Puzzle Topic
Visual illusions, impossible figures

Puzzle Question
How many blocks would it take to make the tri-bar in the picture?

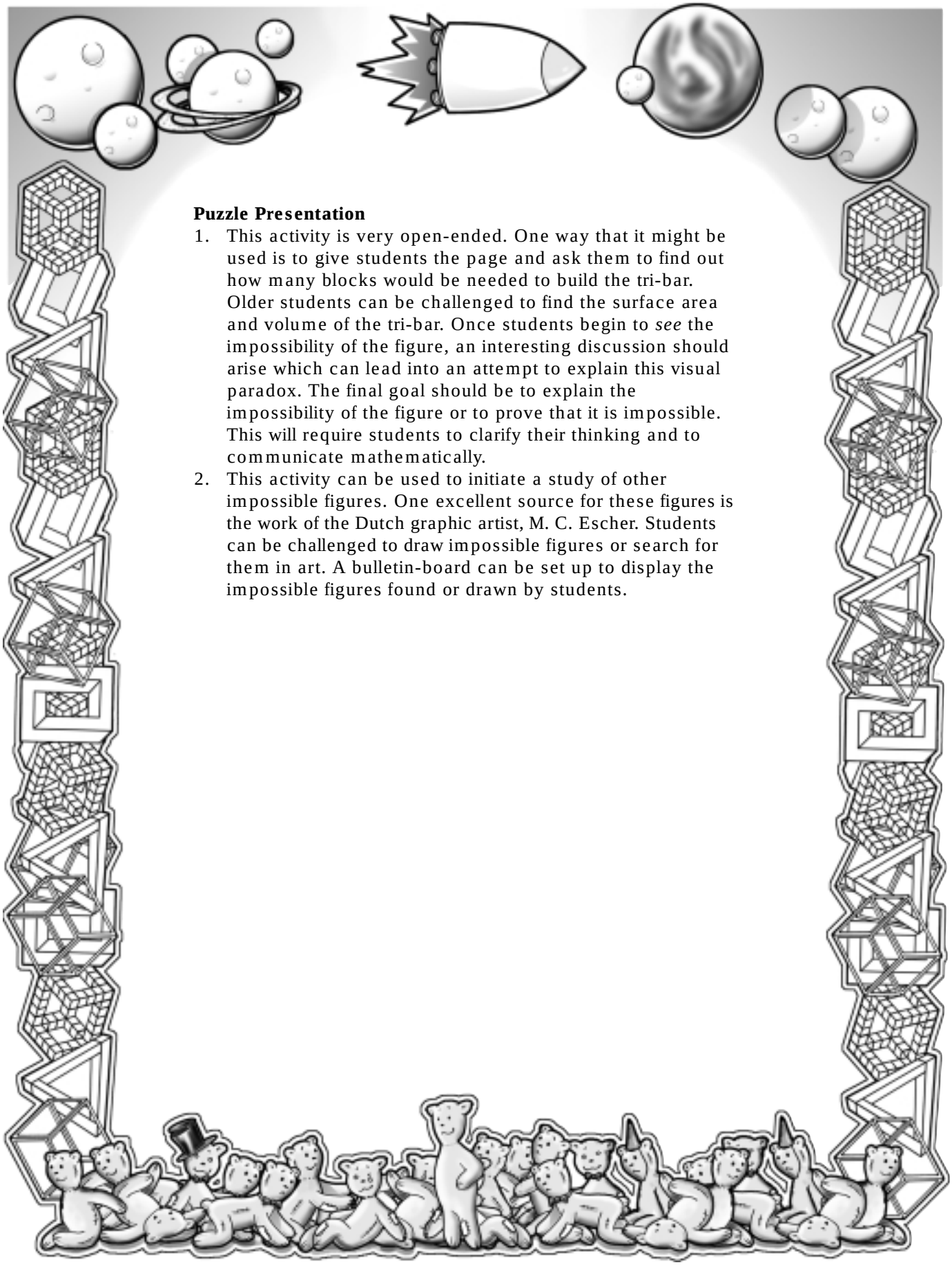
Materials
Student sheet
Bulletin board space, optional

Puzzle Background

Impossible figures such as the one in this puzzle have long intrigued mathematicians and non-mathematicians alike. The tri-bar presented on the student sheet is just one of a large family of impossible figures which present perplexing visual paradoxes.

The Swedish artist, Oscar Reutersvard, created the first tri-bar in 1934. He went on to experiment with other impossible figures and made hundreds of drawings of these figures. The tri-bar and many other impossible figures also appear in the work of the Dutch graphic artist, M. C. Escher. Two of Escher's most famous prints, *Waterfall* (1961) and *Ascending and Descending* (1960), were inspired by an article by well-known mathematician Roger Penrose and his father which was published in the British Journal of Psychology in 1958. The article dealt with impossible figures and included a detailed discussion of the tri-bar and the impossible staircase, a new impossible figure created by the father and son team.

