

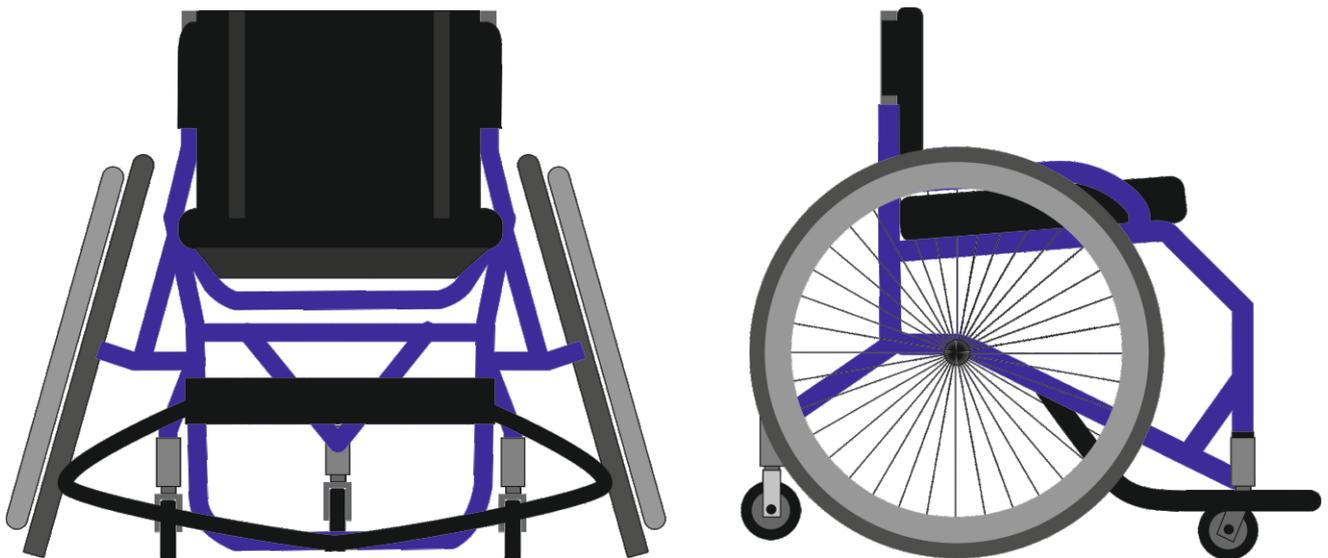
DESIGNING A PRODUCT IN THE STYLE OF David Constantine – Motivation – Multisport Wheelchair



OWEN MACLAREN
Innovative Engineer and Designer

REVISION BOOKLET FOR THE 2018 EXAMINATION

WORLD ASSOCIATION OF TECHNOLOGY TEACHERS <https://www.facebook.com/groups/254963448192823/> www.technologystudent.com © 2017 V.Ryan © 2017





David Constantine was a student in 1989, when he entered a competition to design a wheel chair (along with a colleague Simon Gue), that could be used in a range of terrains, such as those found in the third world/developing countries. David had already been a wheel chair user for several years. The wheelchair had to be manufactured from locally sourced materials, which helped to ensure that its manufacture was sustainable and employed local technicians. The wheelchair had to be affordable.

They won the competition (the Frye Memorial Prize) and formed a non-profit making organisation called 'Motivation', in 1991. Following this, they were invited to go to Bangladesh, to manufacture their wheelchair.

Form, aesthetics and particularly function, were applied to their designs. An important aim of their organisation and designs, was to raise the self-esteem of the disabled user. Over a number of years, the organisation has sent designers, physiotherapists and engineers to developing countries, working with local companies, to design and manufacture wheel chairs.

Each wheel chair is adjusted to fit the individual user, at the point of distribution. The chair's 'empower' the user to be mobile and to earn incomes, becoming active and valued members of society.

Today, Motivation design and manufacture a range of wheelchairs, including sports wheelchairs.

Motivation's design philosophy, is one that aims to motivate the user, through the freedom and independence that their chairs deliver. Their wheel chairs are adjustable, so that they will fit a wide range of users, ergonomically. Further to this, their chairs are affordable and manufactured from locally sourced sustainable materials.

WORLD ASSOCIATION OF TECHNOLOGY TEACHERS <https://www.facebook.com/groups/254963448192823/> www.technologystudent.com © 2017 V.Ryan © 2017

TWO WHEELCHAIRS BY MOTIVATION

CHILD'S WHEELCHAIR



AFFORDABLE RACING WHEELCHAIR



COMPARISON BETWEEN A TYPICAL WHEELCHAIR AND THE MULTISPORTS WHEELCHAIR

TYPICAL WHEELCHAIR



Compared to the Multisports wheelchair, it is less comfortable and more difficult to manoeuvre. It has been designed with little input from the user and it is for general use. The wheelchair is also heavier and less stable, although it is manufactured from tube. The wheels are more difficult to turn by the user and when been pushed from the back. The wheelchair aids the independence of the user, but not to the same degree, as the multisports wheelchair.

MULTISPORTS WHEELCHAIR



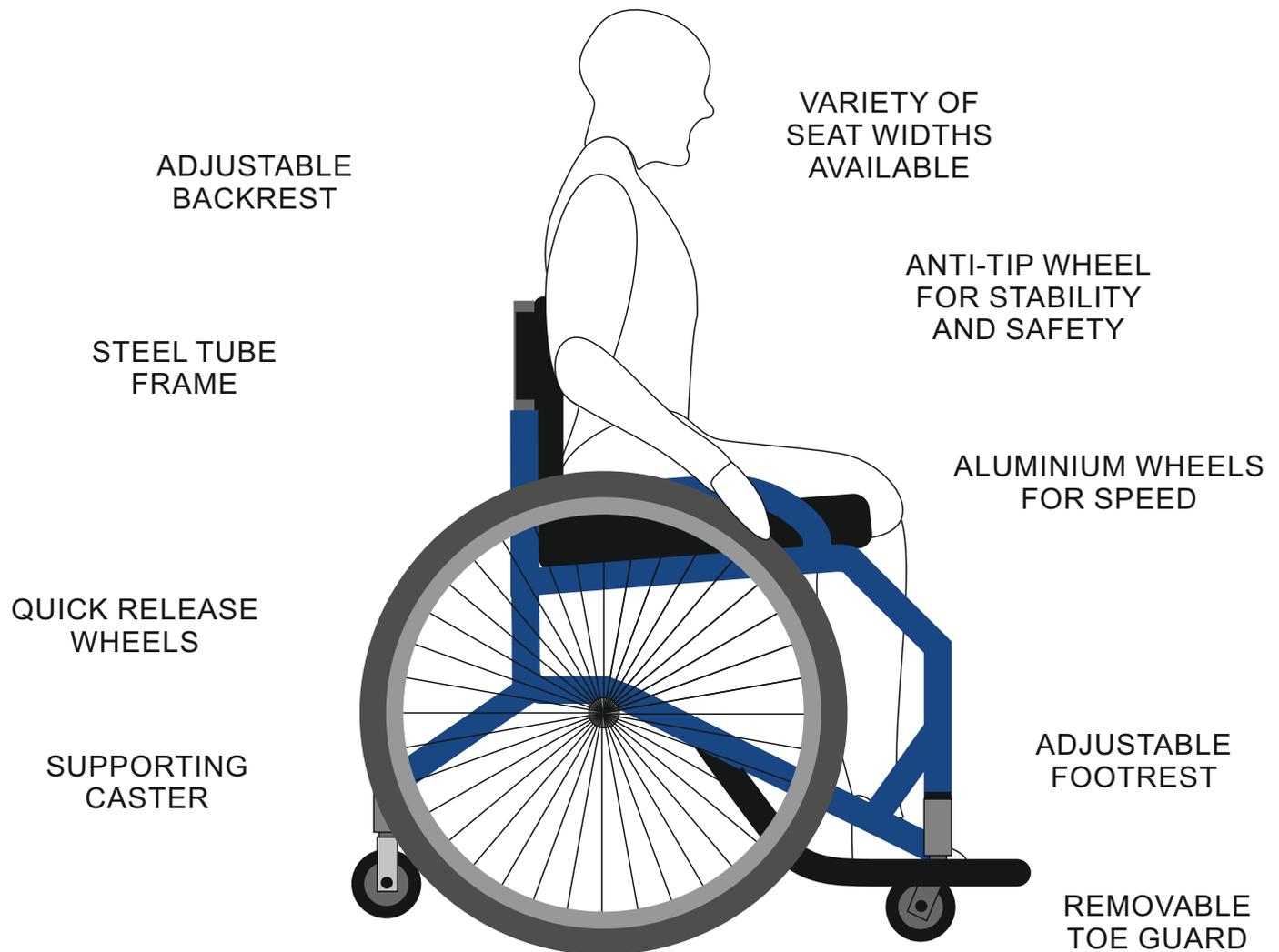
The Multisports wheelchair is lightweight due to its tubular structure. It is an innovative design and offers a greater degree of independence to the user, compared to the traditional wheelchair. It allows the user to get involved in sports, even at a competitive level. The wheelchair is extremely stable, as it has a supporting castor at the back, which prevents tipping. The wheelchair is highly manoeuvrable. This chair develops the users confidence, to a greater degree.

Can you think of another aspect of life, for which a wheelchair needs developing. For example, a tough and durable wheelchair, that allows disabled people to access the paths used by walkers.

Write your description below:

THE MULTISPORTS WHEELCHAIR BY MOTIVATION

In the build up to the London Olympics in 2012, the International Paralympic Committee, asked Motivation to design an affordable sports wheelchair, that athletes from around the world could purchase. The wheelchair was to be at the fraction of the cost of those supplied by other 'specialist' wheelchair manufacturers. The result was Motivation's Multisports Wheelchair, which has been designed for a wide range of users, from school children to adults.



WORLD ASSOCIATION OF TECHNOLOGY TEACHERS <https://www.facebook.com/groups/254963448192823/> www.technologystudent.com © 2017 V.Ryan © 2017

The affordable Multisport Wheelchair, is designed to make sport accessible to disabled people. There are two models, which suit basketball, tennis and no doubt other sports and activities.

The main design features of the chair are;

The backrest is adjustable, ensuring that it fits a range of sizes.

The wheels have been designed to be quickly released and changed.

The inclined / angled wheels, add to the stability of the wheelchair, especially during sporting activities.

The back wheel, also called the caster, is also adjustable, adding stability.

The frame is manufactured from common tubular steel, which is relatively lightweight.

It is highly manoeuvrable, allowing it to be used successfully in sporting activities.

It is robust and strong, able to withstand the type of rough treatment, that occurs in wheelchair sports.

The removable toe guard at the front, keeps the users feet out of harms way.

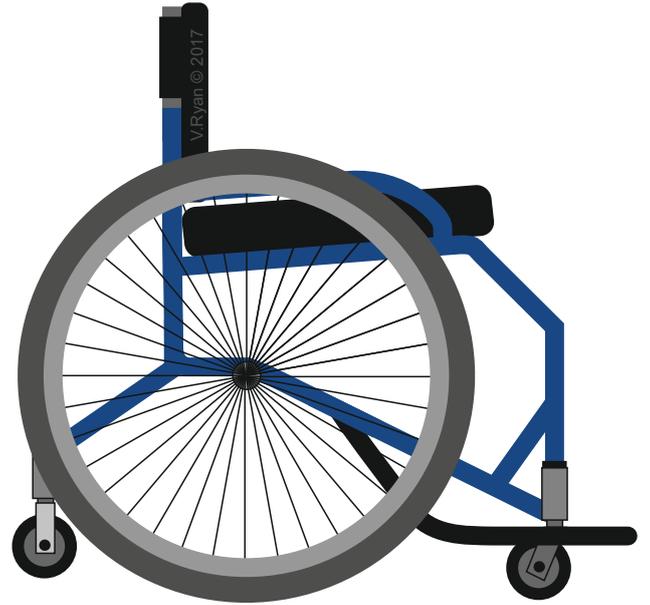
The wheelchair is a fraction of the price of 'professional' sports wheelchairs and yet competes at the same level.

A SELECTION OF IMAGES OF THE MULTISPORTS WHEELCHAIR

WORLD ASSOCIATION OF TECHNOLOGY TEACHERS <https://www.facebook.com/groups/254963448192823/> www.technologystudent.com © 2017 V.Ryan © 2017



FRONT VIEW



SIDE VIEW



THE MULTISPORTS WHEELCHAIR BY MOTIVATION QUESTIONS

WORLD ASSOCIATION OF TECHNOLOGY TEACHERS <https://www.facebook.com/groups/254963448192823/> www.technologystudent.com © 2017 V.Ryan © 2017

1. What organisation asked Motivation to design a sports wheelchair? Why was there a need?

2. In the space below, sketch a labelled diagram of the multisports wheelchair.

3. Describe at least five design features of the multisports wheelchair.

THE MULTISPORTS WHEELCHAIR BY MOTIVATION - QUESTIONS

1. In your opinion, what motivated David Constantine, to design affordable wheelchairs, suitable for a wide range of users?

2. When was the organisation called Motivation formed?

3. When did the multisports wheelchair become available for potential customers?

4. What are the key features of Motivation's design philosophy?

5. Write a comparison of the two wheelchairs below, in terms of size, weight, functions and aesthetics.

TYPICAL WHEELCHAIR



MULTISPORTS WHEELCHAIR



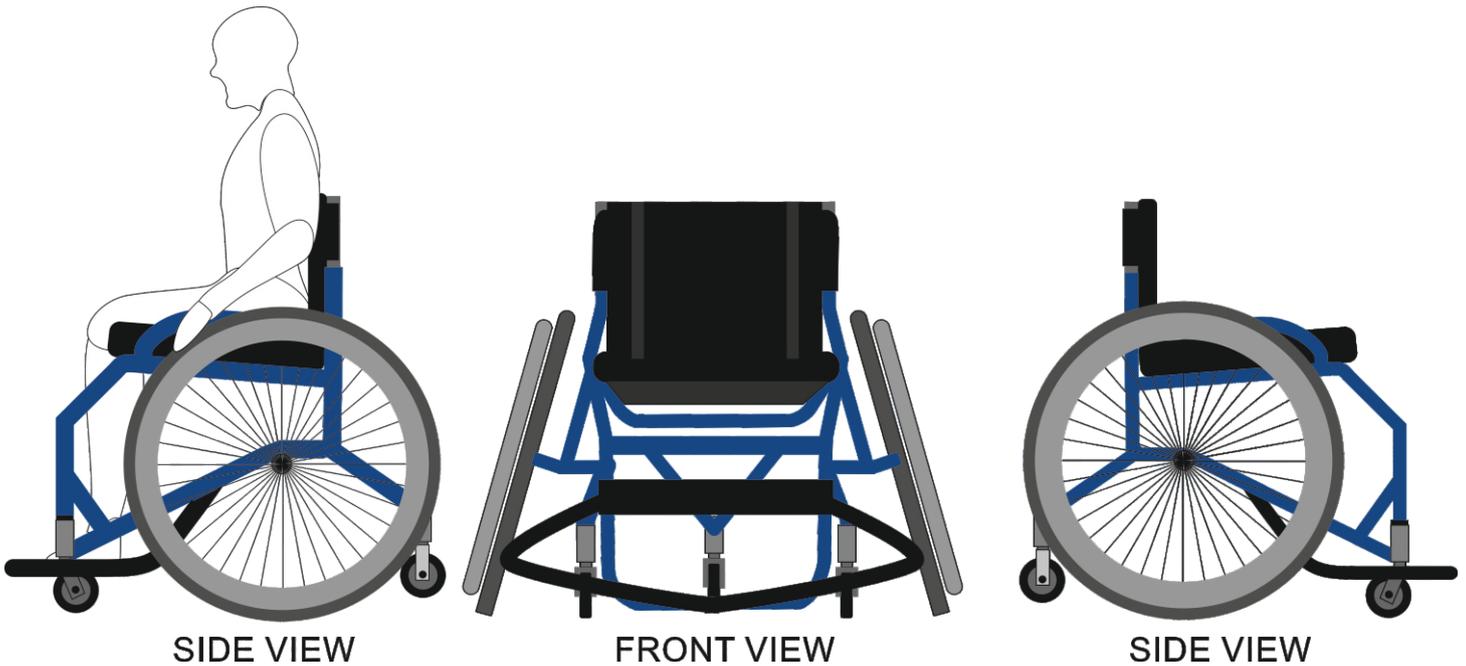
BASIC PRINCIPLES IN THE DESIGN OF MULTISPORTS WHEELCHAIR -QUESTIONS

WORLD ASSOCIATION OF TECHNOLOGY TEACHERS <https://www.facebook.com/groups/254963448192823/> www.technologystudent.com © 2017 V.Ryan © 2017

1. Compared to solid steel, why is steel tube a good choice for the manufacture of a wheelchair?

2. Why is the stability of any wheelchair, especially a sports wheelchair, very important?

3. Study the simplified sketch of the multisports wheelchair. If you were the designer, what notes would you add to the drawings? Add your notes in the space below the drawings.



