

# SOCCER BALL

Designer
Tinkerer <input checked="" type="checkbox"/> Engineer
<b>SKILL LEVEL</b>
RECOMMENDED FOR AGES 8+

# STEP 1

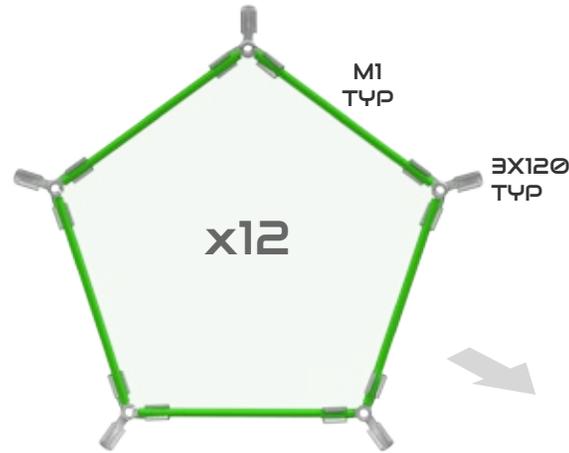
## Building the Ball

The ball will be constructed in 2 identical halves. Each half is called an Assembly. Refer to the image below to see what the final assembly (A1) will look like. These 2 assemblies will be joined together in Step 2 to complete the ball.

In this step you will build the two halves (A1) of the ball as shown. Start by creating 12 regular pentagons (Step 1.A). Next, join the pentagons together as shown in Step 1.B.

### TIP

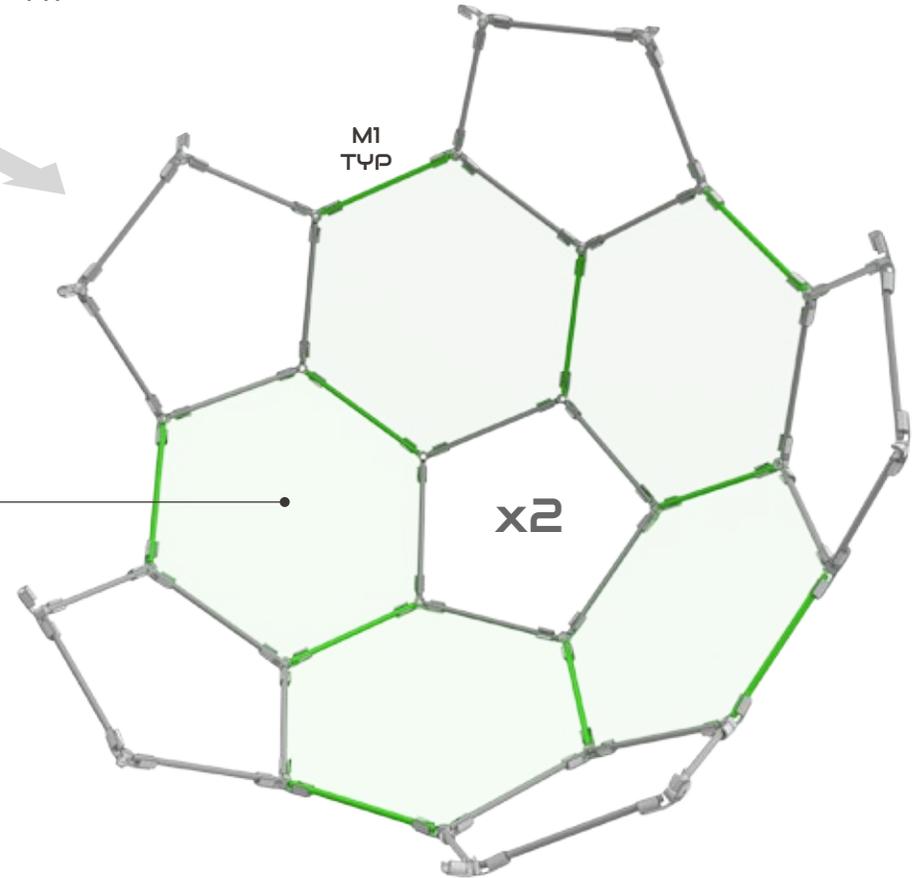
Keep a clean workspace and create an assembly line to increase efficiency and reduce mistakes.



