# Appendix III A Lesson Example: Introduction to Triangles and Their Properties

00:01 Teacher (showing a picture of the Eiffel Tower): Do you know this? It was introduced in your geography class.

00:09 Students (all answers): Eiffel Tower, in France.

00:14 Teacher: What does this iron tower look like? Let’s take a look (part of the method). What are the shapes of these structures?

00:40 Student A: This tower looks like a triangle, and these steel bars also use a lot of triangular structures.

01:01 Teacher: Very good, very careful observation. So, what role do you think the triangle plays in the design of the Eiffel Tower?

01:29 Student B: The triangle can keep the tower stable and prevent it from deforming or collapsing.

01:41 Teacher: Great! So, what other application examples of triangles have you seen in your life?

01:55 Student C: I have seen some furniture at home that also has a triangular structure, such as chair legs.

02:02 Student D: The building also appears. The windows and decorations of some buildings are also triangular.

02:09 Teacher: Very good, you are very observant. So, can we summarise what a triangle is? How should we define a triangle?

02:50 Student E: A triangle has three sides and three angles, and its shape is very stable. A pattern with three line segments is a triangle.

03:09 Teacher: The triangle is indeed a geometric figure with stability and fixity. (Continue to show the enlarged version of the Eiffel Tower PowerPoint) Are these triangular brackets composed of three random iron rods? I gave each of you three wooden sticks before. Imagine that these are equivalent to the brackets of an iron tower. Can they be formed into a triangle?

03:30 Students: (playing with the sticks and found that they cannot form a triangle).

04:18 Student F: This stick is too long and cannot form a triangle.

04:29 Teacher: No, Mo Han said that a pattern with three line segments is a triangle. So why can’t a triangle be made with three wooden sticks? Is there something wrong with the definition of triangle mentioned by Mo Han?

04:50 Student G: I don’t think the pattern of three-line segments is necessarily a triangle. The three line segments must be surrounded.

04:59 Teacher: In other words, there are three line segments, and their endpoints are connected in order to form a triangle, right?

05:06 (Students nodded)

05:08 Teacher presents a PowerPoint slide): We can turn to page 17 to see the definition of a triangle (students read aloud). A figure composed of three line segments that are not on the same straight line and connected end to end is called a triangle. How is this definition different from what Mo Han said?

05:57 Student G: The definitions in the book are so long and rigorous. You can tell the correct answer at a glance.

06:02 Teacher: You can circle “end to end in sequence” and “not on the same straight line”. When you see this definition later, you can remember that we did not spell a triangle when we spelled the sticks today, so we need to add these word restrictions. one time. So we can see how many sides does the triangle have?

06:09 Students (all answers): Three.

06:10Teacher: How many corners are there?

06:12 Students (all answers): Three.

06:13 Teacher: How many vertices are there?

06:15 Students (all answers): Three.

06:17 (The teacher marked the three vertices A, B, and C of the triangle on the PowerPoint slide) Teacher: Can you tell me which three sides, which three angles, and which three vertices?

06:27 Student I: The three vertices are point A, point B, and point C. The three sides are line segments AB, line segment AC, and line segment BC. The three angles are angle A, angle B, and angle C.

07:02 Teacher (show a PowerPoint slide: vertices: point A, point B, point C; sides are line segments AB, line segment AC, line segment BC; angles: ∠A, ∠B, ∠C) Very good. Do you remember this symbol ∠? Represents angle. We can also use the three vertices of a triangle to represent a triangle (show a PowerPoint slide: triangle ABC, written as △ABC). Next, we have to look at what many kinds of triangles look like.

07:30 (The teacher took out my spare tripod and showed it.) Teacher: Look at the tripod used by Mr. Ren to record videos. This tripod forms a triangle. What are its characteristics?

07:39 Student F: Each leg of the tripod is the same length, which makes it very stable.

07:48 Student G: Also, the two sides of this tripod are the same length, and the angle with the floor is also the same.

07:59 Teacher: Yes, we can draw the kind of triangle we see in life. (Draw an isosceles triangle on the blackboard). As Haochen said, the two sides of this kind of triangle are the same length, and the two angles are also the same size (point out). This is called an “isosceles triangle” in mathematics (show the PowerPoint slide and write it on the blackboard at the same time). You can look at the definition in the book (students turn to the definition of an isosceles triangle in the book and circle it).

09:01 Teacher: Let’s take another look at the isosceles triangle formed by this tripod. What are its characteristics?

09:12 Student C: An isosceles triangle has two sides of the same length and two angles that are also equal.

09:18 Teacher: “Very good! We call this kind of “waist”, just like a person’s waist, it is the supporting part. This is the property of an isosceles triangle: the two waists of an isosceles triangle are equal, and the corresponding two angles are also equal.

09:24 Student C: I understand; that’s why it’s called an “isosceles” triangle.

09:34 Teacher: (The teacher took out the triangle iron) Dear all of you, I got this from the music teacher. You practised it last week. Do you remember what it is?

09:39 Students: Answer together, triangle.

09:44Teacher: Is this triangle an isosceles triangle?

09:47 Students: Yes——

09:49 Teacher: Is there anything special about it?

09:54 Student H: I think you can use a ruler to measure it. I think all three sides are equal.

09:59 Teacher: Okay, do you have a ruler? Can you come over and measure it?

10:02 Student H: (walked to the stage with his ruler and said to other students): I measured the three sides, and they were almost 15 centimetres.

