

Lesson 4 Tangram

Learning Objectives

Students will:

1. learn about tangrams;
2. be able to draw a tangram by inserting shapes;
3. be able to use tangram pieces to form animals, figures, letters, plants, etc.;
4. create a story based on the patterns formed with tangram pieces.

Preparation

1. Engraving materials: 3mm basswood sheets
2. **LaserBox**
3. Colored Markers

Session 1 Lead-in

You can start the lesson by describing the history and composition of the tangram.

The tangram, or *qiqiaoban* (in Chinese), is an educational toy originated from the ancient China. However, historians still don't know exactly when they were invented. Some believe that they were invented in Ming or Qing Dynasty (Mid-14th century to early-20th century), while others argue the invention can be dated back to more than a thousand years ago.

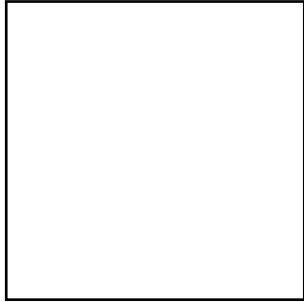
Qiqiaoban (referring to seven intriguing pieces in Chinese) consists of five isosceles right triangles (two small, one medium, and two large ones), one square, and one parallelogram. Amazingly, these seven pieces can make at least 1600 designs, including numbers, English letters, human figures, animals, plants, buildings, etc.



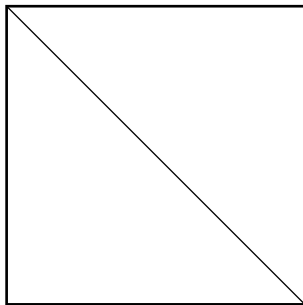
Session 2 Draw a Tangram

Demonstrate how to draw a tangram in the **laserbox** software.

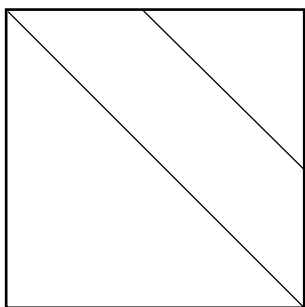
Step 1 Draw a 70mm*70mm square.



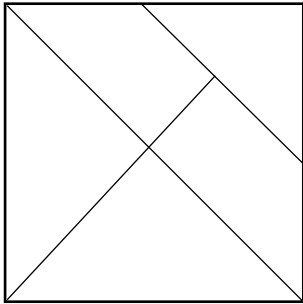
Step 2 Draw a diagonal line from the top left corner to the bottom right corner, creating two triangles.



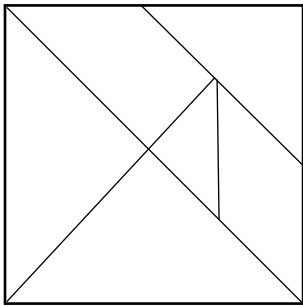
Step 3 Draw a line from the midpoint of the top side and stop at the midpoint of the right side.



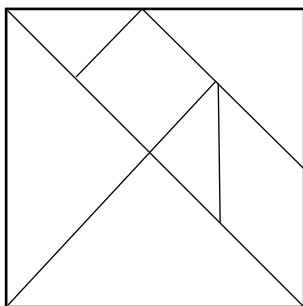
Step 4 Draw a line from the bottom left corner through the center of the first line and stop at the second line you just drew.



Step 5 Start a line from the end point of the third line (the point where the second line and third line meet), and draw it downward until it meets the diagonal line (the first line).




Step 6 Again, start a line from the midpoint of the top side, but this line will be vertical to the diagonal line. Stop when the line meets the diagonal line.



Session 3 In-class Task

Have students work in pairs and draw a tangram following the steps above. Process students' tangrams with **LaserBox** when they finish drawing.

Demonstrate

- Draw a tangram by following the instructions above.
- Select "3mm basswood" in the software. (Alternatively, you can adjust parameters based on the materials used in this session.)
- Click the **Start**  icon at the top right corner of the software.
- Press the **Start** button on the laser cutter.



You can name some shapes that can be formed with the tangram pieces when the device cuts out students' tangrams. Then explain the rules of playing tangram. For example, the seven pieces of a tangram must be all used when you make a design; each piece has to have contact with at least one of the others, while no overlapping lies between any of them. It's a fun task: make stories based on the tangram shapes. You can start the task by telling one of your stories.

Encourage students to make tangram designs based on the story as it goes.