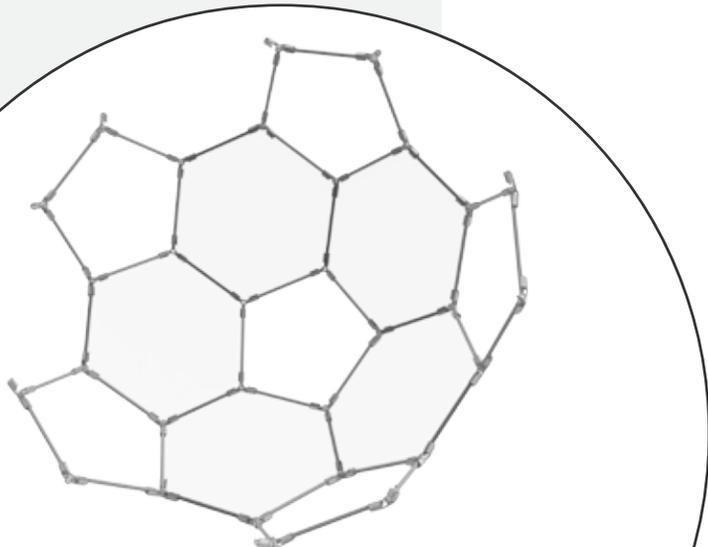
**STEP 1.A**  
Assemble the Pentagons

### NOTE

Notice the hexagon shapes that are created between each pentagon.



**STEP 1.B**  
Complete Assembly (A1) by connecting 6 pentagons from Step 1.A as shown



COMPLETED ASSEMBLY A1 (x2)

### PARTS REQUIRED FOR THIS STEP



# STEP 2

## Complete the Ball

In this step you will join the 2 ball halves (A1) as shown to complete the ball.

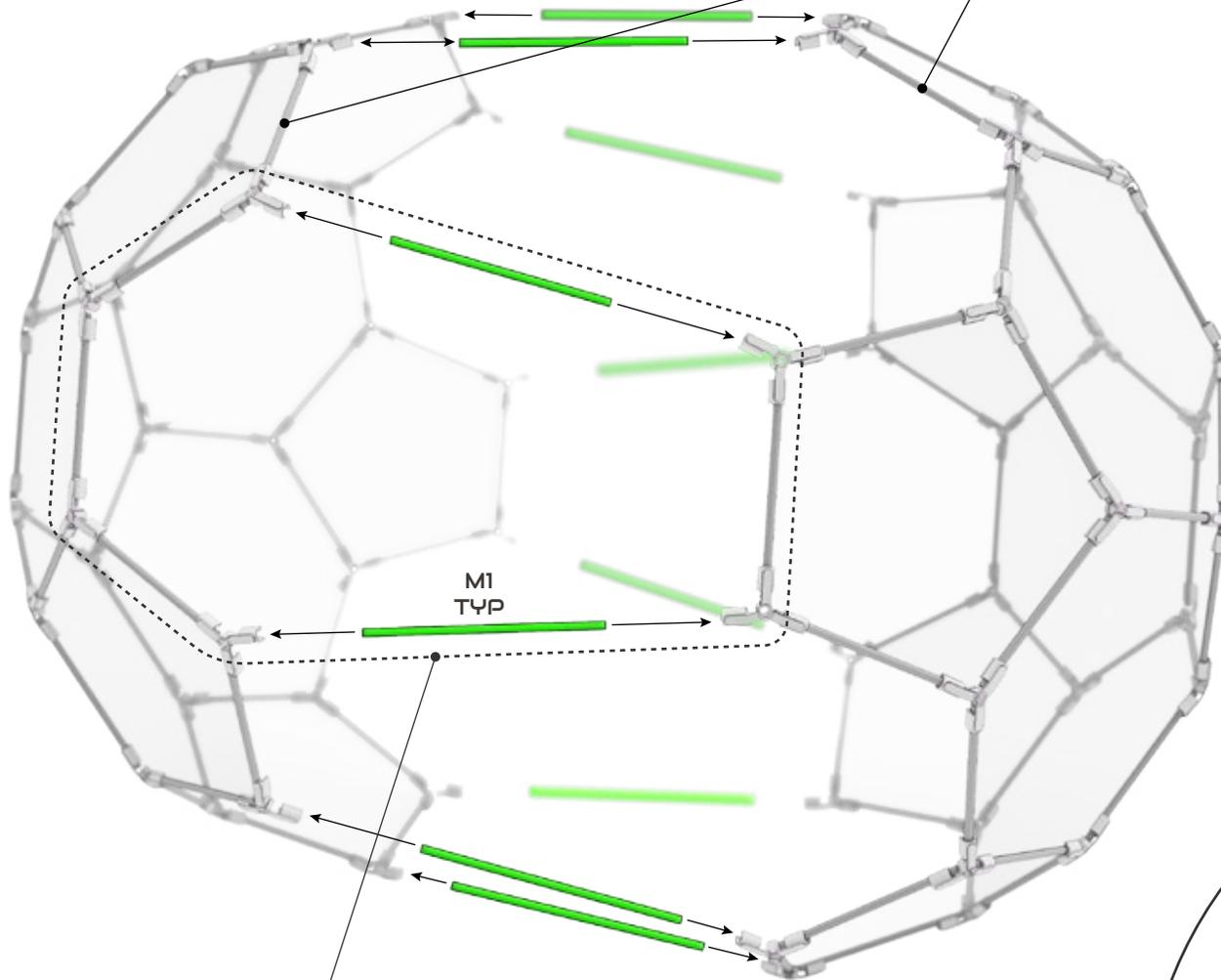
Great job! Easy, Right? You can even bounce it and kick it around a little too!



