STEAM: STRUCTURES

Structures of all sizes surround us – whether natural or man-made. Structures are elements that are combined to support a load in a stable manner. By understanding these, Engineers can design structures that break with tradition and still be rigid and stable.

There are three types of structures:
Shell – solid outside but hollow inside
Frame a combination of parts that work together increase strength of individual parts
Mass – structure has only one solid part
These three types are often combined.

All structures have four basic functions. These are: to **support**, to **contain**, to **protect** and to **span**.

THE FUNDAMENTALS

Design should take into consideration:

- The forces that will be acting upon the structure (e.g. gravity, weather)
- Have an aesthetic appeal
- Use appropriate materials
- A strong base for stability so that the mass is distributed equally to prevent collapse
- Suitable manufacturing processes
- Appropriate reinforcement techniques
- Meet safety aspects during and after construction
- Have minimal environmental impact
- Fit within budget constraints

INVESTIGATION

Try these activities with your students.

- Investigate the most stable shape – triangle. Why is it the best shape? Find examples of its use.
- Investigate Australian structures e.g.
  Tallest building: Q1, Surfers Paradise;
  Longest bridge: Melbourne's Bolte Bridge (5km);
  Cultural building: Sydney Opera House
- Symmetry is used in many structures. This is for stability e.g. a table will tip if not symmetrical. It is more economical to construct a building with symmetrical design. The more of the same components used, the cheaper it is to manufacture and assemble.
- Compare strengths of a variety of materials. Investigate if reinforcing improves performance of materials
- Investigate ways to increase the strength of paper. Try folding, rolling or other techniques. How much weight can it hold?
- In 2015 a driveable cardboard Lexus IS Saloon, the world's first cardboard car was unveiled. It was made by laser cutting each layer and then assembling.

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GLOSSARY OF TERMS:

aesthetic	force	span
bridge	frame	specification
cantilever	function	stability
components	mass	steel
constraints	planning	structure
contain	protect	support
design	prototype	symmetry
develop	reinforcement	testing
engineer	safety	tolerance
evaluation	shell	tower

Remember!

Keep working with your first idea....don't get stuck on only one idea...modify it....change it...make it better...add something...take something away....look at it upside down....**get creative!**

http://www.edu.gov.on.ca/eng/studentsuccess/thinkliteracy/library.html

SCORPIO KITS

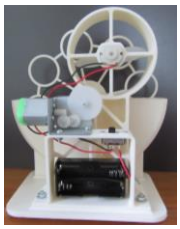
These Scorpio kits give opportunities to investigate structure by making modifications and trying out a range of ideas.

Introductory:

- **BUBBLE BLOWER**

Intermediate:

- **LED TOUCH LAMP**
- **MR WALKER**
- **SOLAR HOUSE**



Bubble Blower - A great way to design simple structures. The bubble ring, gearbox / motor and propeller need to be supported by structures. What design will be the most appropriate?

The **LED Touch lamp** designed and manufactured using different materials and techniques.

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Check out our website for new catalogues and updates.

NEW!

- Chemistry clearance
- Biology clearance
- Primary clearance
- Whiteboard accessories
- Coming soon – Physics, Primary STEAM

Please pass this information to colleagues in other departments.

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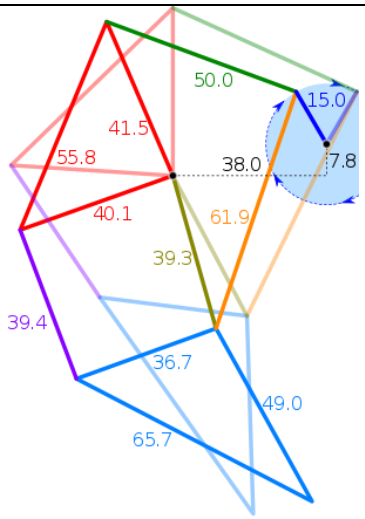
A STEAM CASE STUDY

"The walls between art and engineering exist only in our minds." (Theo Jansen)

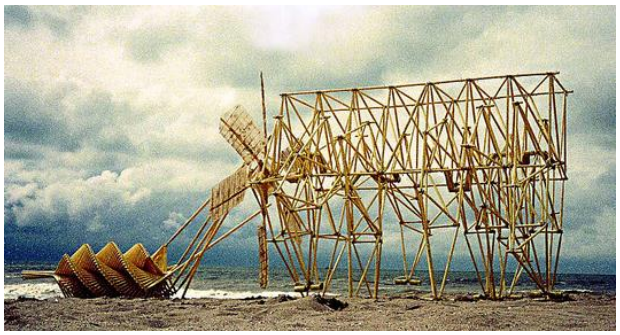
Since 1990, Theo Jansen (Netherlands) a physicist, began creating self-propelling structures he calls "**Strandbeests**" ("*beach animals*"). They combine Science, Technology, Engineering with Art and Mathematics.

These large moving kinetic structures are made out of PVC, wood, and fabric airfoils. They are designed to "walk" on sand using wind power. Artificial intelligence allows them to change direction when an obstacle is detected. One model is capable of anchoring itself to the earth if an approaching storm is sensed.

Jansen has devised a linkage system that provides support and makes it possible for the Strandbeests to move. The linkages convert the rotation of an axle into a stepping motion. These leg mechanisms have applications in mobile robotics and in gait analysis.



"Theo Jansen's linkage. When the blue line at the right end of the picture is driven in a clockwise rotary motion, the leg (blue triangle at the bottom) executes a walking motion. Relative (dimensionless) proportions shown." https://en.wikipedia.org/wiki/Jansen%27s_linkage



The Strandbeest move due to systems such as crankshafts and hydraulics. As a leg is lifted the other legs support it. Using a computer generated model it was possible to determine the mathematical

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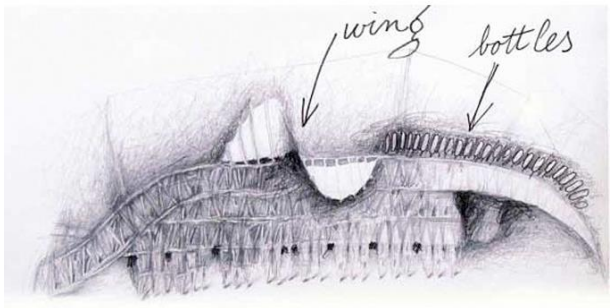
proportions of the length of the legs so that the structure could move.



The wind system used in the Strandbeest.

The Strandbeest series continues to improve or as Jansen would say “evolve”. New techniques and designs ensure that the wind’s energy is harnessed more efficiently. Some can now even store air pressure in order to propel themselves in the absence of wind.

STRANDBEEST - BEACH ANIMALS

Check out these YouTube clips to see these amazing structures.

https://youtu.be/KsqlnGMzMD4

https://youtu.be/0Tqbym9gzX8

https://youtu.be/MYGJ9jrbpvg

https://youtu.be/pJtWBnVkkz0

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IMAGE CREDITS:

- http://www.strandbeest.com