4. On the back of this paper, sketch and describe one improvement you would make to the design.

David Constantine – Motivation – Multisport Wheelchair

EXAMINATION QUESTIONS

WORLD ASSOCIATION OF TECHNOLOGY TEACHERS <https://www.facebook.com/groups/254963448192823/> www.technologystudent.com © 2017 V.Ryan © 2017

Why can David Constantine and his company Motivation, be regarded as setting a trend?

David Constantine and 'Motivation' can be regarded as trend setting for a number of reasons. They emphasise the importance of sustainable manufacturing, in the production of their affordable wheelchairs, in developing countries. They were the first to work closely with the World Health Organisation, designing and manufacturing personalised wheelchairs, in areas of the world with few resources. Their first sports wheelchair ('Flying Start'), was an affordable competition wheel chair and it was used in the London Paralympic Games of 2012. It allowed disabled people from the developing world, to aspire to become athletes, competing on an equal footing, with those athletes from more affluent countries. Their wheelchairs, showed that it was possible to manufacture a quality product, from sustainable materials, with a local workforce and with a low carbon footprint. All at a time of increased globalisation. Motivation's environmental credentials, combined with their charitable status/aims, sets a high 'moral' standard for other companies to follow. Motivation take a 'holistic approach', as they provide wheelchairs and the necessary support and training, helping disabled people to work and live on equal terms, in society and the business world. All profits generated by Motivation, are put back into their charitable work.

Why is the Multisports Wheelchair regarded as an iconic design?

Why was it so influential?

The multisport wheelchair, was the first truly affordable sports wheelchair and it inspired other designers / manufacturers to follow suit. The simplicity of design, it's functionality and affordability, set a high benchmark, that other designers try to meet. When compared to wheelchairs manufactured by other 'specialist' companies, this affordable wheelchair, has the same key functions.

Motivation have manufactured a high quality product, at the fraction of the price of it's competitors. Further to this, they have strived to use sustainable, local materials, helping to provide local employment, in developing countries.

The ethical and charitable stance of Motivation, coupled with their determination to empower disabled people, sets their wheelchair apart, from many other companies, manufacturing similar products.

CRITERIA USED TO DEFINE ICONIC DESIGN

A simplified criteria, which may help describe or determine which designs are iconic, is written below. Some or all of these points, can be applied to iconic designs.

- A design that sets a bench mark for others to follow.
- A ground breaking design, in terms of its technology or manufacturing techniques used during its production.
- A design that improves on the past.
- A design that sets new standards in terms of quality, functions/features or style.
- A design that stands the test of time, remaining popular despite the passing of years.
- A design that stays in the memory of those who see/use it.
- A design that is often recognised immediately by consumers.
- A design that inspires other designers.
- Sets a trend.
- A design that is innovative.
- A design that is aesthetically pleasing.
- A design that is often emulated/copied by other designers.
- A design that has its place in history, or even helps change history.

Other international iconic designs include; the iPhone, Harley Davidson motorbikes, Rolls Royce cars, OXO Cubes, Hovercraft, Sony Personal Stereo, Jumbo Jet, Concorde, Harrier Jump Jet and many more.

DESIGN A 'DAVID CONSTANTINE / MOTIVATION' INSPIRED FOLDING CHAIR

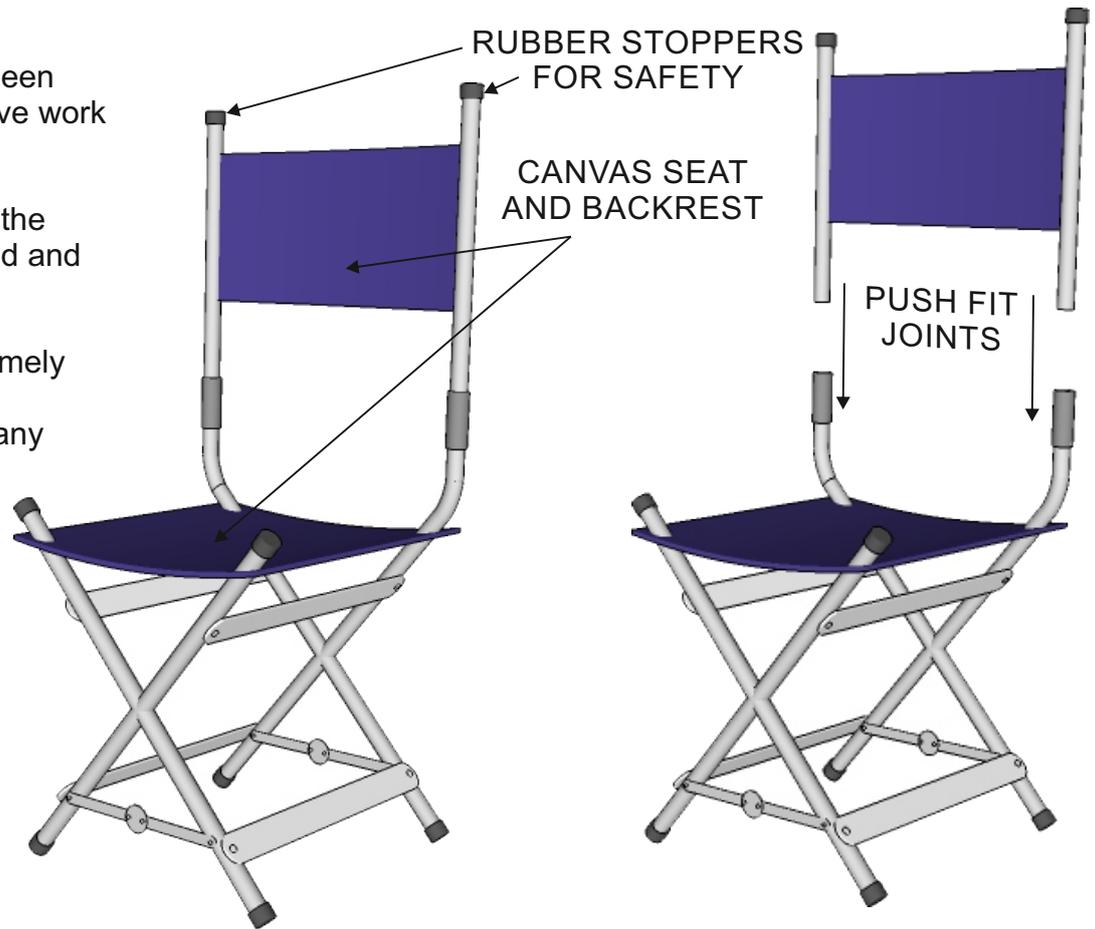
WORLD ASSOCIATION OF TECHNOLOGY TEACHERS <https://www.facebook.com/groups/254963448192823/> www.technologystudent.com © 2017 V.Ryan © 2017

The chair opposite has been inspired by the imaginative work of Motivation.

The seat folds flat whilst the back rest can be removed and also folds.

The canvas seat is extremely durable and can be manufactured in almost any colour.

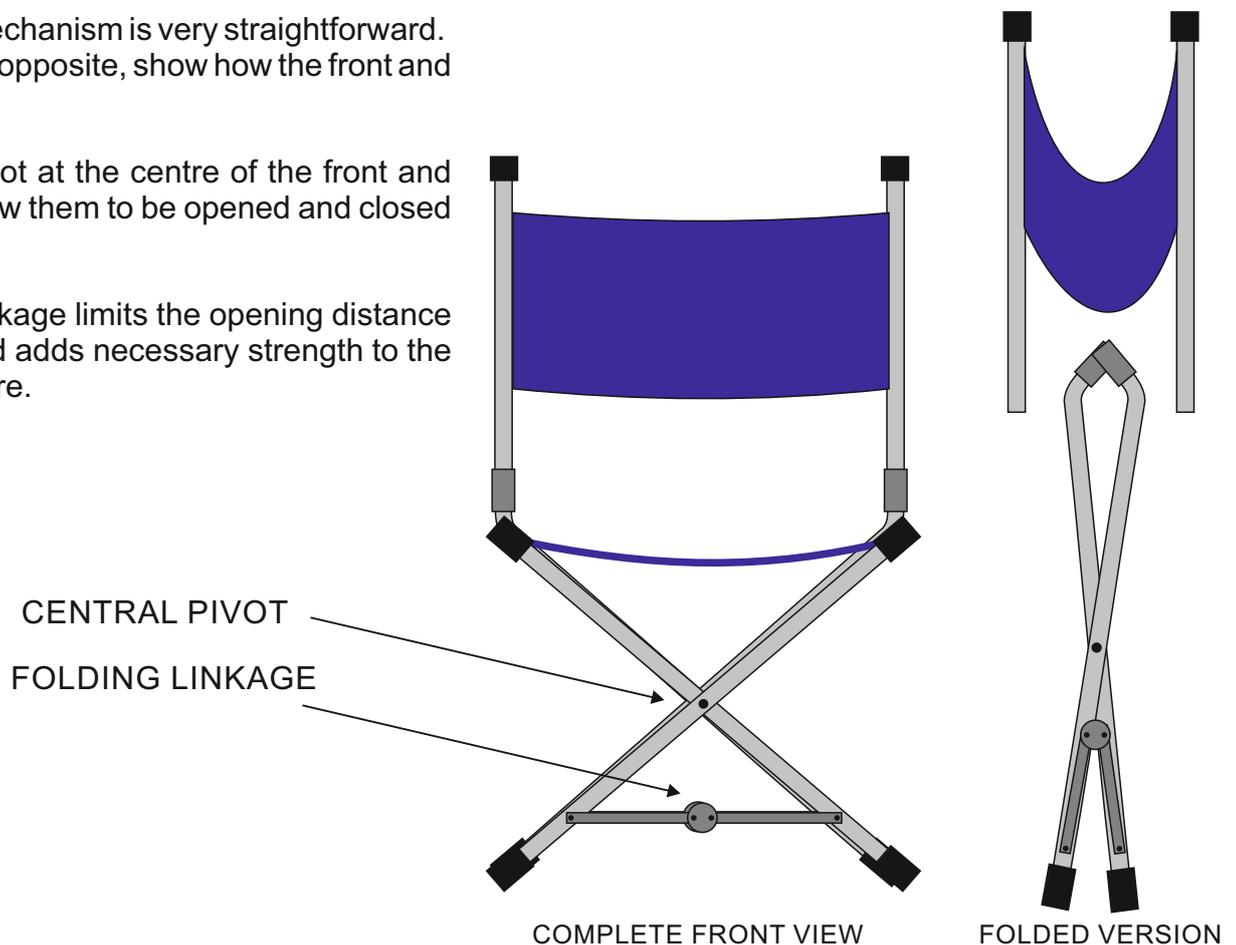
Aluminium tube is used as it is lightweight and relatively strong. This means that the chair can be carried with ease.



The folding mechanism is very straightforward. The diagrams opposite, show how the front and back legs fold.

The single pivot at the centre of the front and back legs, allow them to be opened and closed easily.

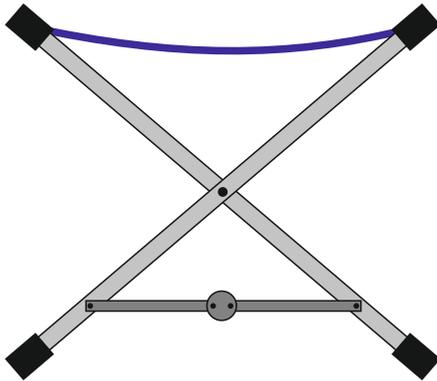
The folding linkage limits the opening distance of the legs and adds necessary strength to the overall structure.



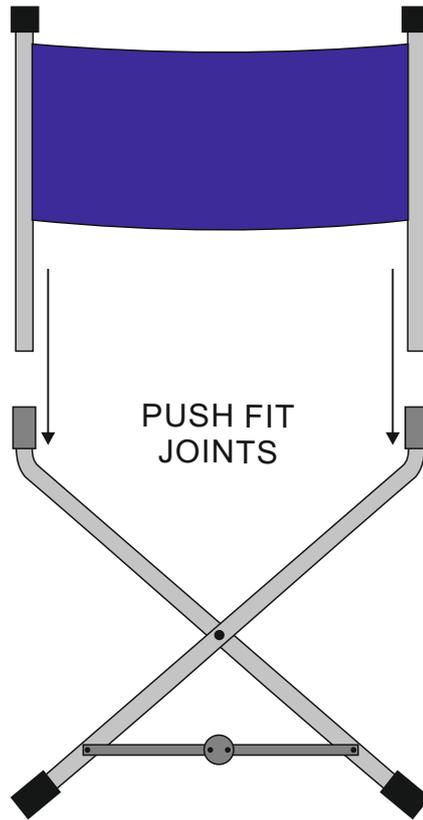
These drawings show the front section / set of folding legs, dia. A.

AND

The back section / folding legs and back rest, dia 'B', can be disassembled and the legs folded in the same way as the front legs.

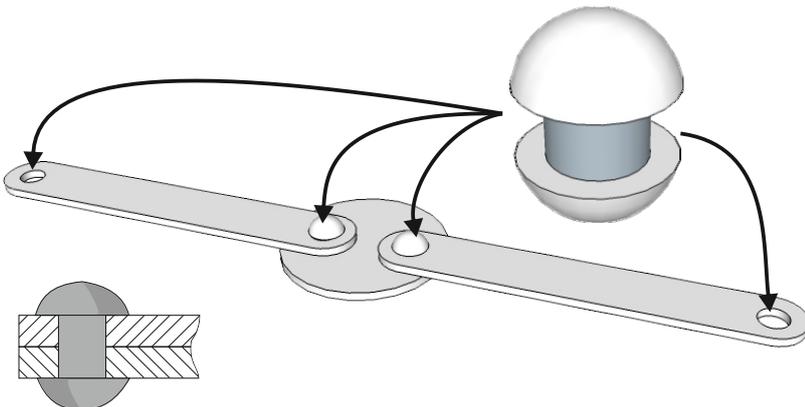
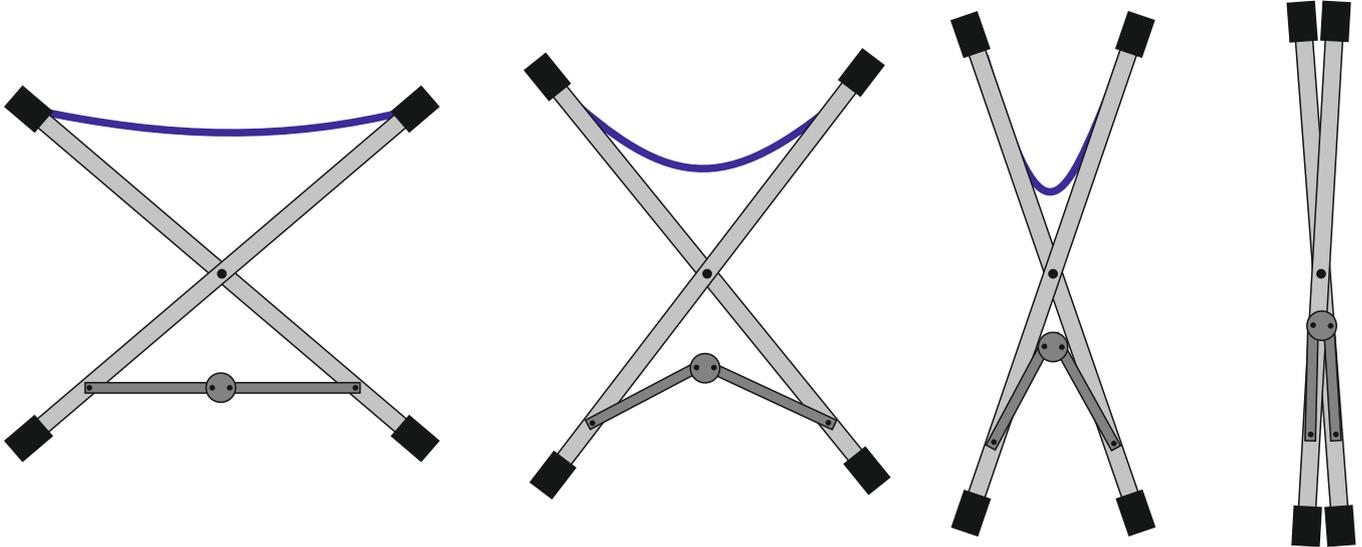


DIA 'A' - FRONT SECTION



DIA 'B' - BACK SECTION

HOW THE LEGS FOLD



Rivets are used to hold the linkage together. They also allow the joint to move, which means that the chair can be folded and unfolded. Nuts and bolts are not used as they will eventually loosen and the joint would fall apart.

