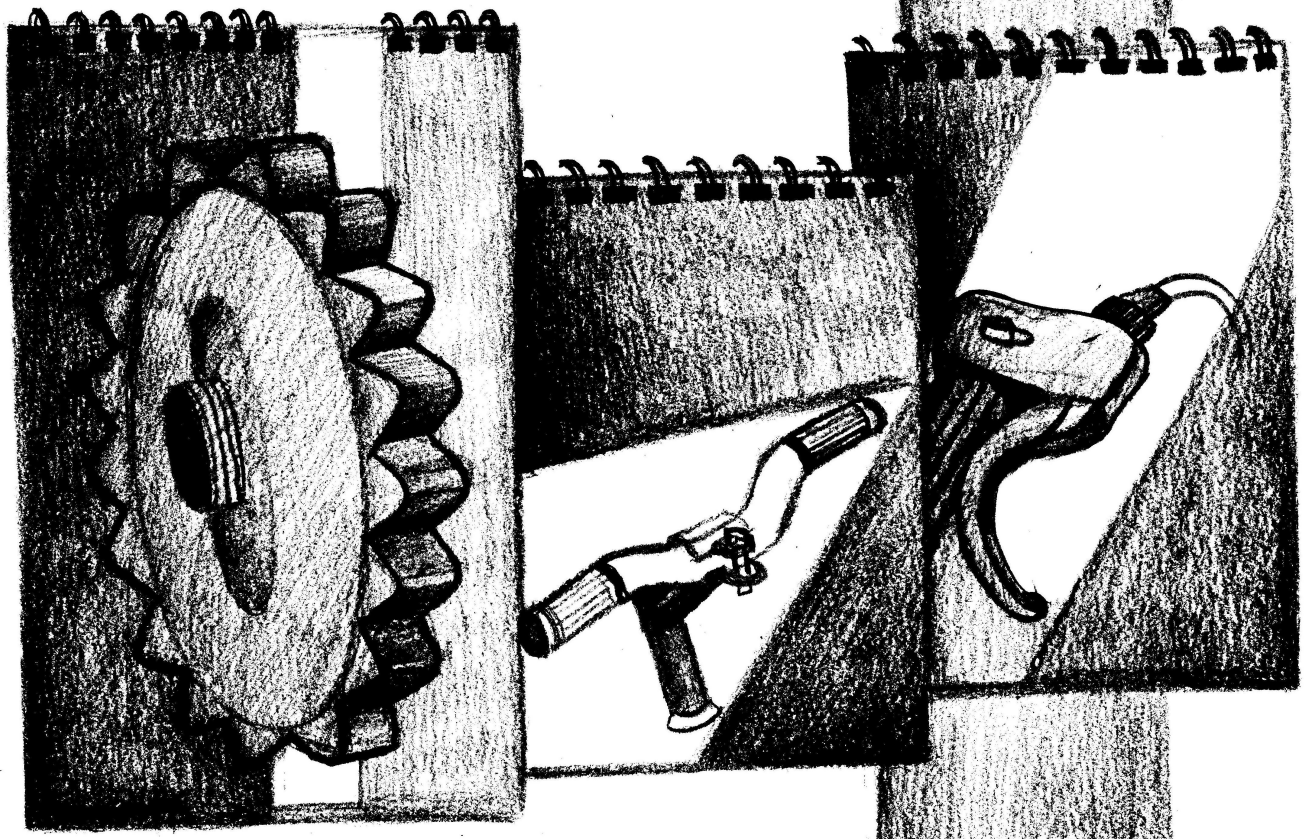
CYCLE-OPEDIA

Learning Expedition for Educators
2010



Introduction

In the early morning mist a young girl mounts her bicycle. As she pushes off and begins pedaling, a smile lights her face. She is riding to school, a place that had been too great a distance for her until a bike was placed in her hands. Now, because this girl can attend school regularly, she dreams of becoming a doctor. Stories like this are repeated in countless villages across India.

In another village, a freed force labor slave pedals to a job twelve kilometers away, work not accessible to him by foot or bus. Because of the bicycle he has found a job that pays him a fair wage.

Fetching water, carrying crops to a more profitable market, delivering lunch to husbands in the fields, granting many women and girls an experience of freedom – the bicycle makes all of these possible. Many who cannot afford a scooter or car discover new opportunities on this two-wheeled wonder of machine efficiency.

