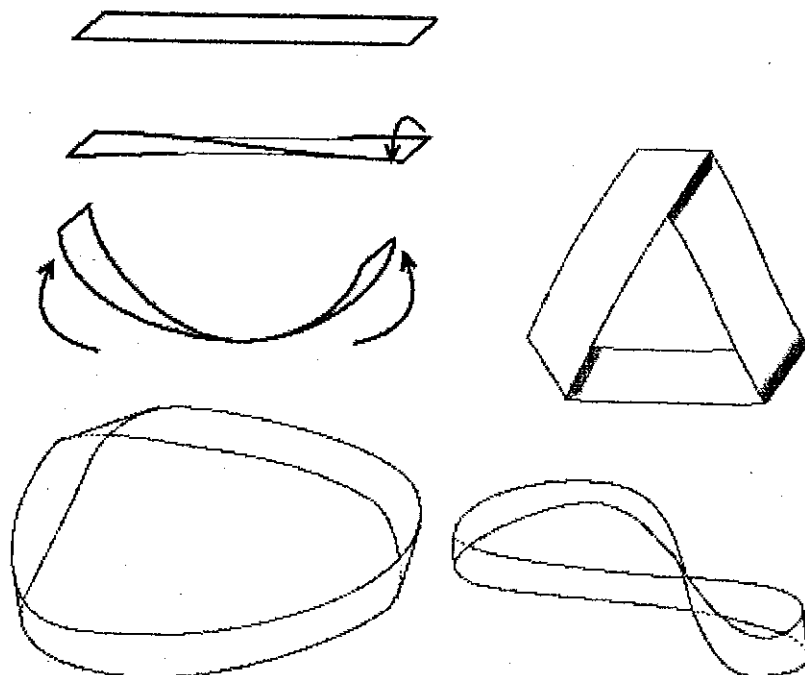


1. Have a look at the picture and tell me what it is.



1. Giving instructions. In pairs, try to write down the simple instruction for the construction of this object, following the steps depicted in the picture.

Expressions you can use: to twist, to join the ends, to stick one end to the other, to bend.

a).....

b).....

c).....

2. What happens if you twist the strip twice?

3. What are the characteristic properties of this object?

4. Read the text, fill in the missing words, and decide whether the statements are true or false.

experiments    construction    middle    observation    form    properties

**The Möbius strip** (from Wikipedia, the free encyclopedia)

The Möbius strip is a 1. .... which has some very strange properties. It is named after Möbius (1790 – 1868) who first wrote about it in 1865 in a book called *Über die Bestimmung des Inhaltes eines Polyeders*.

The 2..... of the Möbius strip can most easily be discovered by 3..... To do this, take a long strip of paper. Now twist it once. Finally stick one end of the paper to the other.

Now you can try a few 4..... with this Möbius strip. If you try to color only one surface of the strip, you will find that it is impossible. Drawing a continuous line along the 5..... of the strip produces a line on both sides of the paper. By cutting along this line, we would expect to divide the strip into halves, but in fact we 6..... a longer, thinner strip which is still one piece.

- a) A Möbius strip has only one surface.
- b) A Möbius strip has two edges.
- c) A Möbius strip is a three-dimensional figure.
- d) Observing a Möbius strip is the easiest way to discover its properties.
- e) Sticking together the ends of a twisted rectangle produces a Möbius strip.

5. Read the text on Topology and answer the following Qs.

- a) What examples of deformations are mentioned in the text?
- b) What does the word topology mean, where did it come from?
- c) What are the most important subfields in topology?
- d) What is a topological space?
- e) Where do compactness and connectedness belong within topology?

6. Read the text again and try to summarize each paragraph in one sentence.

- a).....
- b).....
- c).....
- d).....

## Topology (from Wikipedia, the free encyclopedia)

**Topology** (from the Greek τόπος, “place”, and λόγος, “study”) is a major area of mathematics concerned with spatial properties that are preserved under continuous deformations of objects, for example deformations that involve stretching, but no tearing or gluing. It emerged through the development of concepts from geometry and set theory, such as space, dimension, and transformation.

Ideas that are now classified as topological were expressed as early as 1736, and toward the end of the 19th century a distinct discipline developed, called in Latin the *geometria situs* (“geometry of place”) or *analysis situs* (Greek-Latin for “picking apart of place”), and later gaining the modern name of topology. In the middle of the 20<sup>th</sup> century, this was an important growth area within mathematics.

The word *topology* is used both for the mathematical discipline and for a family of sets with certain properties that are used to define a topological space, a basic object of topology. Of particular importance are *homeomorphisms*, which can be defined as continuous functions with a continuous inverse. For instance, the function  $y = x^3$  is a homeomorphism of the real line.

Topology includes many subfields. The most basic and traditional division within topology is **point-set topology**, which establishes the foundational aspects of topology and investigates concepts inherent to topological spaces (basic examples include compactness and connectedness); **algebraic topology**, which generally tries to measure degrees of connectivity using algebraic constructs such as homotopy groups and homology; and **geometric topology**, which primarily studies manifolds and their embeddings (placements) in other manifolds. Some of the most active areas, such as low dimensional topology and graph theory, do not fit neatly in this division.

**7. Now read the short text on one of the important concepts in Topology, homeomorphism, and decide whether the statements are true or false.**

- a) Topological isomorphism and bicontinuous function are synonyms.
- b) Two spaces with a homeomorphism are identical.
- c) A topologist can not distinguish between a cup and donut since he is not very good at cooking.
- d) Henri Poincaré thought that the relations between object are more important than their shape.
- e) Homeomorphism is a more general term than isomorphism.

## Homeomorphism (From Wikipedia, the free encyclopedia)

In the mathematical field of topology, a **homeomorphism** or **topological isomorphism** or **bicontinuous function** (from the Greek words ὁμοιος (*homoios*) = similar and μορφή (*morphē*) = shape, form) is a continuous function between two topological spaces that has a continuous inverse function. Homeomorphisms are the isomorphisms in the category of topological spaces — that is, they are the mappings which preserve all the topological properties of a given space. Two spaces with a homeomorphism between them are called **homeomorphic**, and from a topological viewpoint they are the same. Roughly speaking, a topological space is a geometric object, and the homeomorphism is a continuous stretching and bending of the object into a new shape. Thus, a square and a circle are homeomorphic to each other, but a sphere and a donut are not. An often-repeated joke is that topologists can't tell the coffee cup from which they are drinking from the donut they are eating, since a sufficiently pliable donut could be reshaped to the form of a coffee cup by creating a dimple and progressively enlarging it, while shrinking the hole into a handle. Topology is the study of those properties of objects that do not change when homeomorphisms are applied. As Henri Poincaré famously said, mathematics is not the study of objects, but instead, the relations (isomorphisms for instance) between them.

# AlgTop0a: Introduction to Algebraic Topology

<http://www.youtube.com/watch?v=jrXPFIJ3XCo>

## Pre-listening

- 1) What kind of a shape is a torus?
- 2) What do you know about Algebraic Topology?
- 3) What is a manifold?

**Listening.** Listen to and watch the video and fill in the missing parts of sentences.

- 1) Algebraic Topology developed from the .....century work in .....theory.
- 2) Henri Poincaré established .....for the subject.
- 3) Recently Poincaré Conjecture has been solved by .....
- 4) Algebraic Topology is concerned with ..... and how to .....
- 5) It is connected to .....
- 6) The new topics of a course will be .....
- 7) The most fundamental 3-dimensional manifold is .....
- 8) The shape professor drew is a .....
- 9) Group theory is .....
- 10) If the students are not familiar with the group theory, they should .....