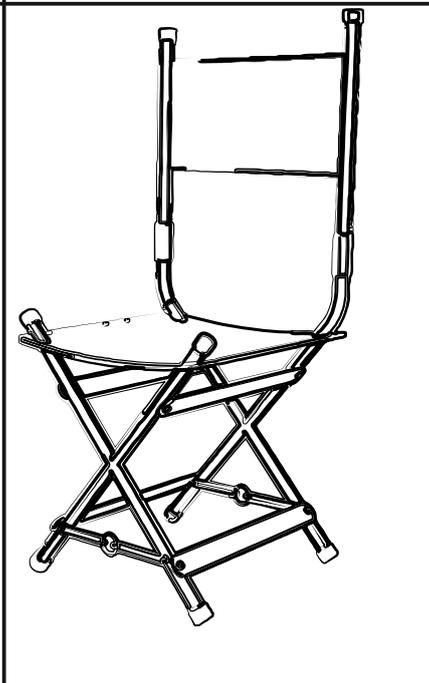
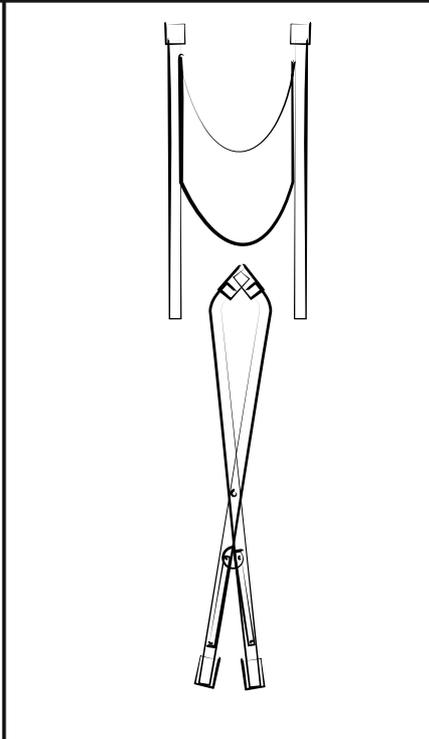
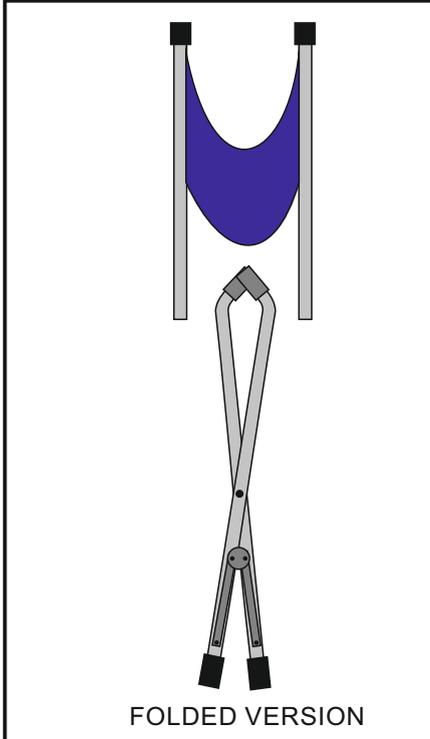
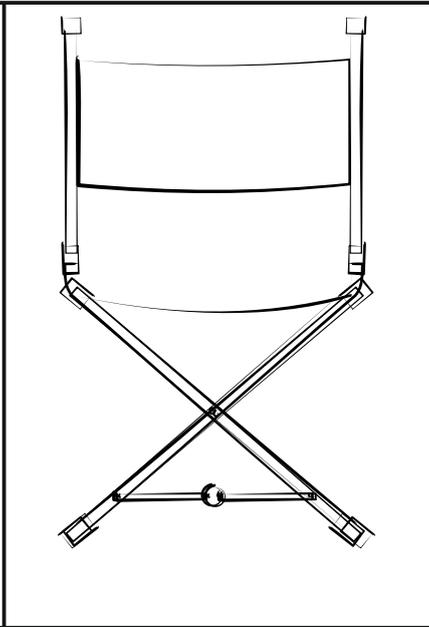
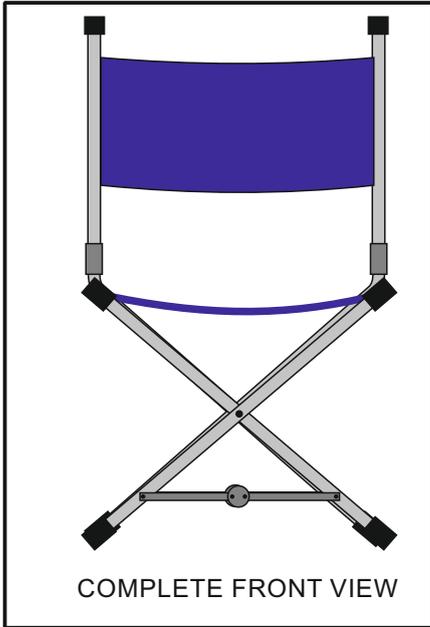
DRAWING / SKETCHING EXERCISE

WORLD ASSOCIATION OF TECHNOLOGY TEACHERS <https://www.facebook.com/groups/254963448192823/> www.technologystudent.com © 2017 V.Ryan © 2017

ORIGINAL
DRAWING

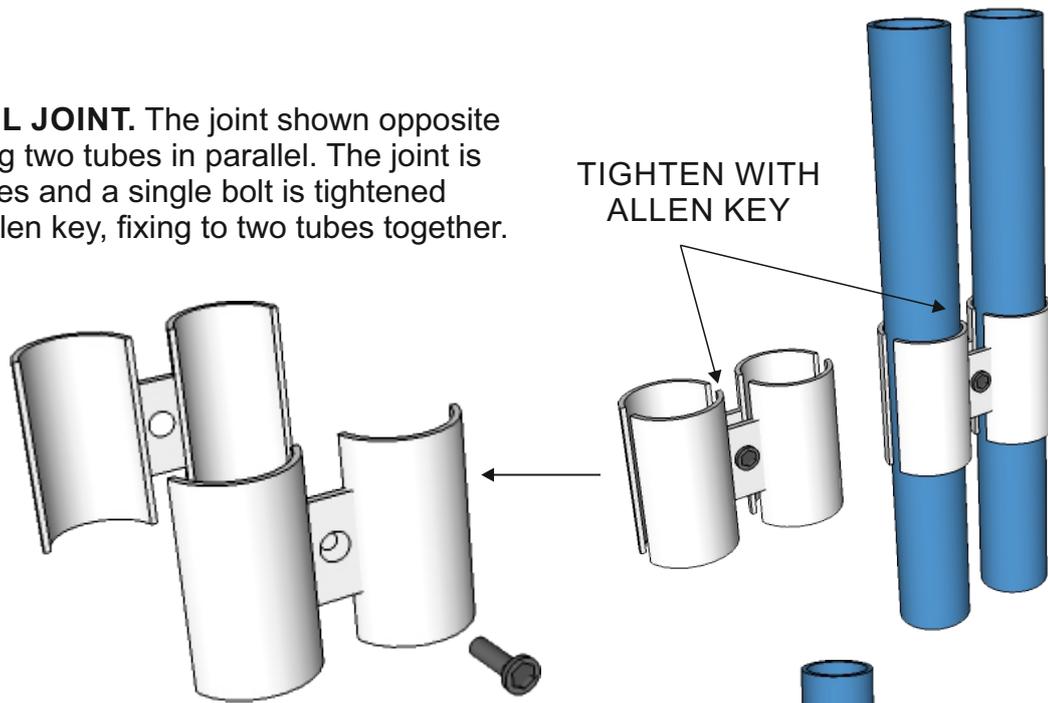
SAMPLE
SKETCH

YOUR
SKETCH

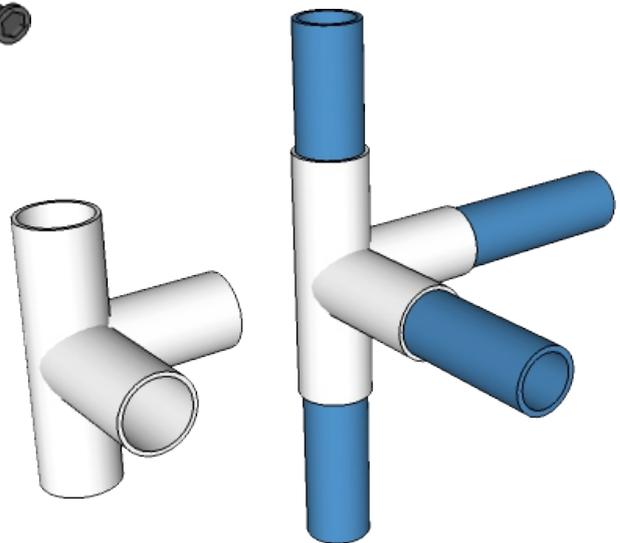


TEMPORARY / PERMANENT JOINTS FOR TUBE

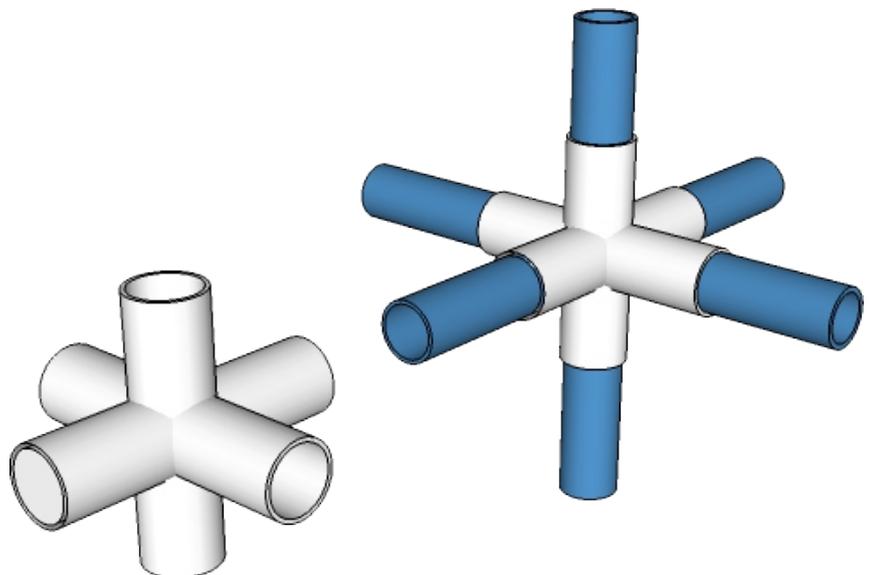
PARALLEL JOINT. The joint shown opposite is for joining two tubes in parallel. The joint is in two halves and a single bolt is tightened using an allen key, fixing to two tubes together.

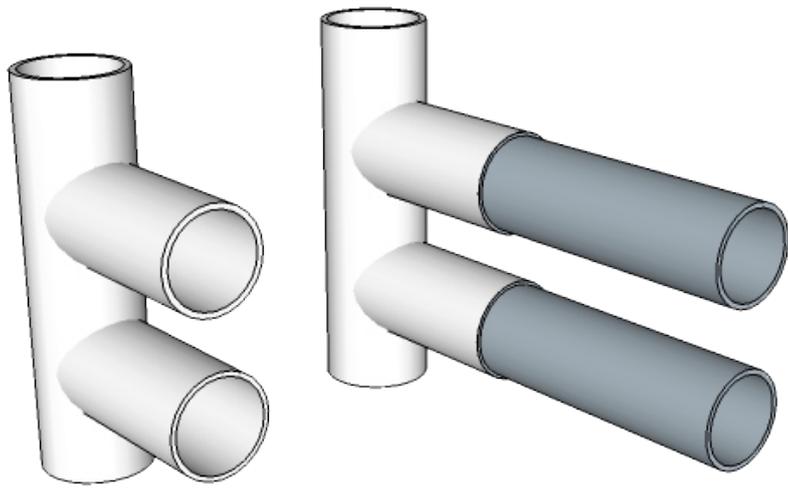


FOUR WAY JOINT. This joint allows four tubes to be fixed together. It is a friction fit, but if the tubes were threaded (had a screw thread) at the end, they would be extremely secure and could be regarded as permanent.



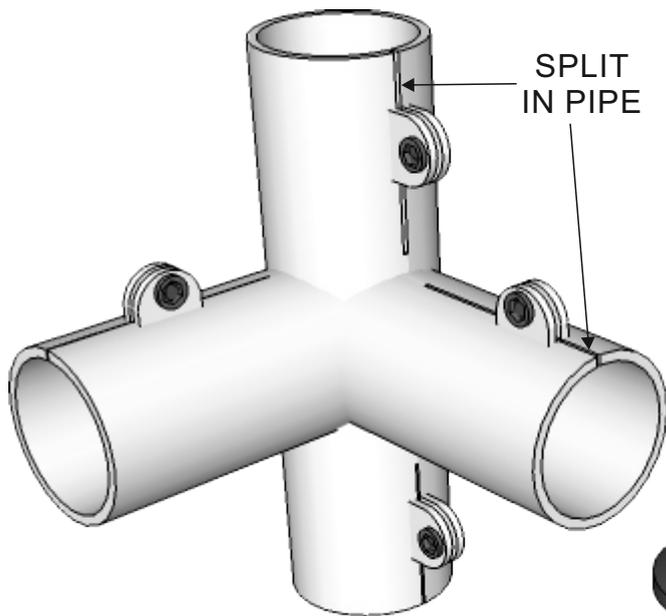
SIX WAY JOINT. This allows up to six tubes to be joined. A friction fit, but if the tube was threaded at each end (screw thread), this would be a very secure joint.





TWO WAY PARALLEL JOINT.
This allows two pieces of tube to be joined in parallel.