The bicycle transforms the energy of the human body into greater strength and endurance than any other machine. This booklet wants to share with you the science behind this extraordinary invention, some if its history, and quotations from riders whose lives have been deeply changed through the bicycle.

Transforming energy, transforming lives – behold the bicycle!

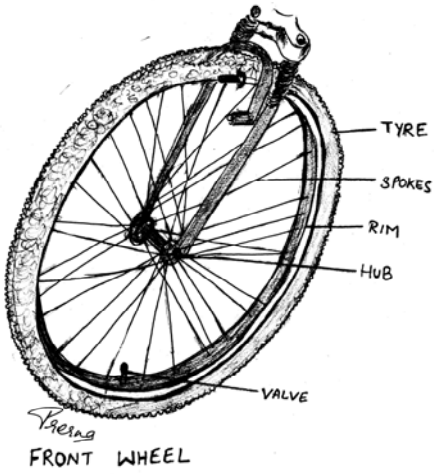
The Authors

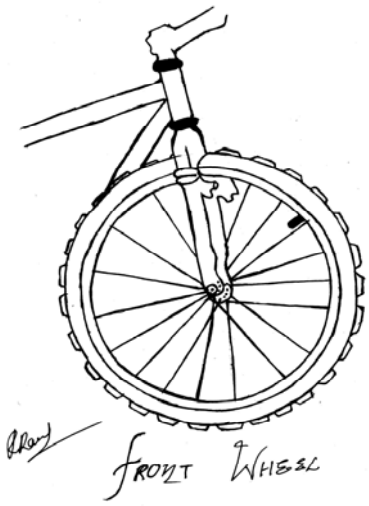
The authors of this book are Educators of Heritage School, Gurgaon and Vasant Kunj who came together for a five day Learning Expedition on Bicycles. The objective of this expedition was to enable educators to develop the understanding of how bicycles can be used as a meaningful context for developing the conceptual understanding and skills required for children. As part of the expedition educators worked on different systems and parts of the bicycle, understanding the science behind the working of each part and their role in the functioning of the bicycle. This manual is the product of research and hands-on work that educators went through in the five days of intensive learning.
Following systems were studied by the educators

1. Front wheel System – Crew 1: Nilam, Shibani, Anjali, Rabindra, Prerna
2. Brake System – Crew 2: Mitu, Reshmi, Poonam, Narayana and Ritu
3. Crank and Pedal System – Crew 3: Prakash, Prerna, Meenu, Arveen, Poonam
4. Steering and Handle System – Crew 4: Kanchan, Priyanka, Anjali, Rajaram, Neha
5. Rear Wheel System – Crew 5: Kamakshi, Smriti, Usha, Lalit, Shivali
6. Gear System – Crew 6: Vandana, Jayshree, Archana, Swati, Manisha
7. Safety, Comfort and Suspension System – Crew 7: Preeti, Anu, Harpreet, Gunjan, Sukrita
8. Structure, Shape and Design – Crew 8: Anisha, Ruchika, Tripti, Anku, Lakshmi

As a group we would like to appreciate and thank Steven Levy (Expeditionary Learning Schools, USA), Joanna Levy (Convent School, USA) and Parminder S Raparia (Disha India Centre for Experiential Learning, India) for designing and facilitating the expedition. We would also like to appreciate and thank Sahil and his team for supporting us in bicycles repair, Manish, Gurdeep and Bindu of Pedalyatri group for sharing their experiences of riding bicycles, our didis – Suchitra, Reena, Mehrul and Susheela, Shivender Singh from Firefox bicycles for sponsoring bikes, Veena and Shankar for their art expertise, Aurorashmi Mohanti for all round support and grade 6 and 7 students of year 2010-11 for sharing their experiences and managing the bike Olympics event.

Front Wheel System



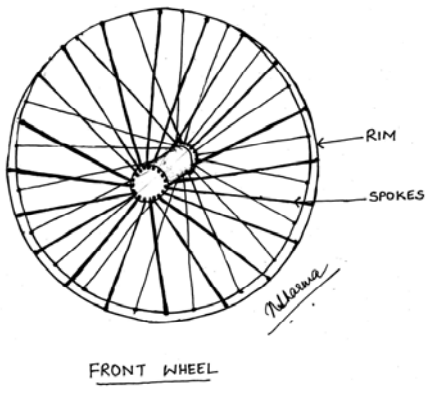


A front wheel has five main parts-the Rim, Hub, Spokes, Tyre and Inner tube. The hub is smaller and the spokes are lighter than those in the rear wheel. The first bicycle wheels had a wooden hub, a fixed axle, wooden spokes and shrink fitted iron tyre. A modern wheel has undergone a transformation. It has a metallic hub, wire tension spokes, and a metal or carbon fiber rim.