### TIP

Attach all 10 M1s to one side of the ball first. That will make it easier to connect the second half.

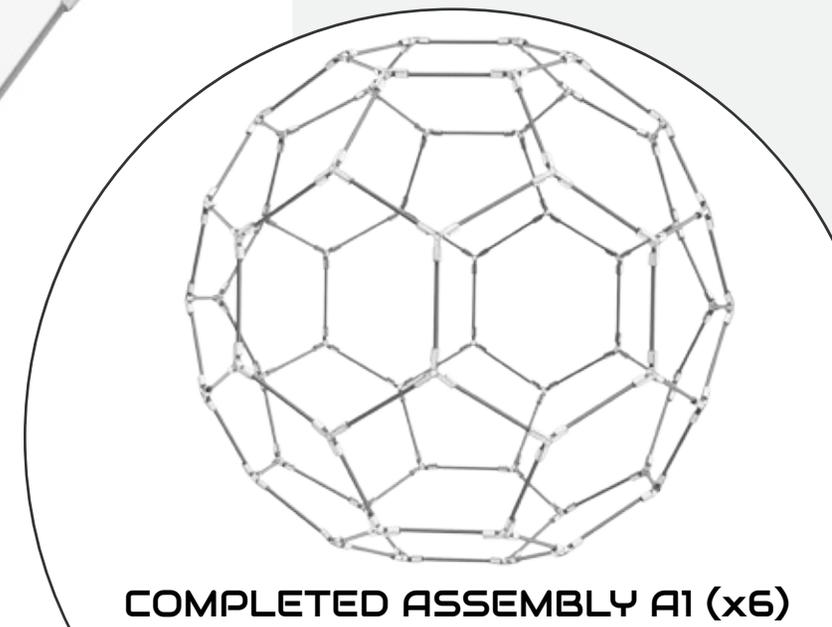
Completed Assembly A1  
Created in Step 1



M1  
TYP

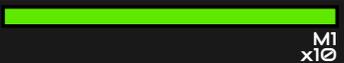
### ! NOTE

Notice the hexagon shapes that are created when connecting the two halves. If you notice squares between the two halves then you need to rotate one half slightly as shown.



COMPLETED ASSEMBLY A1 (x6)

PARTS REQUIRED FOR THIS STEP



M1  
x10

## Anatomy of a Soccer Ball

When you think of a soccer ball you probably picture a white ball with black spots. If you actually look at that type of soccer ball you will notice that those black spots are very specific shapes - pentagons. If you look closer you will see that each black pentagon is surrounded by white hexagons. All of those pentagons and hexagons fit perfectly together to create the outer shell of the ball. Cool, right?

This type of solid object is known as a Polyhedron.

### Polyhedra (plural)

A polyhedron is simply a three-dimensional solid made of polygons that are joined at their edges. Think about a cube; just 6 squares joined together at their edges to create a solid shape (See Image A). That common black and white soccer ball is built using the same principles. Instead of using squares, the soccer ball is built using both pentagons (5 sides) and hexagons (6 sides). There is something special about those pentagons and hexagons though; for all of them to fit together perfectly, all of their sides need to be exactly the same length - these are known as regular polygons.