11:14 Teacher: It seems that all three sides of this triangle are equal. Dear all of you, this is called an “equilateral triangle” (show the PowerPoint slide and write it on the panel under “Isosceles”). What does the book say? (Students turn to the definition of equilateral triangle in the book and read it aloud together)

12:16 Teacher: Are the angles of an equilateral triangle really 60 degrees? In the textbook, you can use a protractor to measure the equilateral triangle.

12:27 (At the same time, the teacher asked student H to measure the angle of the triangle, which was 60 degrees)

12:53 Teacher: The PowerPoint slide shows the properties of an equilateral triangle: all three sides are equal, and each angle is 60 degrees.

12:59 Teacher: Just now, we also used the triangle ruler in my hand to measure the size (show the triangle ruler) to see what characteristics this triangle has.

13:20 Student I: I noticed in the book that it was a right triangle.

13:31 Teacher: So, what are the characteristics of a right triangle?

13:38 Student D: A right triangle has a 90-degree angle.

13:44 Teacher: Yes, a right triangle has a right angle. So, besides this right angle, can you find any other properties?

15:40 Teacher (present the PowerPoint slide, students read aloud) (Classification of triangles:

Classification based on side length relationship: equilateral triangle, isosceles triangle, scalene triangle.

Classification is based on angular relationships: acute triangle, right triangle, and obtuse triangle.

Properties of triangles: 1. Stability)

17:22Teacher: What exactly does the stability of this triangle mean? Let’s show it with a wooden stick. (The teacher begins to build a triangular frame with wooden sticks)

17:58 Teacher: Look at this triangle. No matter how I shake it, this triangle frame can maintain a stable shape and is not easily deformed.

18:20 Student A: Wow, it’s really stable!

18:22 Teacher: Yes, this is the stability principle of triangles. So, do you know why triangles have this stability?

18:31 Student J: It’s because the three sides of the triangle support each other, forming a stable structure.

18:39 Teacher: Very good! The three sides of the triangle do support each other, forming a stable structure. Now, let’s compare quadrilaterals. (The teacher began to build a quadrilateral frame with wooden sticks)

18:50 Teacher: You see, this quadrilateral frame is easily deformed and is not as stable as a triangle.

18:59 Student C: I discovered that a quadrilateral does not have stable support like a triangle.

19:20 Teacher: What a great observation! A quadrilateral does not have a solid support like a triangle, so its shape changes easily. This is why we often see the application of triangular structures in real life, such as bridges, buildings, etc.

19:31 The teacher shows the PowerPoint slide: (Property 2 of a triangle: the sum of any two sides of a triangle \_\_\_\_\_ the third side, the difference between any two sides \_\_\_\_\_ the third side.)

19:42 Teacher: It’s okay, let’s give an example. Just now, we used three wooden sticks to discover that they cannot form a triangle. The lengths of these three sticks are 3 cm, 4 cm and 8 cm respectively. So why not form a triangle?

19:58 Student C: No, because 3 plus 4 equals 7, which is less than 8, so it cannot form a triangle.

20:40 Teacher: Great! The sum of any two sides must be greater than the third side; otherwise, a triangle cannot be formed. Then, in turn, the difference between any two sides must be smaller than the third side. This is also to ensure that the three sides can form a closed figure.

20:52 Students: (The teacher shows the PPT to fill in the blanks, and the students read aloud) The sum of any two sides of a triangle is greater than the third side, and the difference between any two sides is less than the third side.

21:11 Teacher: Next, we can design a small, stable structure based on this property, such as a bookshelf. How will you use the stability of the triangle?

21:30 Student G: We can add some triangular supports to the bottom of the bookshelf so that it won’t fall over easily.

21:37 Teacher: You can take out the long paper sticks given out before class. How to cut it to make such a support frame? Please discuss it in your group.

21:44 (Students began to discuss in groups and design a stable structure, and the teacher patrolled for guidance)

22:30 Student C: We can first determine the size of the bookshelf and the position of the support frame and then use mathematical formulas to calculate the length and angle of the support frame to ensure that they can form a stable triangular structure.

23:38 Teacher (inspection guide): Note that the stability principle of the triangle must be fully considered during the design process to ensure the stability of the structure.

26:32 (Students completed the design and began to present) Student D: We designed a simple support frame with four triangular support frames at the bottom. By calculating the length and angle of the support frames, we ensured that they could form a stable structure.

27:46 Student I: The properties of triangles we just learned are useful when cutting paper sticks because, after our group discussion, we decided to cut the 15cm stick into 4cm, 4cm and 7cm. Such a triangle is more flat and stable. Cutting like this can also ensure that the sum of the two sides is greater than the third side and the difference between the two sides is less than the third side.

29:32 Teacher: In this way, when we do questions in the future, we can build a support frame just like we did today. We only need to know the lengths of three line segments to know whether a triangle can be formed.

30:08 Teacher (show exercise in the PowerPoint slides): Determines which of the following groups of line segments can form a triangle.

(1) a=3cm, b=4cm, c=5cm

(2) a=4cm, b=5cm, c=9cm

(3) a=5.5cm, b=8cm, c=3.5cm

30:10 (Students answer independently)

34:28 Teacher: (show exercise in the PowerPoint slides): As shown in the figure, in triangle ABC, AB=6, AC=4, if BC is an even number, what is the possible length of BC?

34:30 (Students answer independently)

39:49 Class is over.