The Skeletal System of the Wheel

One glance at the tyres and you just can not miss me!! I am 'THE RIM"- The circular metallic movable skeleton on which the tyres plunk themselves tight, secure and smug. We work as a team. The tyre, hub, spokes and I.

The cylindrical hub is at my centre. 28-36 spokes shoot out of me from both ends of the hub. These spokes are my ribs. A specialized nut called the nipple, at the end of each spoke, adjusts the tension which helps me keep in good shape. So you see, I move around with my fitness expert!!!



Various inventions have witnessed my various forms. I have been cast in wood, aluminum, plastic, carbon and steel. Stainless steel is my personal favorite. It makes me more durable and attractive.

"Cycling gives me the freedom to unite with nature."

THE HUB

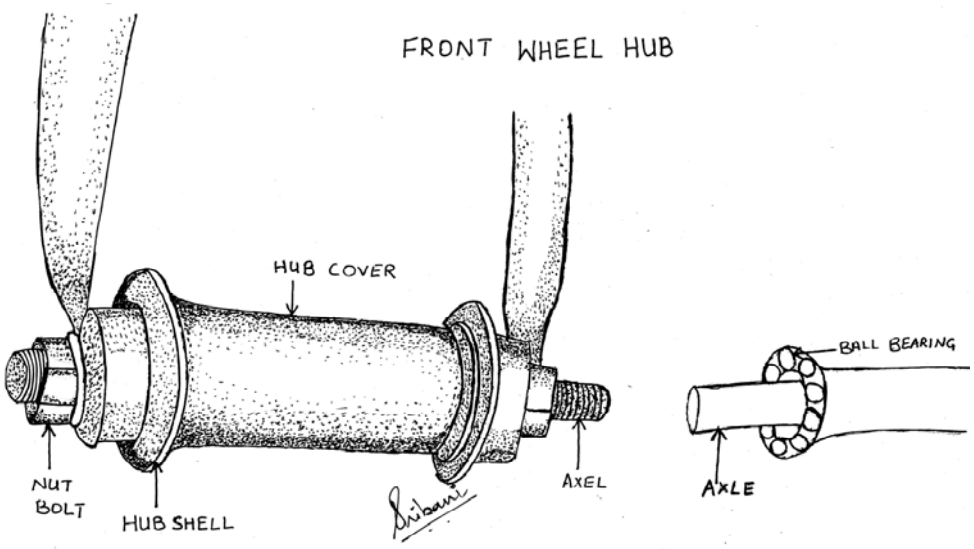
The hub is the center of a bicycle wheel. The hub shell houses an axle and ball bearings which are at the heart of all tyre movement. Can you guess each of these seemingly tiny, yet very important parts?

A large threaded cylinder, like a giant bolt,
Pierces the hub to kiss the spinning wheel.
What is it? The Axle

A large cylinder, with cups on either side,
Like Hercules, it shoulders two metal flanges.
What is it? The Hub Shell.

Tiny iron balls, grease helps them revolve,
They hold you and your bike, as you wiz through miles.
Who are they? The Bearings.

If you are in trouble and find your wheel niggling, it may be your hub calling.
Lend your hub an ear.



"Cycling everyday keeps the doctor at bay."