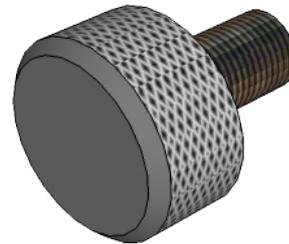
SPLIT TUBE JOINTS



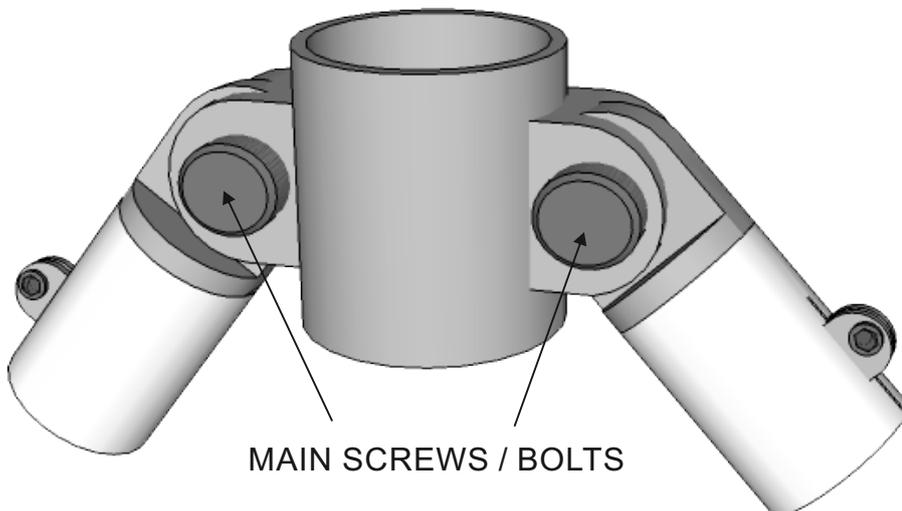
This four way joint can be adjusted / tightened with a allen key. As the allen key is turned, the split in the tube narrows, tightening on the tubes. The allen screw could be replaced with a screw that can be turned by hand, such as a wingnut or a 'knurled' pattern.



ALLEN KEY
FOR TIGHTENING
ALLEN SCREW



KNURLED PATTERN
FOR GRIP
(ENLARGED DRAWING)



ADJUSTABLE JOINT.
Loosening the main screws / bolts, allow the tubes to be adjusted to the right position and then tightened.

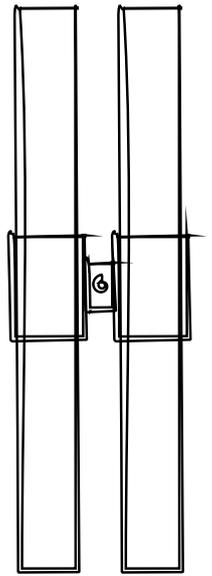
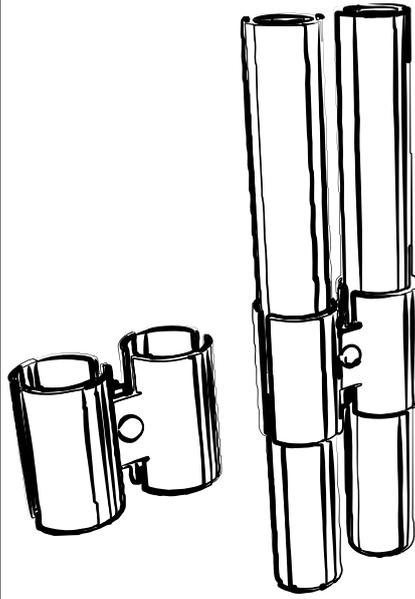
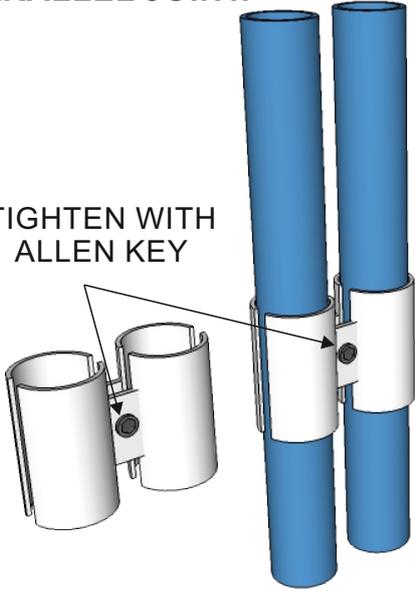
ORIGINAL
DRAWING

3D SKETCH

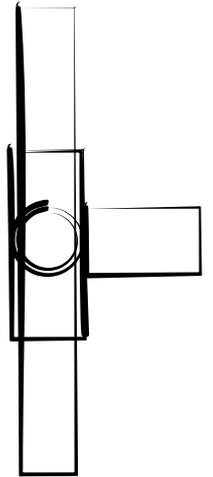
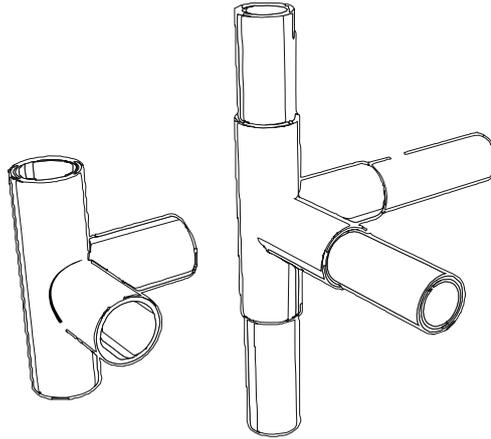
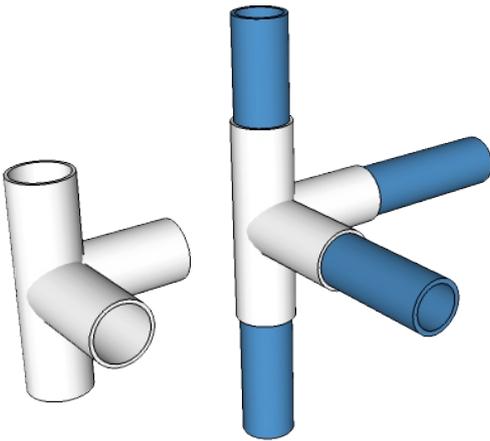
2D SKETCH

PARALLEL JOINT.

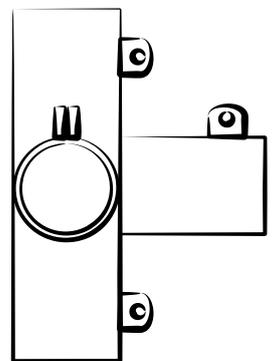
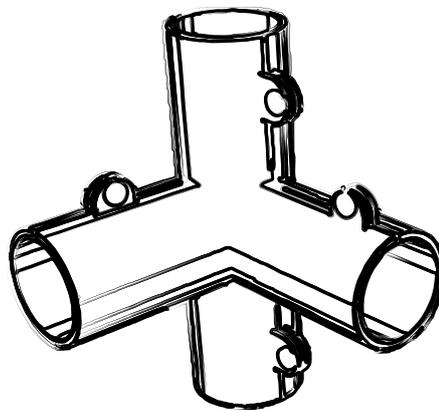
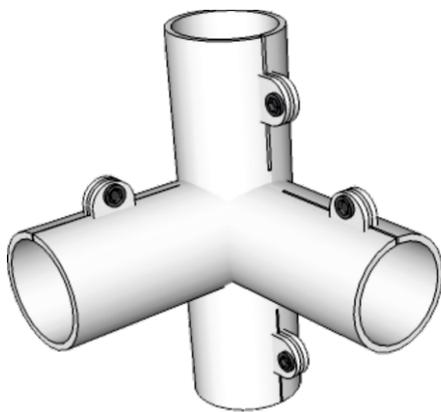
TIGHTEN WITH
ALLEN KEY



THREE WAY JOINT.



FOUR WAY JOINT.

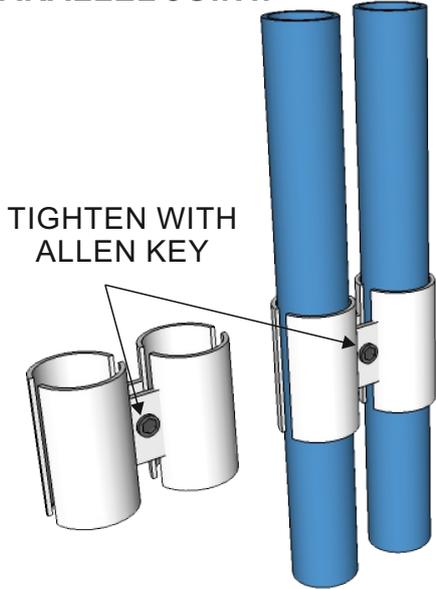


ORIGINAL
DRAWING

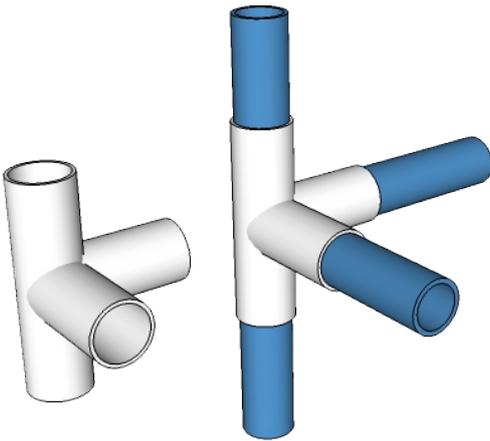
3D SKETCH

2D SKETCH

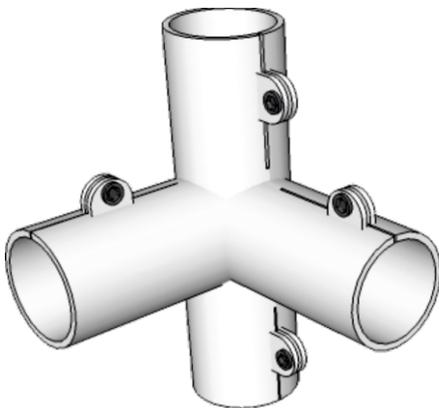
PARALLEL JOINT.



THREE WAY JOINT.



FOUR WAY JOINT.

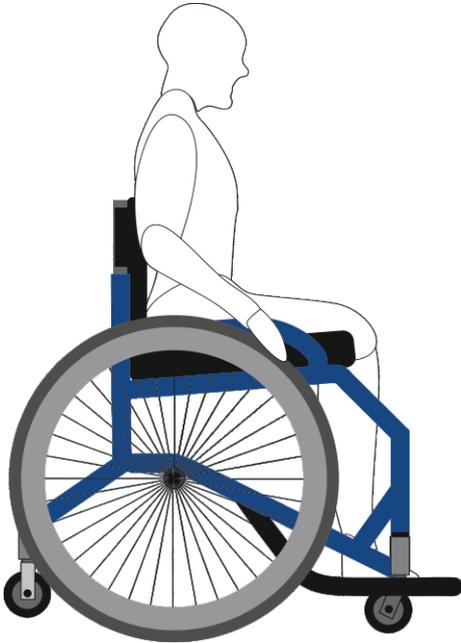


MULTISPORTS WHEELCHAIR - SKETCHING EXERCISE

WORLD ASSOCIATION OF TECHNOLOGY TEACHERS <https://www.facebook.com/groups/254963448192823/> www.technologystudent.com © 2017 V.Ryan © 2017

Study the wheelchair design below, drawn in the top row. In the blank rows below, sketch your version, in pencil or with a fine black pen

SIDE VIEW

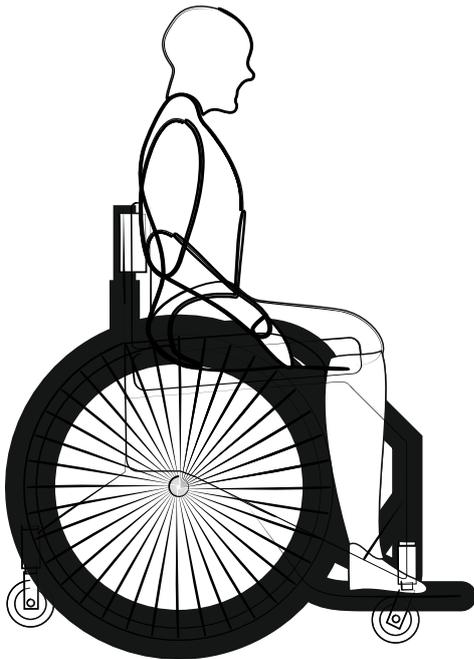


FRONT VIEW

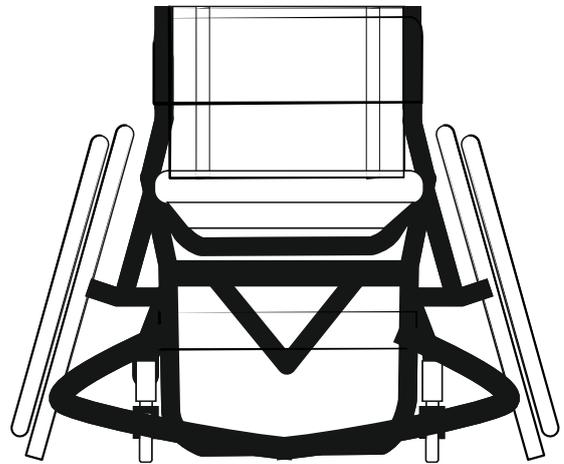


YOUR SKETCHES

SIDE VIEW



FRONT VIEW

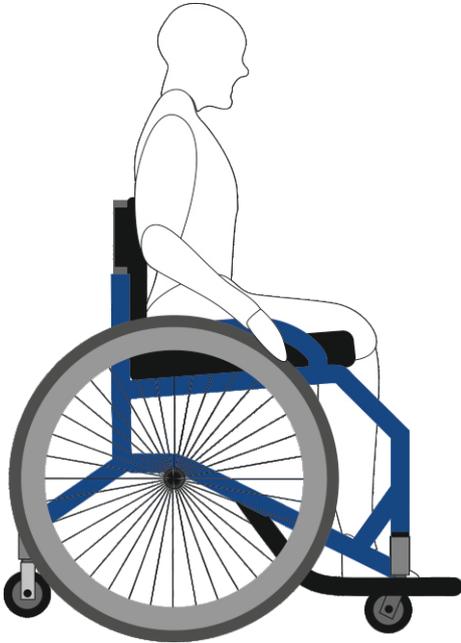


MULTISPORTS WHEELCHAIR - SKETCHING EXERCISE

WORLD ASSOCIATION OF TECHNOLOGY TEACHERS <https://www.facebook.com/groups/254963448192823/> www.technologystudent.com © 2017 V.Ryan © 2017

Study the push chair design below, drawn in the top row. In the blank rows below, sketch your version, in pencil or with a fine black pen

SIDE VIEW



FRONT VIEW



YOUR SKETCHES

SIDE VIEW

FRONT VIEW

SPECIFICATION QUESTION - PRODUCT IN THE STYLE OF THE MULTISPORTS WHEELCHAIR

WORLD ASSOCIATION OF TECHNOLOGY TEACHERS <https://www.facebook.com/groups/254963448192823/> www.technologystudent.com © 2017 V.Ryan © 2017

You are to design a folding chair for use at a music festival, in the style of Motivation's Multisport Wheelchair.

You will:

Write a specification for the folding chair.

Draw a variety of initial ideas, for a folding chair.

Select your best idea and develop it further.

Include detailed notes / annotation that explain your developed design.

Write a specification. Identify four specification points / design requirements for the folding chair.

1. _____

2. _____

3. _____

4. _____

SAMPLE SPECIFICATION POINTS

1. The chair will be in the same style as the Multisports Wheelchair.

2. Lightweight tubular aluminium / steel (round section) will be used in the manufacture of the chair.

3. The chair will fold, so that it can be carried and stored easily. It will lock in position when opened, so that it is safe.

4. The chair will be ergonomically designed, so that it is comfortable when seated and comfortable to pick up, move and fold away.