### Regular Polygons

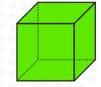
A polygon is just a bunch of connected lines that create a closed shape. So, a pentagon, for instance, doesn't always need to look like the building in Washington D.C.; it just needs to have five sides (see Image B). In fact, the shape on the left in Image B does have 5 sides, and they are the exact same length. So is this a regular pentagon? No, because in addition to sides being the same length, the angles between the sides also need to be identical. Same lengths + same angles = regular polygon.

### Let's Get Technical

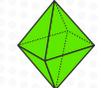
Now you know that the shape of a soccer ball is a polyhedron and it uses two different shapes - pentagons and hexagons, but did you know it has a very specific name - wait for it - it called the Truncated Icosahedron! (/ikō-seh-hē-dren/). This fascinating combination of two (or more) regular polygons working together perfectly to create a solid object is really not that common. In fact, there are only 13 different known combinations - known as the Archimedean solids (named after the Greek mathematician, physicist, engineer, inventor, and astronomer, Archimedes - also known as a really smart guy!) Some of these shapes even have three different types of polygons working together. The really cool thing about Archimedean solids is that they can fit perfectly into a sphere so every vertex (corner) of the solid would touch the wall of the sphere. This is why the truncated icosahedron is such a great shape for a soccer ball. Once inflated, the ball becomes a perfectly round. That's what we call a Gooooaaaaal!!!!



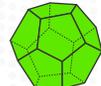
**Tetrahedron**  
4 Triangles



**Hexahedron**  
6 Squares



**Octahedron**  
8 Triangles



**Dodecahedron**  
12 Pentagons



**Icosahedron**  
20 Triangles

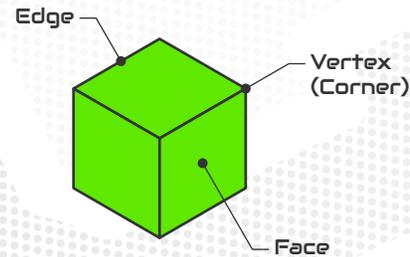


Image A

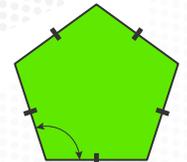
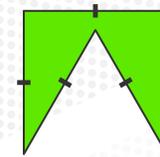
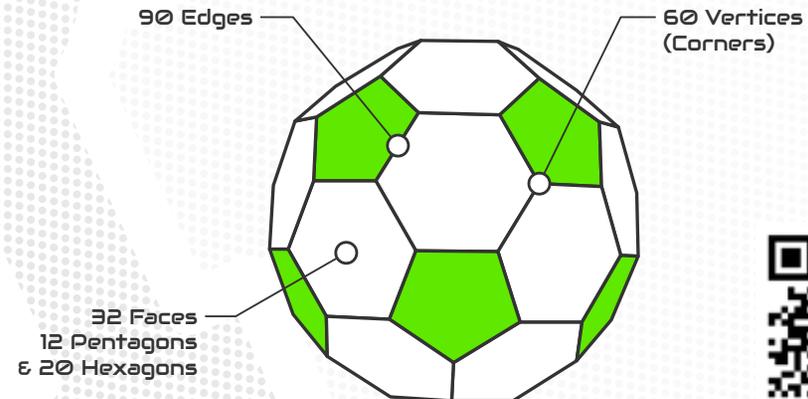


Image B



Truncated Icosahedron

## The Regular Polyhedra

A regular polyhedron is a three-dimensional shape with the following characteristics:

- Each face is built from the same type of regular polygons - that is, their sides are all equal length.
- There are the same number of polygons meeting at every corner of the shape.

The following regular polyhedra exist; there are only 5:

- Tetrahedron, has 4 sides, is made of triangles
- Cube, Hexahedron, has 6 sides, and is made of squares.
- Octahedron, has 8 sides, and is made of triangles.
- Dodecahedron, has 12 sides, and is made of pentagons.
- Icosahedron, has 20 sides, and is made of triangles.

### Uses

The Platonic Solids are often used as dice in role-playing games. These shapes are used because they provide perfectly fair results.

