Five Platonic Solids

- An important group of three-dimensional shapes are the five platonic solids.
- These include:
  - tetrahedron (4),
  - Cube (6),
  - octahedron (8),
  - dodecahedron (12) and
  - icosahedron (20).
- These are the only shapes whose faces are all identical regular polygons.

Space Frame

- A truss system with members that lie in three dimensions.
- Two usual forms
  - tetra-hedron (three-sided pyramid)
  - half-octahedron, i.e. (four-sided pyramid)

Tetrahedron

- The tetrahedron is all triangles and clearly more stable.
Octahedron

- Half-octahedron’s square side makes it more convenient for most construction projects.
- Rigid joints are required to prevent the angles from changing.

Redundancy

- A space frame system consists of layers of struts
- Some struts are connected to the supports (columns),
- Others radiate outwards from those.
- Any applied loads have many choices of route to get to supports at corners;
- This provides a redundancy in case one member is broken and makes space frames safer.

Are Members Identical?

- Are all the members of the space frame identical?
- The structure usually repeats
- The elements closest to the supports take the most weight.
- The elements closest to the supports are thicker than those farther away.

Famous Space Frame

Entrance to Louvre
Biosphere 2 in Arizona

Connectors

- Very important pieces for any space frame
  - the connections between the members.
- Two common types of connector
  - Unistrut
  - Mero, with spherical connectors

Spherical Shapes

- Geodesic Dome are spherical space frames.
- The most standard method uses a three-frequency subdivision of an icosahedron,
  - a soccer ball, a system surrounded by hexagons.
- Developed and patented by Buckminster Fuller (1895-1963)

Buckminster Fuller
Characteristics

- Geodesic domes enclose a great deal of space without interior supports; therefore, they are efficient structures for heating and cooling.
- A difficulty with them is that it can be hard to remove struts to make convenient openings for doors or windows.
- Many people like the shape, and build houses from them.

Support through compression and tension

- Geodesic domes have most members in compression
- However, the lower horizontal struts can be in tension.

Large domes

- Just as with cables, the less horizontal a given strut is, the less compression it needs to withstand an applied load.
- Having very few joints leads to a stronger structure, less smooth – space is used inefficiently.
- A way around this issue is to have two concentric domes, and run the struts from one to the other, allowing the truss depth to be larger.
- This method is generally necessary to have larger geodesic domes.
Montreal's Biosphere

Epcot Center
VIDEO!

- Video about geodesic domes and Buckminster Fuller (1895-1963)