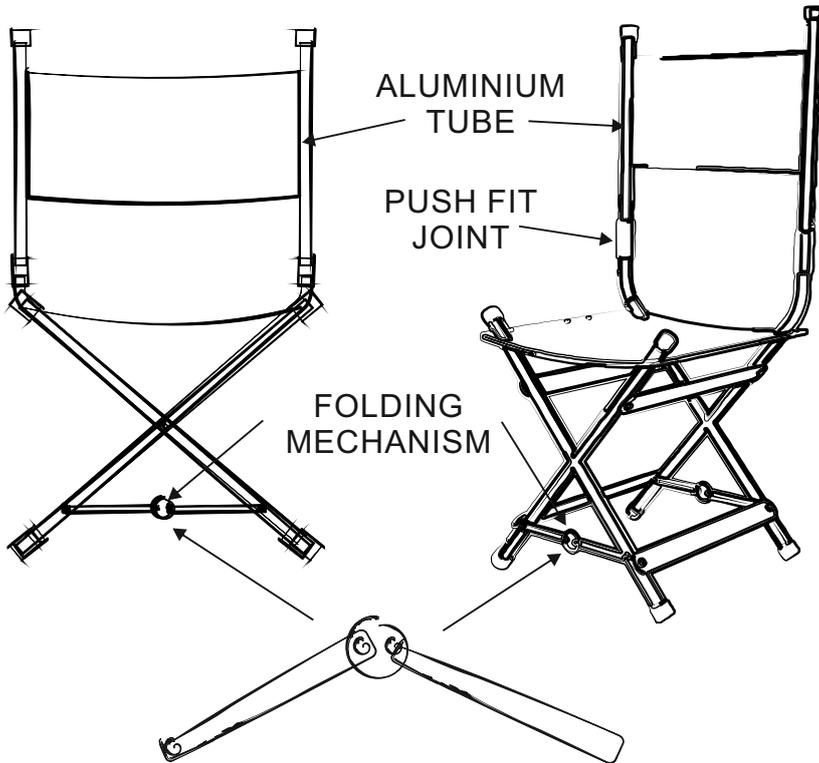
5. The joints will allow for movement (folding) and be strong, in order to take the weight of an adult.

EXAMINATION QUESTION - PRODUCT IN THE STYLE OF THE MULTISPORTS WHEELCHAIR

WORLD ASSOCIATION OF TECHNOLOGY TEACHERS <https://www.facebook.com/groups/254963448192823/> www.technologystudent.com © 2017 V.Ryan © 2017

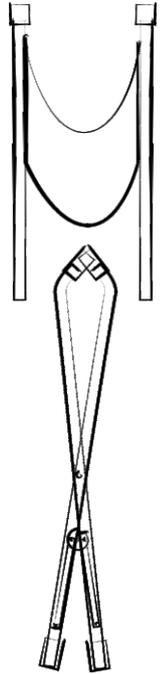
Draw a variety of ideas for your folding chair. Include notes / annotation and labels to help explain your designs.

CHAIR ONE



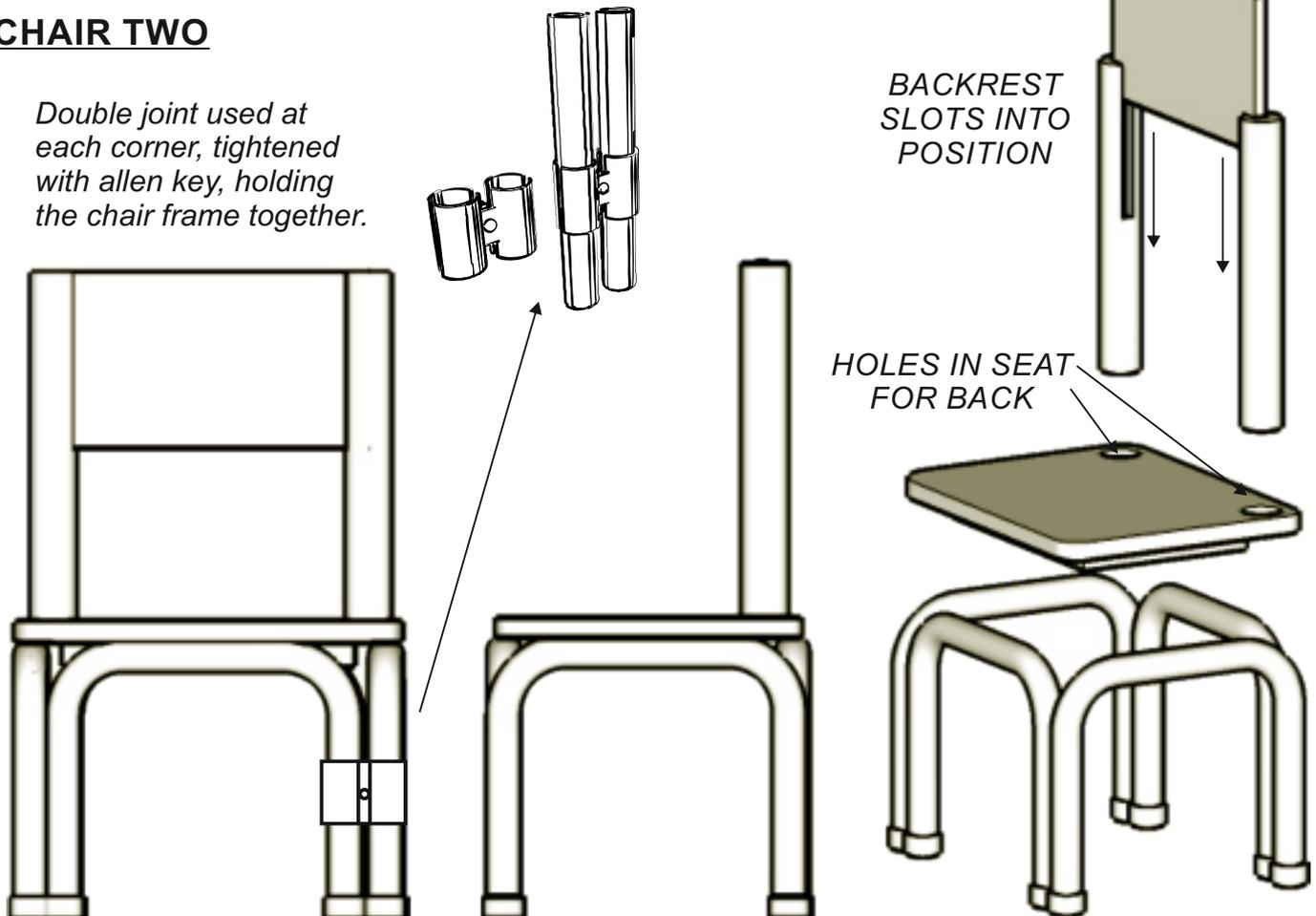
This chair is manufactured from aluminium tube. The folding joints have a rivet at their centre, allowing movement.

The chair folds so that is quite narrow



CHAIR TWO

Double joint used at each corner, tightened with allen key, holding the chair frame together.



EXAMINATION QUESTION - PRODUCT IN THE STYLE OF THE MULTISPORTS WHEELCHAIR

WORLD ASSOCIATION OF TECHNOLOGY TEACHERS <https://www.facebook.com/groups/254963448192823/> www.technologystudent.com © 2017 V.Ryan © 2017

Draw a variety of ideas for your folding chair. Include notes / annotation and labels to help explain your designs.

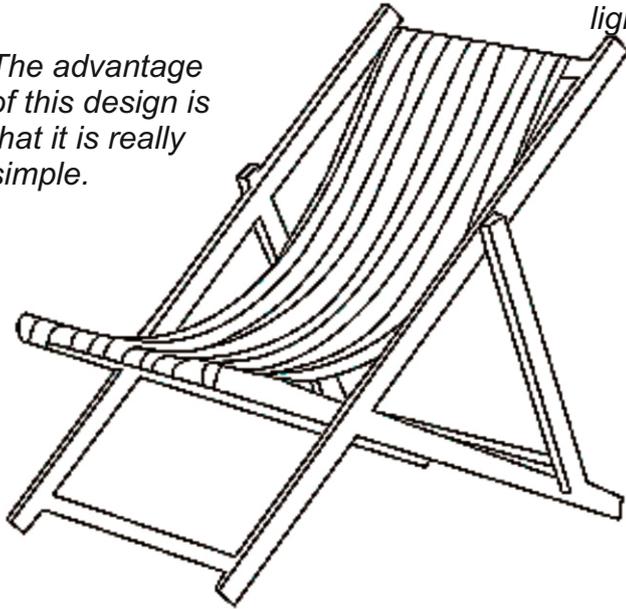
EXAMINATION QUESTION - PRODUCT IN THE STYLE OF MULTISPORTS WHEELCHAIR

WORLD ASSOCIATION OF TECHNOLOGY TEACHERS <https://www.facebook.com/groups/254963448192823/> www.technologystudent.com © 2017 V.Ryan © 2017

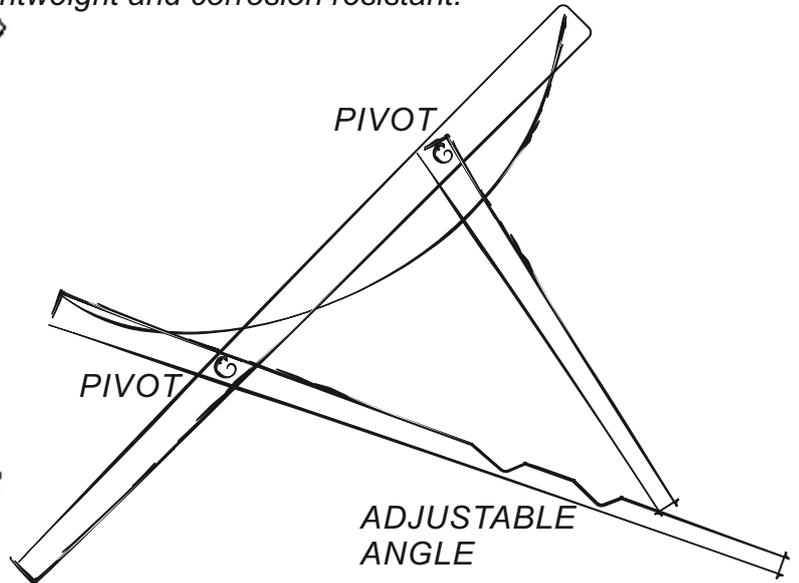
Draw a variety of ideas for your folding chair. Include notes / annotation and labels to help explain your designs.

CHAIR THREE

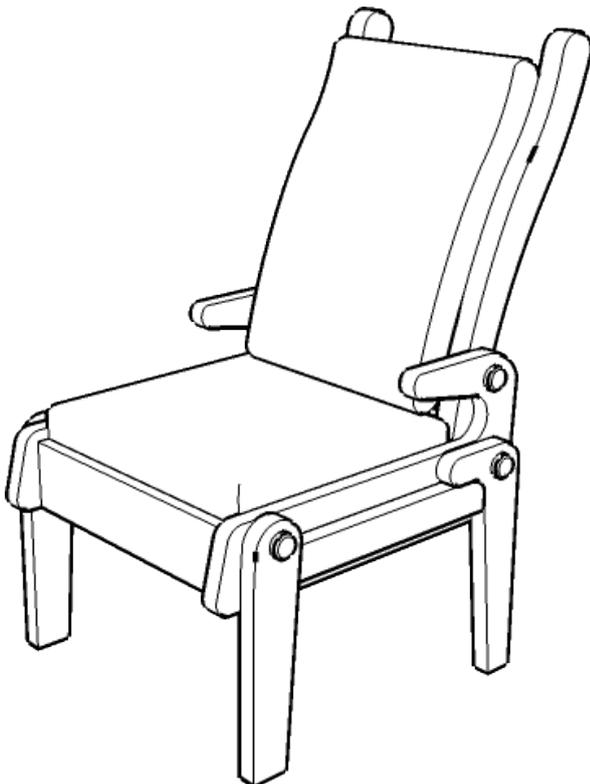
The advantage of this design is that it is really simple.



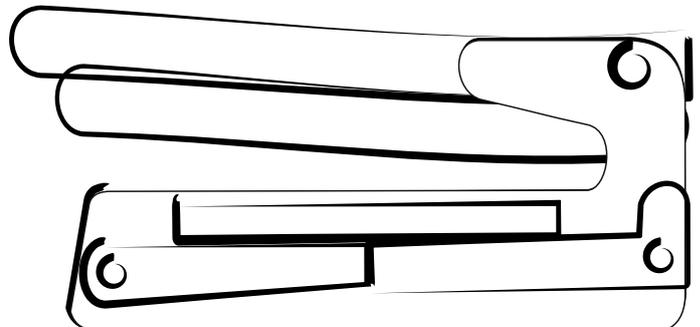
This folding chair is based on a deck chair. Aluminium rectangular section tube is the selected material, as it is lightweight and corrosion resistant.



CHAIR FOUR



This chair folds into a cuboid shape. It can be placed in the back of a car for transport, as it is a regular shape. It has two comfortable cushions and the seating position has been determined to meet ergonomic demands.

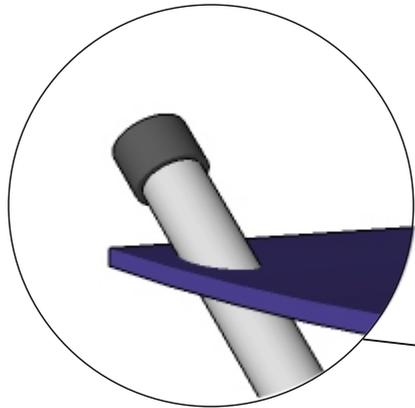


EXAMINATION QUESTION - PRODUCT IN THE STYLE OF MULTISPORTS WHEELCHAIR

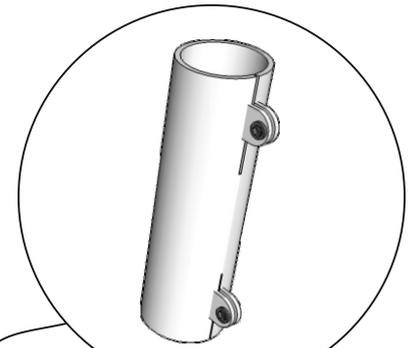
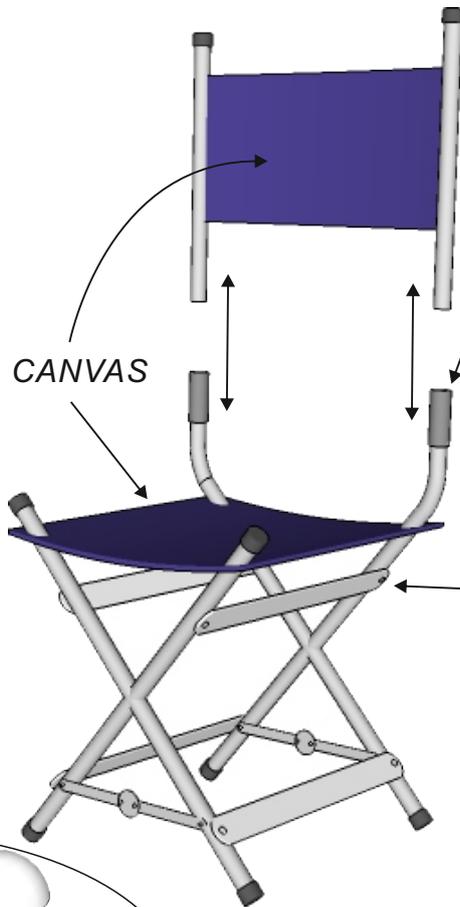
WORLD ASSOCIATION OF TECHNOLOGY TEACHERS <https://www.facebook.com/groups/254963448192823/> www.technologystudent.com © 2017 V.Ryan © 2017

Select your best idea and develop it to a final design. Include notes / annotation and labels to help explain the design and how it meets the original design need (a folding chair for music festivals).

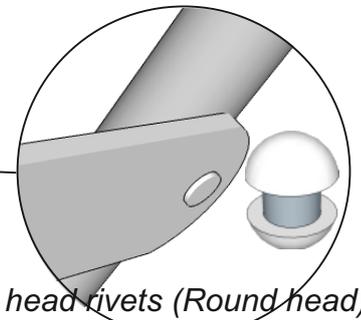
The tubular aluminium is both lightweight and extremely strong



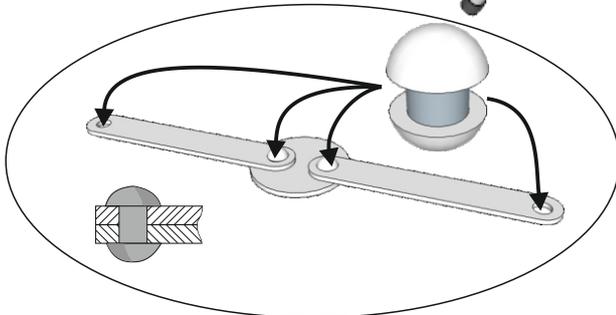
The caps for the end of each piece of tube are manufactured from synthetic rubber or nylon.



