties-uses/.**
6. **Wheatley, Kyle.** ***Ways to Flip a Puzzle*****. 2025.**