At first glance, the tri-bar may seem perfectly normal, and one might even be tricked into calculating how many blocks would be needed to build it. It even seems possible to calculate its volume and surface area. For some, only a close examination of the tri-bar, or an attempt to construct it, brings out its impossibility. Whether the impossibility is immediately apparent, or takes some time to discover, this visual paradox exercises the logic and spatial-relationship areas of the brain.

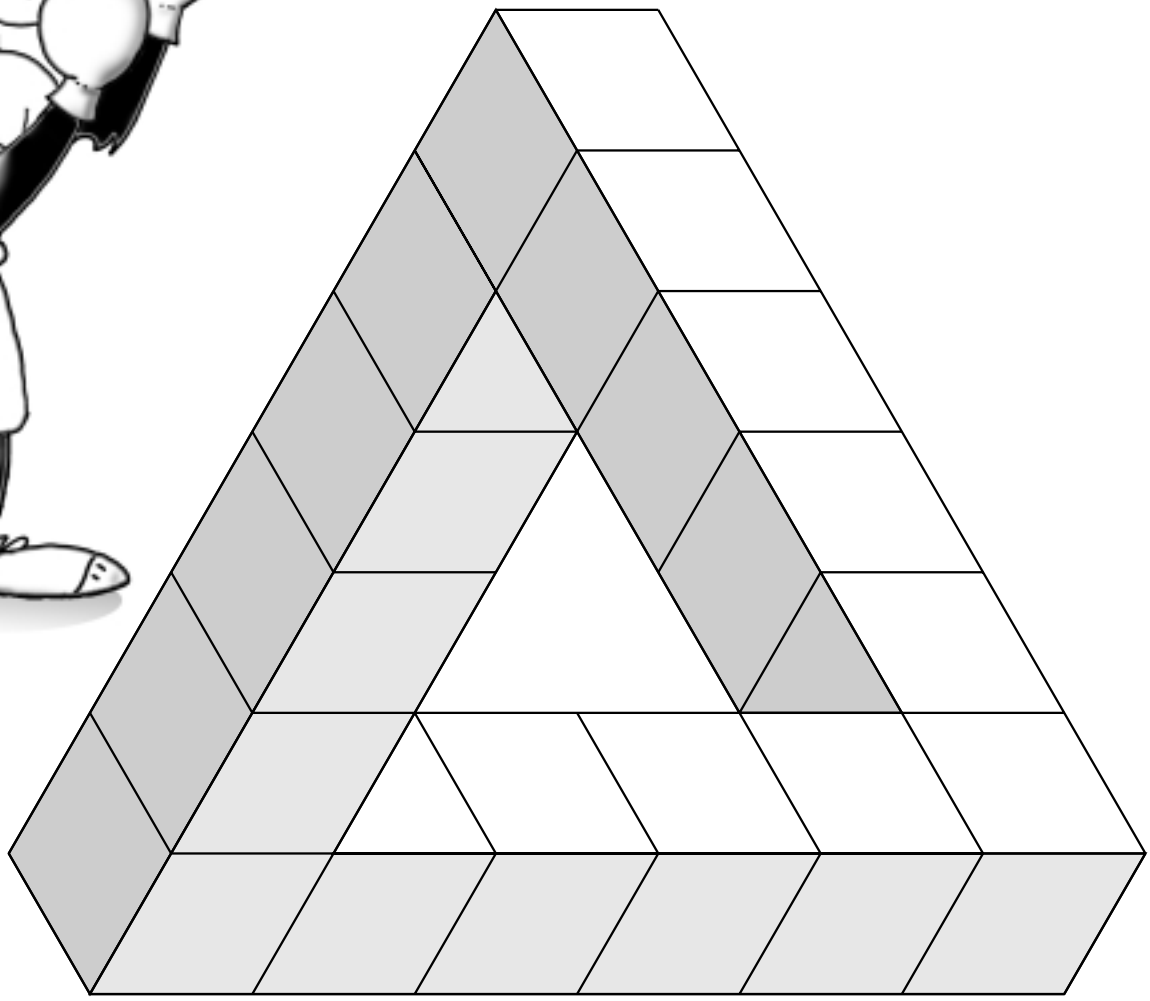


Puzzle Presentation

1. This activity is very open-ended. One way that it might be used is to give students the page and ask them to find out how many blocks would be needed to build the tri-bar. Older students can be challenged to find the surface area and volume of the tri-bar. Once students begin to *see* the impossibility of the figure, an interesting discussion should arise which can lead into an attempt to explain this visual paradox. The final goal should be to explain the impossibility of the figure or to prove that it is impossible. This will require students to clarify their thinking and to communicate mathematically.
2. This activity can be used to initiate a study of other impossible figures. One excellent source for these figures is the work of the Dutch graphic artist, M. C. Escher. Students can be challenged to draw impossible figures or search for them in art. A bulletin-board can be set up to display the impossible figures found or drawn by students.

tri-bar trauma

Study the figure below.



How many blocks would it take to make the tri-bar pictured above?

What do you notice about the tri-bar?