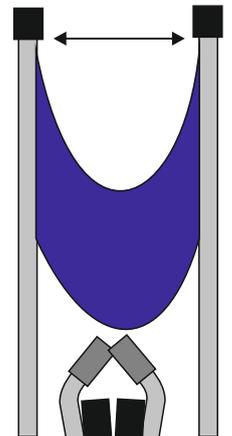
A two-way joint (above) fixes the back with the back folding mechanism, tightened by an allen key



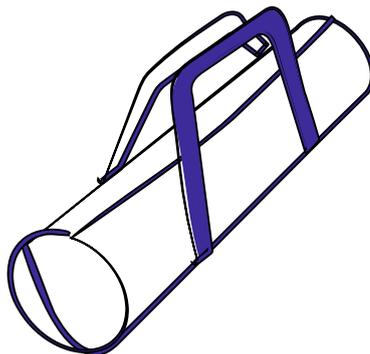
Snap head rivets (Round head) (above) are used to fix the rails and the legs together permanently and they allow movement / folding.



The linkage (left) is connected by four rivets which enable the folding of the front and back legs.



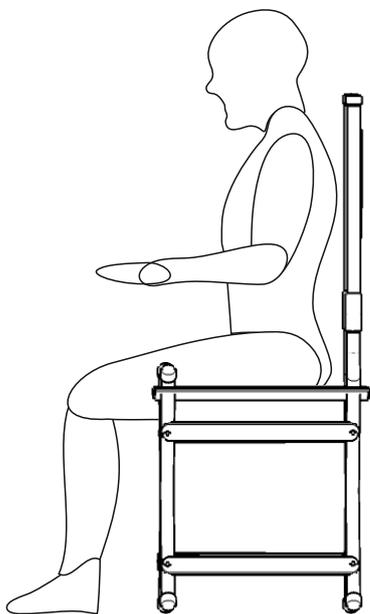
CANVAS BAG FOR FOLDING CHAIR



The chair can be folded to a small 'footprint' / size.

The back rest folds separately.

Both parts of the folding chair are stored in 'long' canvas bag.



ERGONOMIC POSTURE

EXAMINATION QUESTION - PRODUCT IN THE STYLE OF MULTISPORTS WHEELCHAIR

WORLD ASSOCIATION OF TECHNOLOGY TEACHERS <https://www.facebook.com/groups/254963448192823/> www.technologystudent.com © 2017 V.Ryan © 2017

Select your best idea and develop it to a final design. Include notes / annotation and labels to help explain the design and how it meets the original design need (a folding chair for music festivals).

EXAMINATION QUESTION - PRODUCT IN THE STYLE OF MULTISPORTS WHEELCHAIR

WORLD ASSOCIATION OF TECHNOLOGY TEACHERS <https://www.facebook.com/groups/254963448192823/> www.technologystudent.com © 2017 V.Ryan © 2017

How does your final design meet each of the four specification points you wrote earlier? Use sketches and notes to answer this question.

1. The chair will be in the same style as the Multisports Wheelchair.

I selected tube for my folding chair, as it is the same style as the Multisports wheelchair. The mixture of canvas and tube also relates to traditional wheelchairs. In addition the chair folds away.

2. Lightweight tubular aluminium / steel (round section) will be used in the manufacture of the chair.

The round section aluminium tube I have selected for my design, is ideal as it is lightweight and yet strong. The aluminium is easy to cut and shape compared to steel, with the added bonus that it will not 'rust'. A cheaper version could be manufactured from steel tube.

3. The chair will fold, so that it can be carried and stored easily. It will lock in position when opened, so that it is safe.

My chair can be folded with ease, as seen in the developed design. It is in two parts and is kept in its own canvas bag. This keeps the two parts together, ready for use next time it is needed. The folding mechanism locks in position, when the chair is open and ready for use.

4. The chair will be ergonomically designed. It will be comfortable when seated and comfortable to pick up, move and fold away.

The chair has been designed with ergonomics in mind. The canvas seat is comfortable and the vertical back rest ensures that the person sat on the chair, is sat in the correct posture. The height of the seat has been calculated using anthropometric data, working out the average seating distance.

5. The joints will allow for movement (folding) and they will be strong, in order to take the weight of an adult.

The main linkage joints allow the necessary folding and are very strong due to using rivets. The moving joints do not comprise the strength of the chair. The two way push fit joint, has allen key adjustment that locks the joint and tube together. The chair is strong and stable and will have a long life cycle. It can be completely recycled at the end of its lifetime.

EXAMINATION QUESTION - PRODUCT IN THE STYLE OF MULTISPORTS WHEELCHAIR

WORLD ASSOCIATION OF TECHNOLOGY TEACHERS <https://www.facebook.com/groups/254963448192823/> www.technologystudent.com © 2017 V.Ryan © 2017

How does your final design meet each of the four specification points you wrote earlier? Use sketches and notes to answer this question.

1. The chair will be in the same style as the Multisports Wheelchair.

2. Lightweight tubular aluminium / steel (round section) will be used in the manufacture of the chair.

3. The chair will fold, so that it can be carried and stored easily. It will lock in position when opened, so that it is safe.

4. The chair will be ergonomically designed. It will be comfortable when seated and comfortable to pick up, move and fold away.

5. The joints will allow for movement (folding) and they will be strong, in order to take the weight of an adult.

OTHER POTENTIAL PRODUCTS YOU
MAY NEED TO DESIGN AND
INFORMATION YOU NEED TO KNOW.

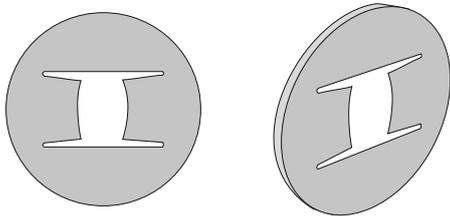
**REMEMBER, THE PRODUCTS YOU
DESIGN, MUST BE DESIGNED IN THE
STYLE OF THE MULTISPORTS
WHEELCHAIR.**

FITTINGS FOR WHEELS, SHAFTS AND SCREW THREADS

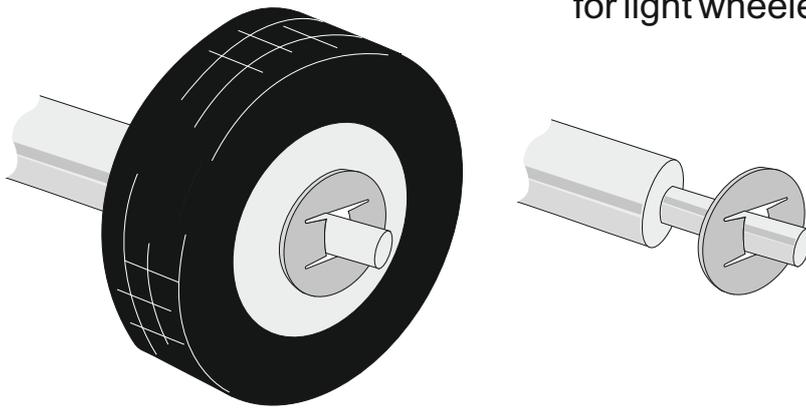
WORLD ASSOCIATION OF TECHNOLOGY TEACHERS <https://www.facebook.com/groups/254963448192823/> www.technologystudent.com © 2017 V.Ryan © 2017

A large range of fittings for wheels, shafts and screw threads are available. Most fittings are temporary in that they can be tightened and untightened when required. All the fittings shown here are strong, safe and low cost.

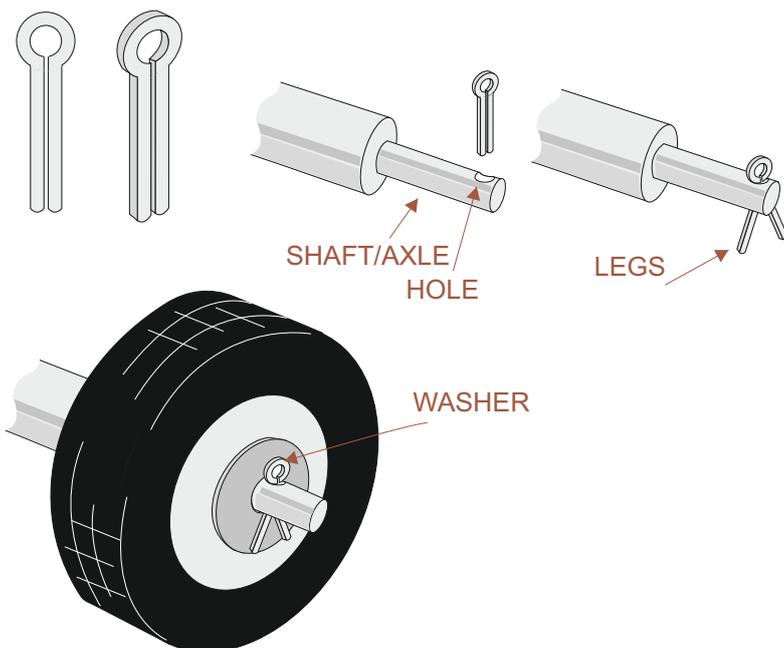
Push on Fittings.



Push on fittings are very popular as they are simply pushed onto the steel / plastic shaft. They are made from hardened spring steel which makes them tough and flexible. They can only be pushed in one direction only (forwards). To remove them they must be forced backwards, this will damage them so that they cannot be used again. As they are very cheap and disposable, they can be replaced. They are suitable for light wheeled vehicles such as light trolleys.



Split Pins



Split pins are very common as they are easy to use and effective. Often they are found on self-assembly trolleys, light wheel barrows, lawn mowers and similar items. They are usually made from 'soft' steel or aluminium and they come in a range of sizes.

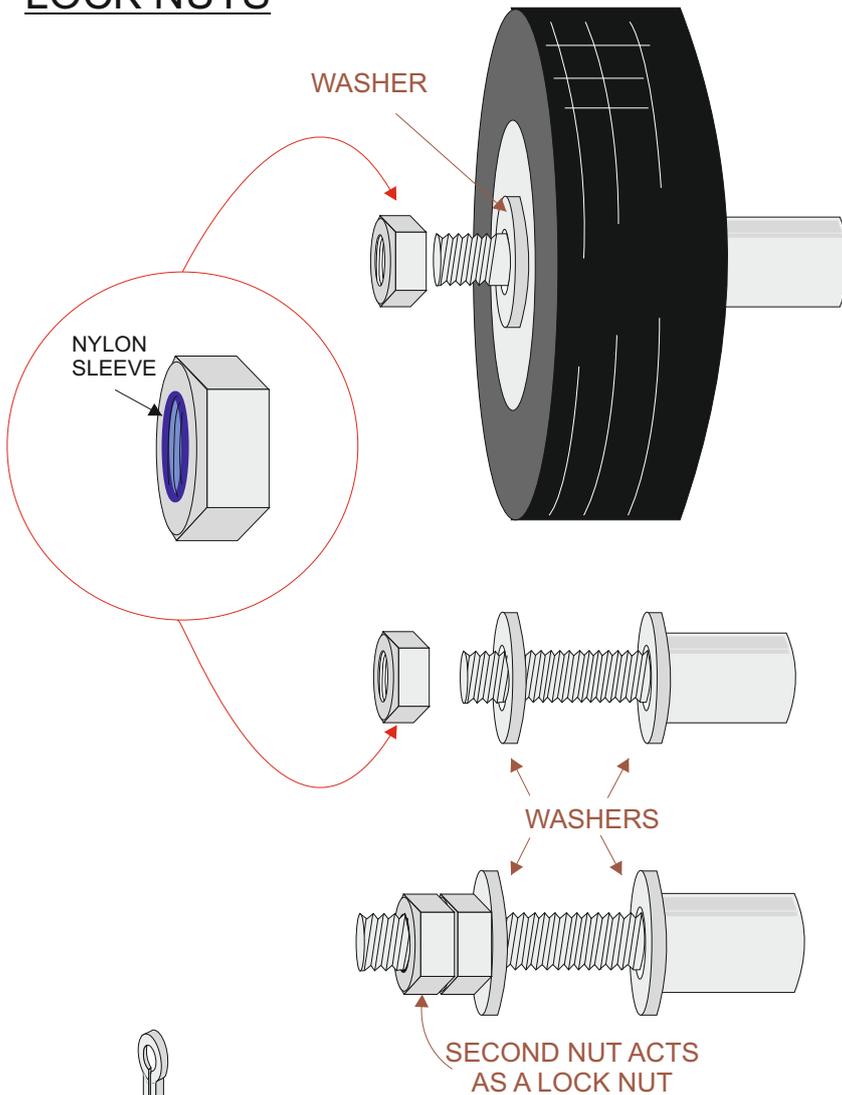
The shaft/axle is normally drilled so that the split pin can drop through or can be 'tapped' through with a hammer. The legs of the split pin are then bent to form an angle, holding the split pin and wheel in place.

A washer can be used to reduce friction between the split pin and the wheel.

Split pins are strong but after time they can wear and break.

FITTINGS FOR WHEELS, SHAFTS AND SCREW THREADS

LOCK NUTS



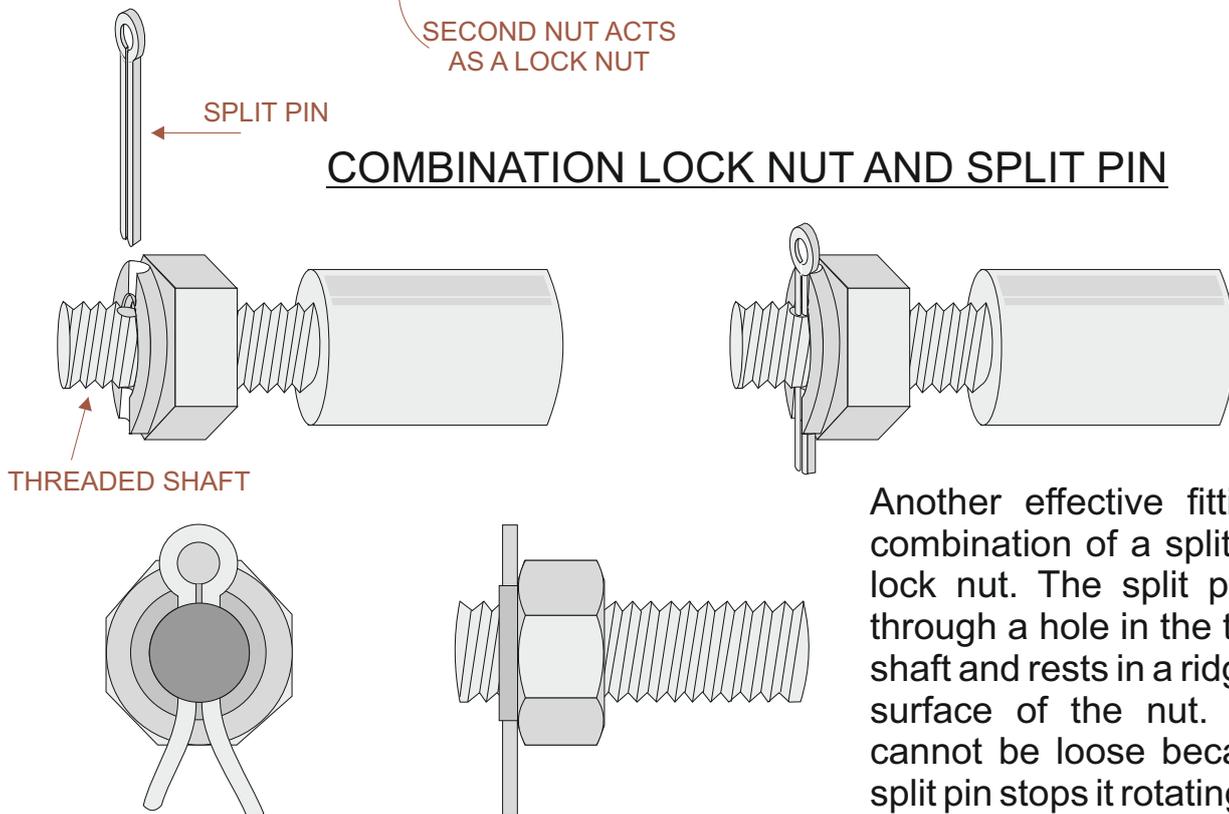
Lock nuts are very useful and are used by engineers and mechanics. The diagram opposite shows a wheel pushed onto a threaded shaft. Washers are placed on either side of the wheel and a lock nut is finally threaded in position. This is a highly effective method of securing a wheels on shafts / axles.