One day, Grandpa and Jane play tangrams under a peach tree. "Grandpa, let's tell a story based on tangram foxes," said Jane. Grandpa then made two different foxes with the tangram pieces. Seeing the foxes, Jane clapped and urged Grandpa to start the story. Then the story of two foxes began:



Once upon a time, there were two foxes, Ginger and Amber. They were friends, they played but also competed with each other every now and then. They got on until one day the rivalry almost killed their friendship.

That day, they were resting under a willow before starting a brag battle about their magic power.

"I can turn myself into a rabbit in just a blink. I bet you can't do that, " Amber boasted.

"Of course I can!"

"I doubt that. Whatever, just watch," Amber changed into a rabbit the second she finished.



"That's all?" mocked Ginger, "I can surely do much better than you do". Then he turned himself into a dog.



Ginger looked and acted like a dog, showing his teeth and wagging his tail. "Oh, I like rabbits. I'm going to catch you, then eat you up," he barked, throwing a fierce look at Amber.

Ginger approached Amber, closer and closer. Scared, Amber kept backing away from

Ginger, her eyes wide open. Then an idea hit her: what if I climb up the willow?

Then a long hairy tail appeared but the rabbit ears disappeared. Amber turned herself into a squirrel!



The squirrel Amber climbed up the tree as fast as lightning.

"Sly Ginger may change into a cat and climb up as well," Amber murmured, "but he's not going to get me. I can jump between trees, he's never going to catch me."

Amber read Ginger's mind. Ginger did think about changing into a cat, but he also expected that might be what Amber had been expecting. "What can I do to scare her?" Ginger thought to himself. "Oh, right! Why not swoop down to catch her?", saying this, he turned into an eagle.



Ginger hovered above the willow, hunting for Amber. At the same time, Amber was scanning for Ginger through the leaves and withies.

Round after round, hovering Ginger eventually found Amber.

Ginger screamed and swooped down to grab Amber.

Ginger's razor-sharp beak seemingly to pierce her any time, Amber was so scared that her whole body was shivering.

"If I stay in a rock-hard shell, I'll survive his attack!" Amber assured herself.

Amber turned into a turtle and jumped into the river from the willow as soon as Ginger stretched out his talons.



Amber crawled onto a stone in the middle of the river. She felt safe as she was well camouflaged, looking like part of the stone. However, Ginger, after hovering and scanning, still spot Amber. He then fired another shot, swooping down to Amber.

That was close! But Amber jumped into the water as fast as she can.

"If you jump in, you'll drown yourself," shouted Amber.

Unconvinced, Ginger said, "Let's see," then jumped into water.

He changed again. But this time he became a predator with a long body covered with scales. His huge tail slapping the water, his toothy mouth wide open, Ginger changed into a crocodile.



Amber kept diving towards the river bottom while Ginger was chasing after her. Ginger bit Amber with his sharp teeth as soon as reaching her.

"Got you!", Ginger hissed through clenched teeth.

"No! Not yet, " shouted Amber. Then she started to shrink and turned into a goldfish.

Luckily, she escaped Ginger's jaw.



Amber hid herself among the water weeds. Wagging his giant tail, Ginger scanned around for Amber. She knew Ginger wouldn't give up.

I should fly away, she thought.

Then she changed into a swan.



Ginger tried to catch Amber. Before he got her, she spread her wings and flew to the sky.

Ginger saw Amber land on an island where there was a flock of swans looking for food. Great. He was furious and starving. He was going to eat a swan even though that wasn't Amber. Then he dived, sneakily approaching the flock.

Seeing Ginger getting closer and closer, Amber cried to warn other swans of danger. The flock flew away when they heard Amber's cry. By the time Ginger reached the island, the swans had all gone.

Surprisingly, his fury faded with the swans flying away farther and farther.

"Why are we playing this silly game?" mourned Ginger, "I don't want to see Amber anymore."

He closed his eyes, leaving his body sink. All of a sudden, he had second thoughts. Then he changed into a swan and flew to the sky.

Ginger flew as fast as he could to catch up with Amber and the flock. They were so far away at first that he couldn't see or hear them. But he didn't give up, and kept on flying to his last breath.

Every time he flapped his wings, he felt closer to Amber. Finally, he reached Amber.

"I want to quit this silly game!" cried Ginger. "Come back, back to our place, to the willow."

Amber was just about to utter when something shot Ginger's right wing. He started to fall.

A man was hunting swans! Amber flew to Ginger as fast as she could, put her left wing under Ginger's right one, preventing him falling. They then escaped to a forest together.

The hunter was still chasing after them.

"Just go," Ginger cried to Amber, "Save yourself, just go, go!"

"No, I won't go anywhere without you," sobbed Amber.

"Rooaaarrr!" A loud roar penetrated. Amber transformed herself to a lion, scaring the hunter away.