A close look at the lock nut shows that it has a nylon sleeve. As the nut is tightened, the thread on the shaft / axle cuts into the nylon, holding it firmly in position.

As the wheel rotates a normal nut will loosen because of friction and vibration of the wheel. However, the nylon holds the nut firmly in position.

An alternative is to use two normal nuts. The second locks the first in position.

COMBINATION LOCK NUT AND SPLIT PIN



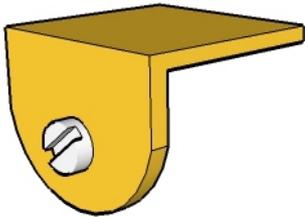
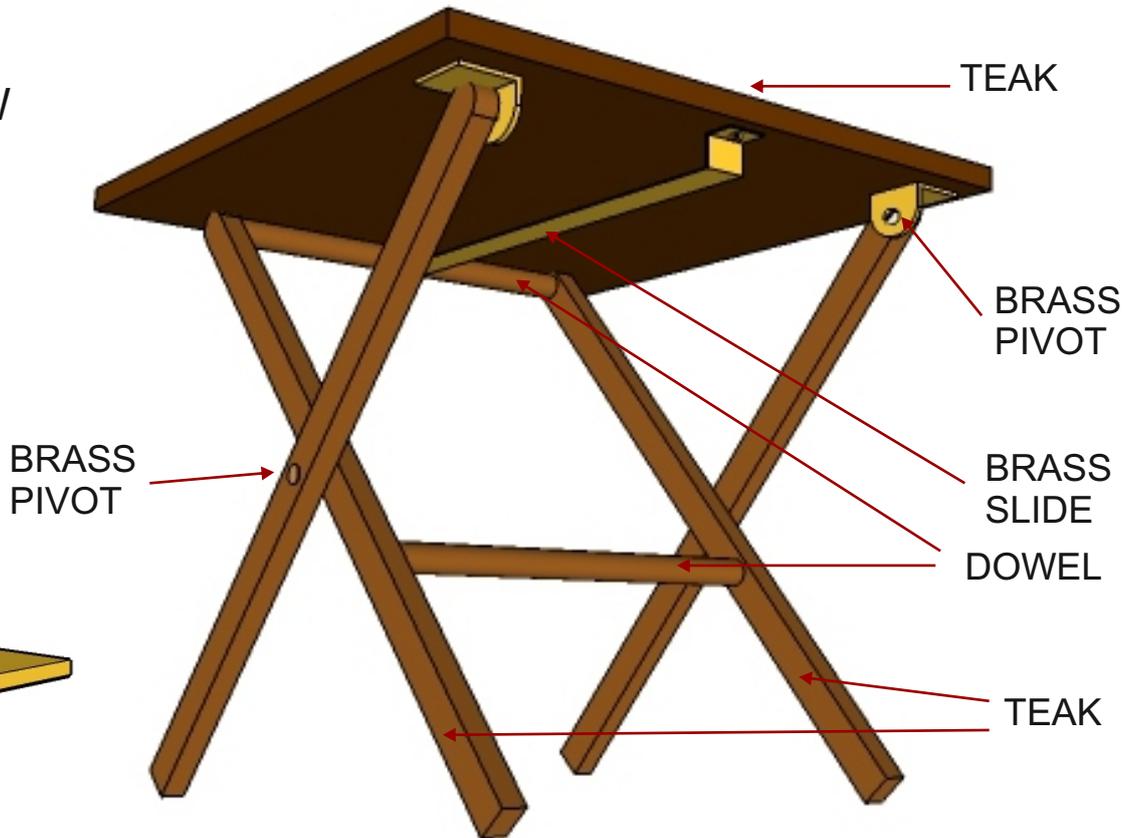
Another effective fitting is a combination of a split pin and lock nut. The split pin drops through a hole in the threaded shaft and rests in a ridge on the surface of the nut. The nut cannot be loose because the split pin stops it rotating.

PRODUCT 1 - WOOD BASED (TEAK)

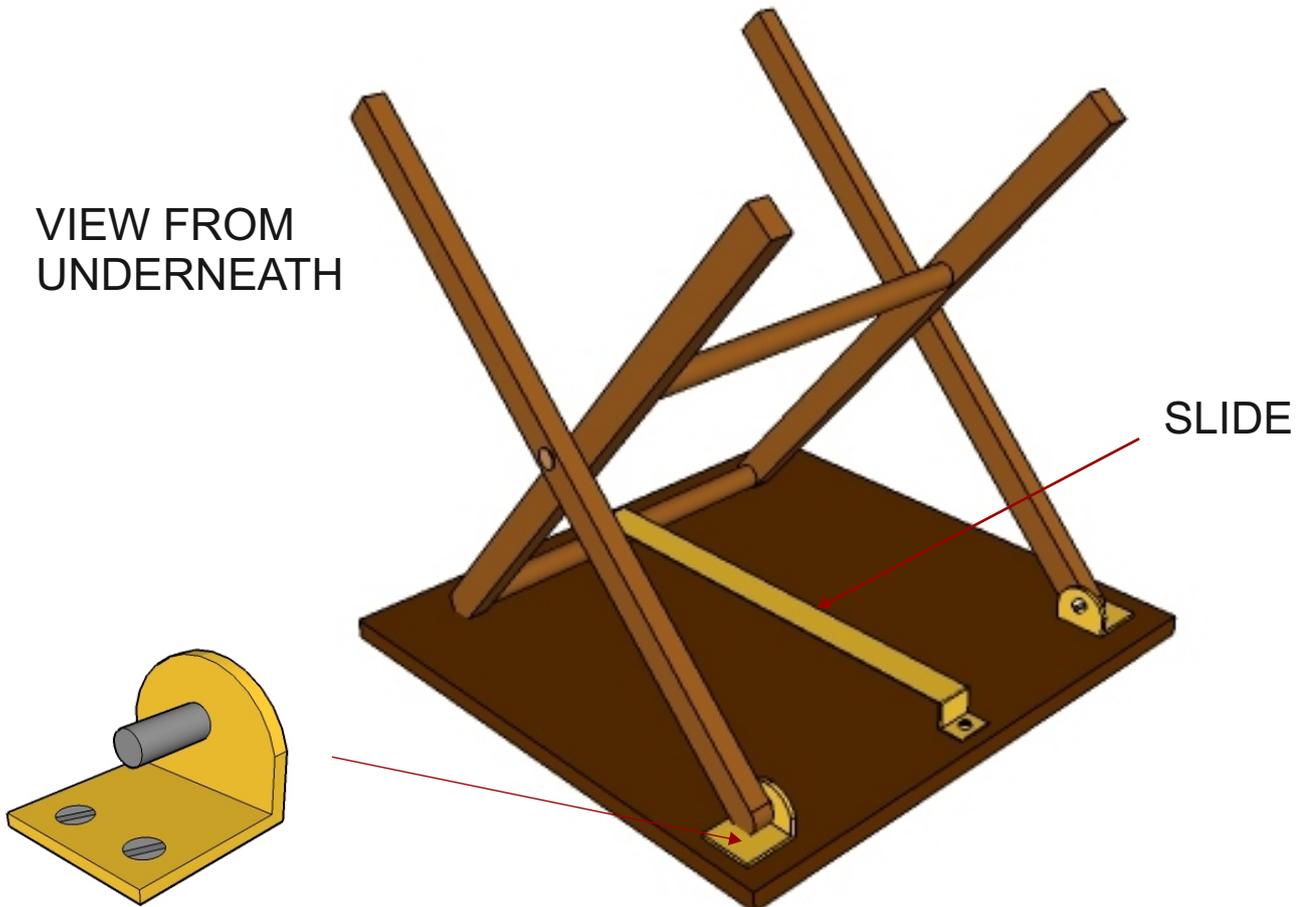
WORLD ASSOCIATION OF TECHNOLOGY TEACHERS <https://www.facebook.com/groups/254963448192823/> www.technologystudent.com © 2017 V.Ryan © 2017

Teak is a natural wood, ideal for outside furniture. It contains natural oils that protect it against wet and cold weather. It can also be treated with teak oil giving it more protection against the elements. Teak is expensive although the growth of sustainable teak plantations means that the price will eventually fall and it will be more widely available.

3D VIEW

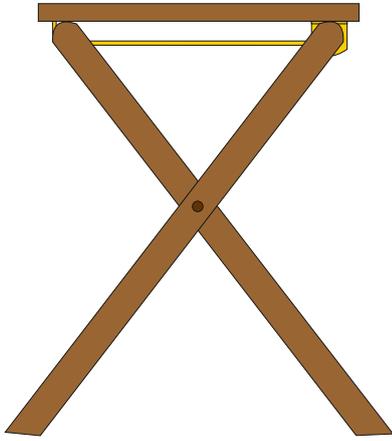


VIEW FROM UNDERNEATH

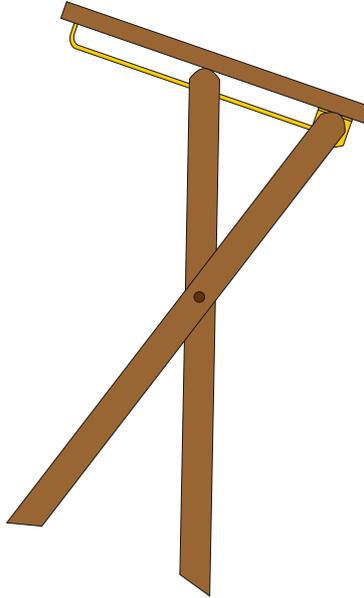


The teak table folds away very easily. Care must be taken to protect hands and fingers by ensuring that they are away from the moving parts. The brass fittings will not rust or require oiling. The surface of the table can be wiped clean. If stored outside, a coating of teak oil each summer/spring will keep the table in good condition.

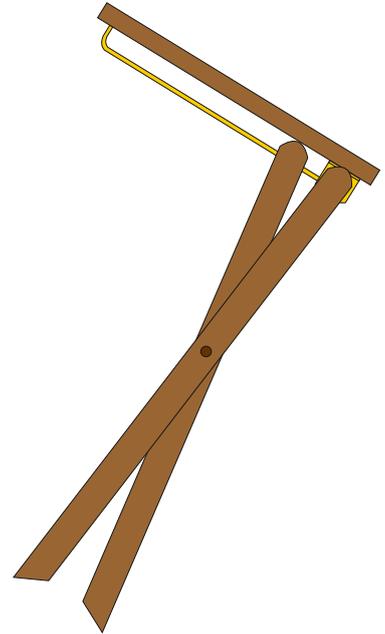
1.



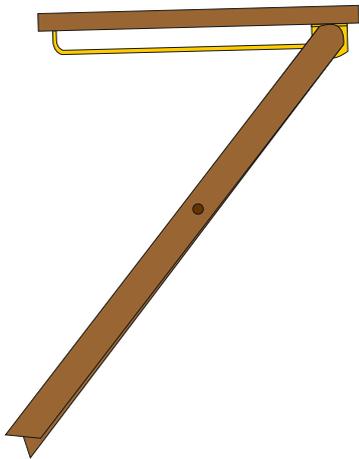
2.



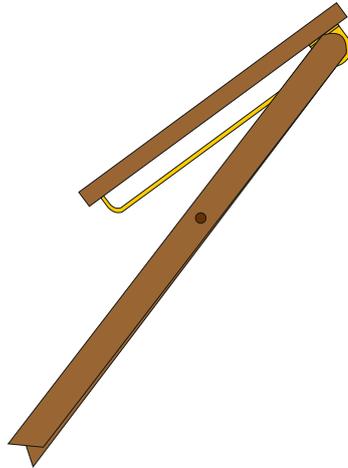
3.



4.



5.



6.



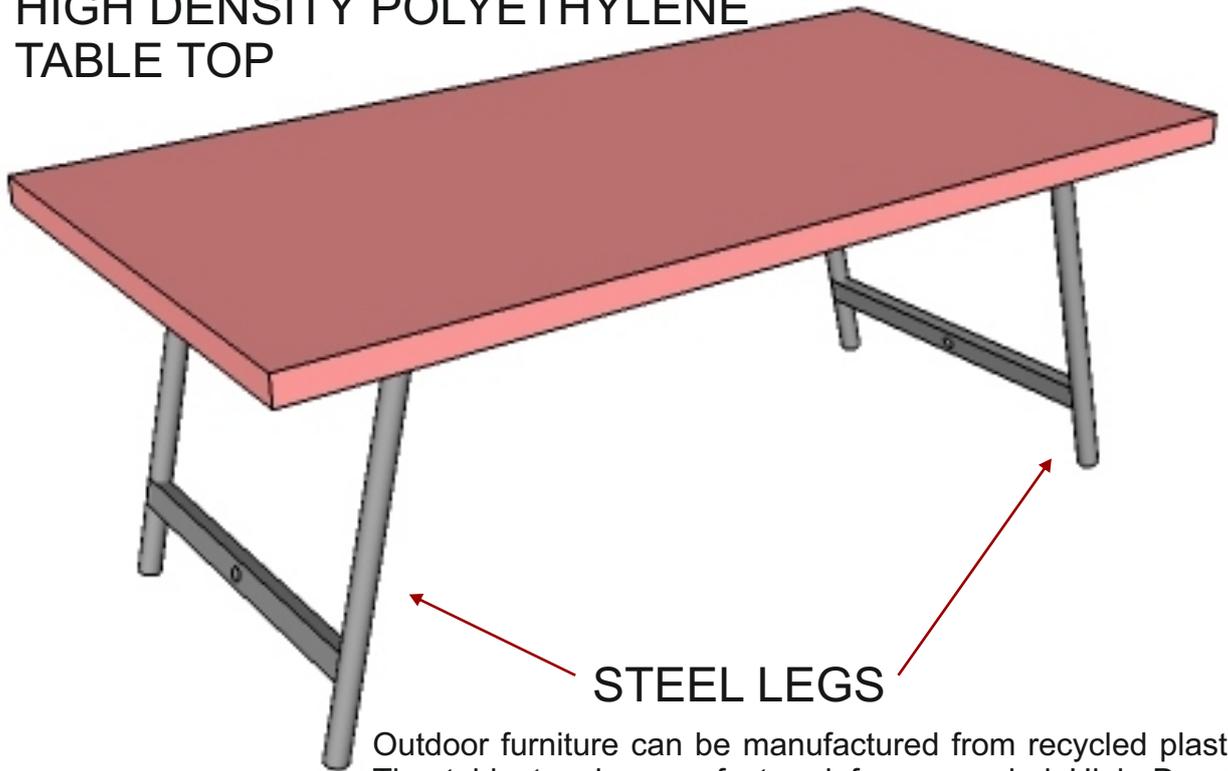
This table is quite small although it could easily be redesigned so that the table top is larger. Being small it will fit in the boot of a car easily. However, it is not particularly strong and if excess weight is applied it may break/collapse.

What do you think of the table?

HDPE AND STEEL/ALUMINIUM

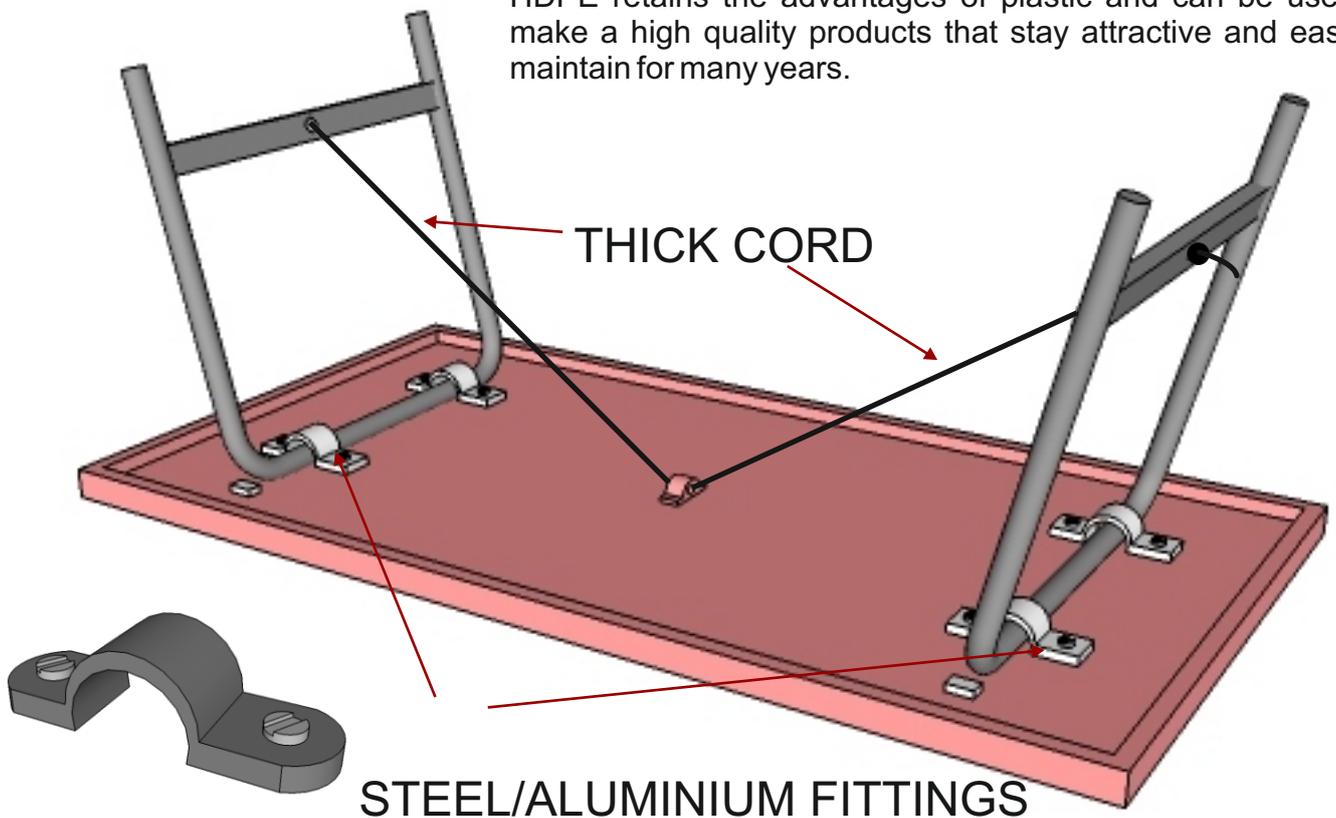
HIGH DENSITY POLYETHYLENE TABLE TOP

3D VIEW



STEEL LEGS

VIEW FROM
UNDERNEATH



THICK CORD

STEEL/ALUMINIUM FITTINGS

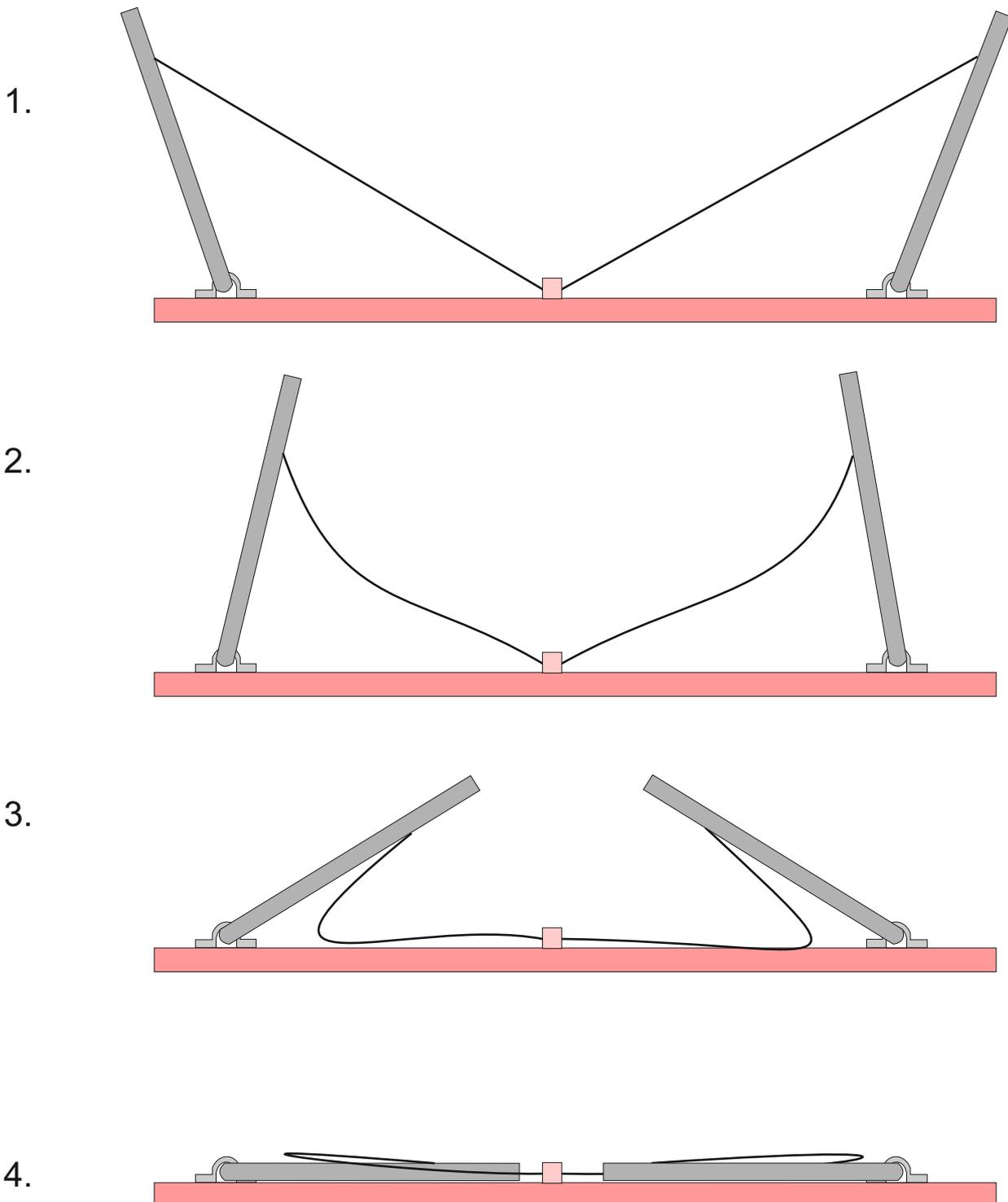
Outdoor furniture can be manufactured from recycled plastic. The table top is manufactured from recycled High Density Polyethylene (HDPE) - HDPE is endlessly recyclable. HDPE can be given the appearance of wood by the use of colour pigments during the injection moulding process. However, HDPE retains the advantages of plastic and can be used to make a high quality products that stay attractive and easy to maintain for many years.

The legs and fittings of this piece of furniture can be manufactured from recycled steel or aluminium.

STAGES - FOLDING THE TABLE

WORLD ASSOCIATION OF TECHNOLOGY TEACHERS <https://www.facebook.com/groups/254963448192823/> www.technologystudent.com © 2017 V.Ryan © 2017

When set up the cord holds the table legs firmly in position. For folding the table is turned upside down and the legs easily fold into the table top. As this happens the cord becomes slack. Care must be taken to wrap the cord rather than allowing it to become loose. If this happens could cause a trip hazard for an adult and be even more dangerous to a young child.



This type of table is very light and can be carried quite easily. It can be stored in the boot of a car for transport. The surface of the table can be cleaned by simply wiping it with a damp cloth.

The table is cheap to mass produce as the top is injection moulded. The tube legs can be formed very easily using a pipe bender. All the materials - HDPE and aluminium/steel can be recycled and used again.

MANUFACTURING A STEEL / ALUMINIUM TROLLEY



The trolley is manufactured from round section steel tube, solid section round steel, sheet steel, square section steel tube and square section aluminium tube.

Why do you think a combination of materials have been used to manufacture this trolley?

Why does the shelf have 'slots', where material has been removed?

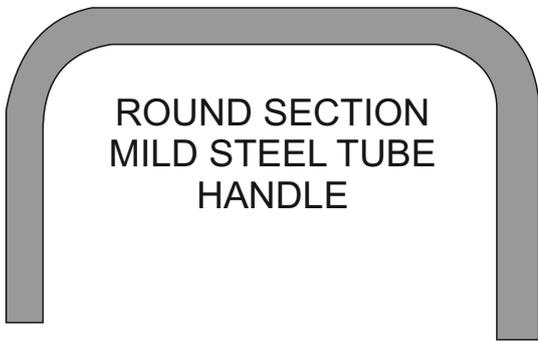
For each of the identified parts, name the metal and section, giving reasons for their inclusion.

WORLD ASSOCIATION OF TECHNOLOGY TEACHERS <https://www.facebook.com/groups/254963448192823/> www.technologystudent.com © 2017 V.Ryan © 2017

PART	SECTION	REASON
HANDLE		
SIDE		
STRENGTHENING PIECE		
SHELF		

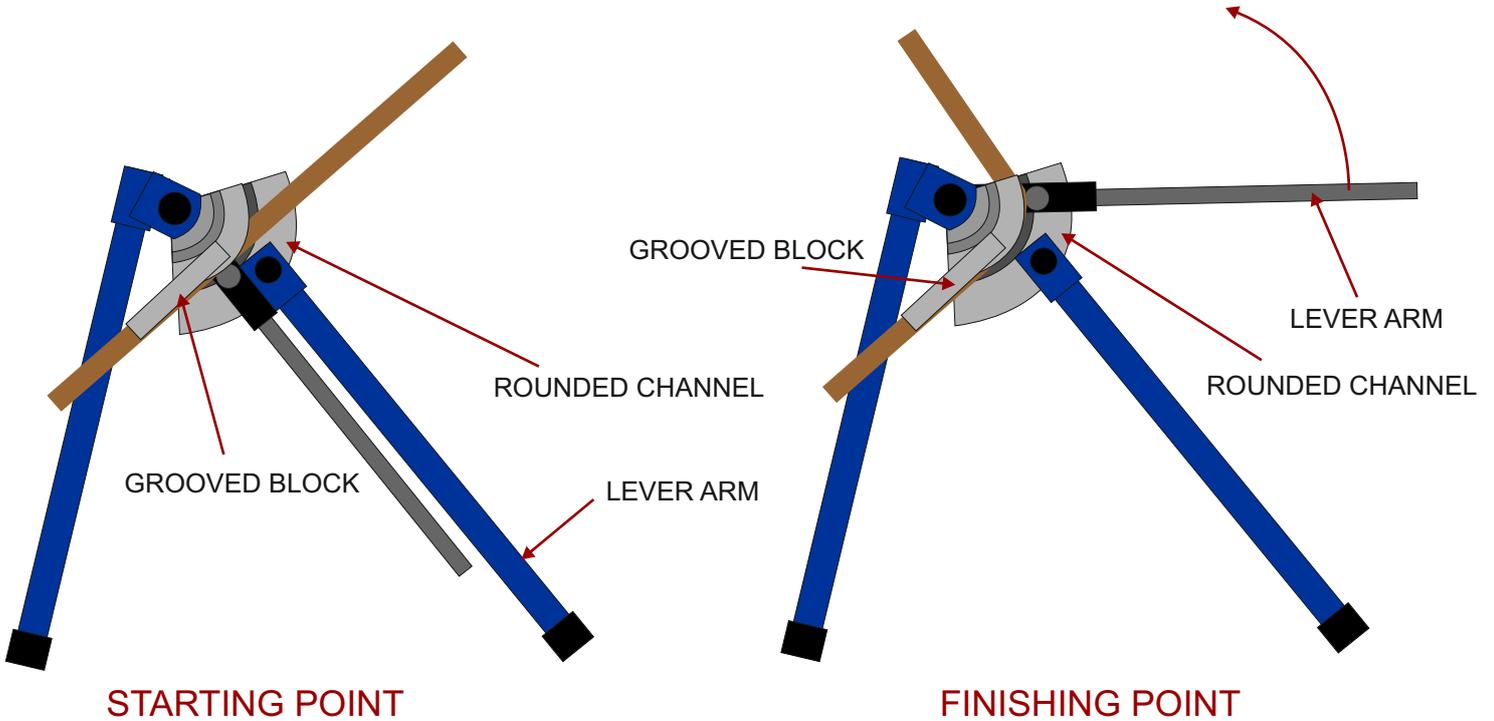
Steel can corrode if its surface is left unprotected. What type of corrosion forms on the surface of unprotected steel?

Describe the various ways in which steel can be protected from the corrosion you named above.



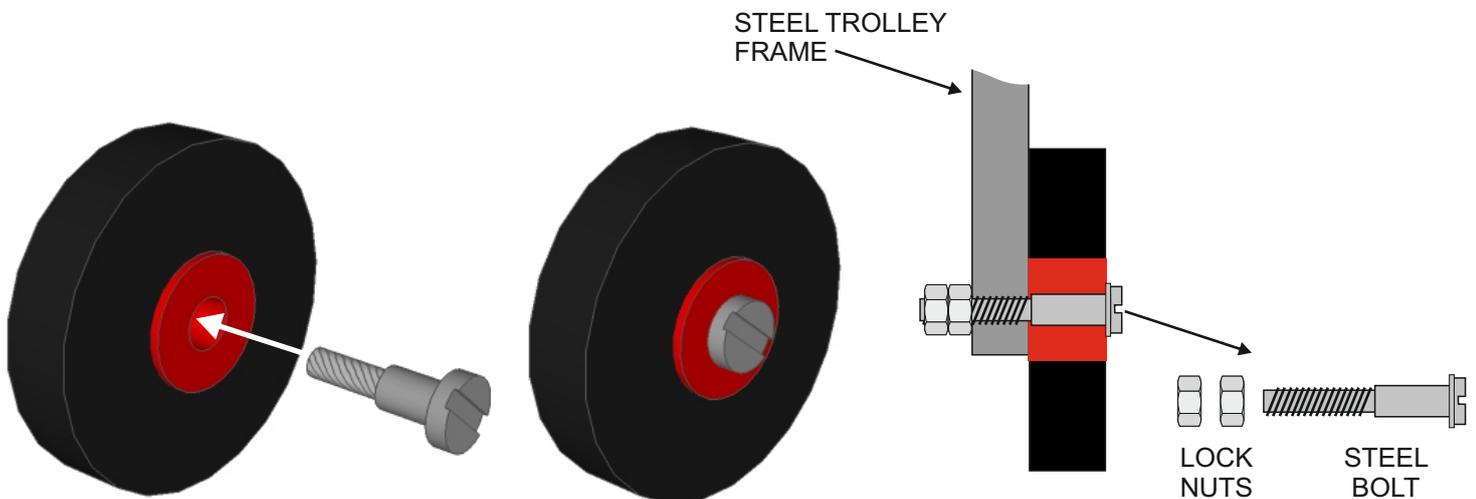
A pipe bender is used to form the 'curved' trolley handle. A pipe bender is a piece of equipment used to bend tube to a precise radius. The rounded channel can be replaced with one that has a larger or smaller radius. The tube is first positioned in a straight grooved block - this holds it firmly. The lever arm is then rotated, bending the pipe slowly to the shape of the rounded channel. The handle is formed in this way.

WORLD ASSOCIATION OF TECHNOLOGY TEACHERS <https://www.facebook.com/groups/254963448192823/> www.technologystudent.com © 2017 V.Ryan © 2017



With great care, even unusual shapes can be achieved. Sometimes the tube may need to be packed with sand to prevent distortion and weakening of the tube wall.

The steel bolts are manufactured using a centre lathe. The wheels will eventually be held in position using the bolts and lock nuts. The wheel will rotate and yet remain attached to the main frame of the trolley.



The trolley is ready for assembly using a simple range of everyday tools such as screw drivers and spanners, as well as specialised processes including brazing and welding.