In the end, Ginger and Amber changed back to foxes and went back to their willow. They were as good as before and lived happily ever after.

"Have they played that game since then?" asked Jane.

"Yes, many times," Grandpa answered, "But they played very carefully and avoid hurting each other."

"It's a fun story," said Jane, "Let's make another one!"

Grandpa re-arranged the tangram pieces. Soon a design showed.



"Is it a story about people?" asked Jane.

"Yes," said Grandpa, "It's a story about an old man. He was tired and resting under a willow."

"Like Grandpa, isn't he?" said Jane.

"Yes, like me," replied Grandpa.

Jane then arranged her tangram pieces, made a shape and put it beside Grandpa's.



"Is this a little girl?" asked Grandpa.

"Yes!" answered Jane. "She's like me, sitting beside her grandpa."

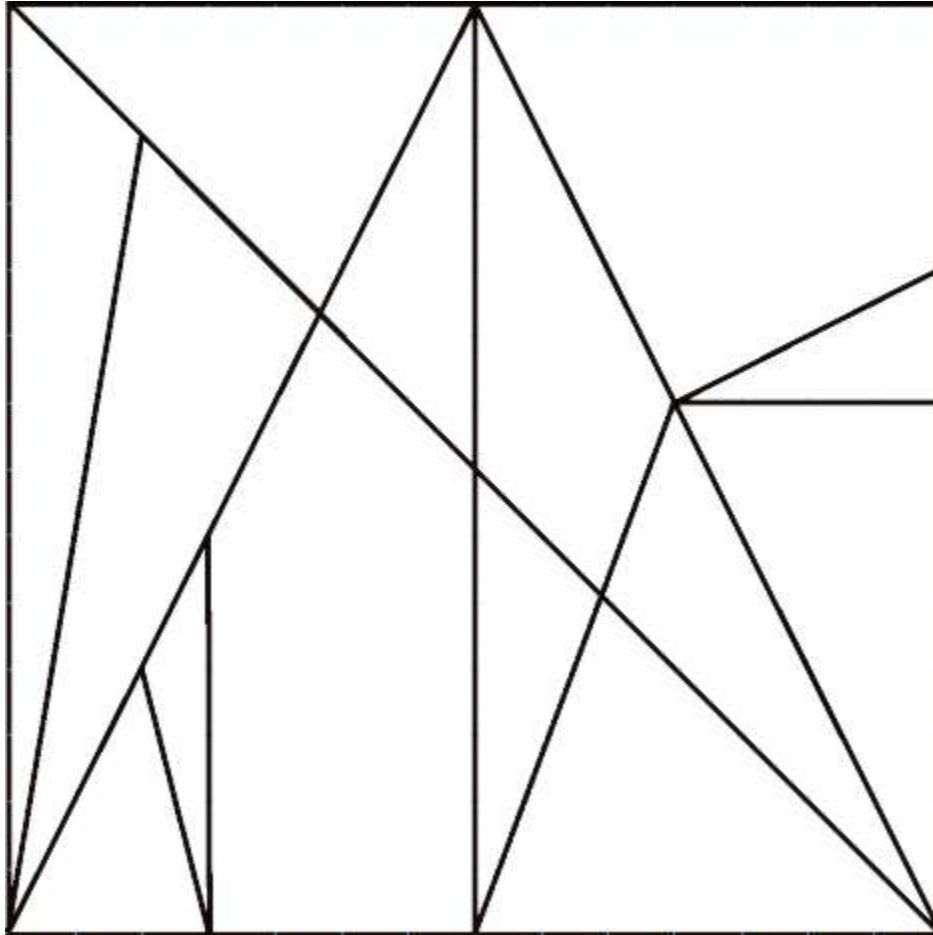
"Oh, I'm sure her grandpa is very happy," smiled Grandpa.

When you finish the story, have students work in pairs and task them with the following activities: (There are four tasks listed below. You can assign any of them to students based on the session plan.)

1. Use your tangram pieces to form the shapes mentioned in the story.
2. Color your tangram.
3. Stretch your imagination and use the tangram to make designs, such as figures, letters, animals, people and buildings.
4. Write a story based on the shapes you make and share your story with the class.

Session 4 Extension

Archimedes' *Stomachion* is a Greek mathematical puzzle similar to the tangram. You can cut a square following the pattern below to make a *Stomachion*.



Strikingly, mathematicians who study combinations found that there are 17,152 solutions to the *Stomachion*. Similar to the tangram, the *Stomachion* pieces can be used to make various shapes.

You can encourage students to make a *Stomachion*, solve the puzzle, and make designs with its pieces.