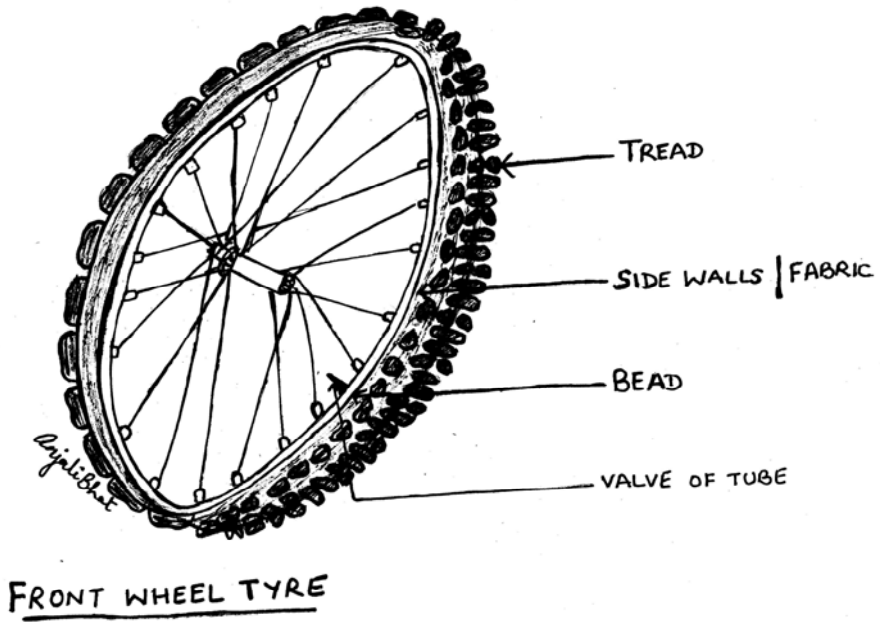
THE TYRE

The tyre is a soft but firm casing which is rolled over the wheel, without which your journey could be bumpy and deafening. There are two types of tyres:
a) clincher tyres or tube tyres
b) tubular tyres or tubeless tyres.

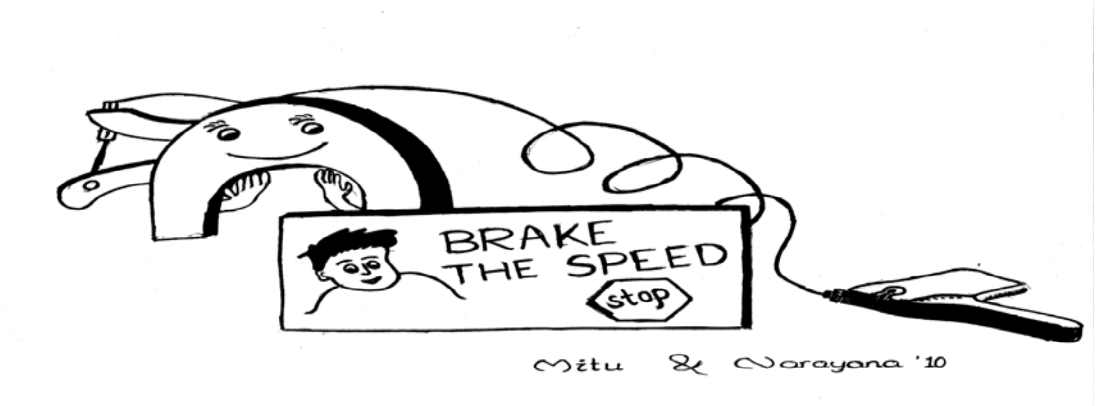
What are tyres made of? Rubber?? This is a general misconception. In fact rubber is the least important material when it comes to tyres.
The tyres are made up of the following parts:
a) bead- it is the edge of the tyre and holds the tyre tight in the rim
b) fabric or side walls- a cloth fabric is woven between two beads intricately, which determines the body of the tyre and enhances its shape.
c) Rubber- once the fabric is woven firmly between the beads, it is coated with melted rubber and then dried. This is done to prevent the fabric from damage.
d) Tread- rubber that comes in contact with the ground and protrudes from the side walls of the tyre. This prevents the wearing of the tyre and the fissures between them provide a good grip to battle friction.

A tube, fitted inside the tyre has a valve, through which air is pumped in and causes it to inflate. Air pressure in the tyre holds the fabric under tension in contact with the road surface.

The first tyre was invented in the year 1880.



"Get out of your car. On to the road!"



It's a breezy spring morning and you are riding a bicycle down a lovely winding road with a song on your lips. Tra! La! La! Suddenly a truck overtakes you. In panic, you try to stop, only to discover that your brakes are not working! ***BANG!!!*** There's a loud crash as your bike hits a wall. Your bike has come to a halt. *But is this the way you would like to stop every time?* Certainly not! By now you must have realized that **no other equipment in your bike is more important than the brake**!

Initially in the 17th century, bicycles lacked this mechanism. Cyclists used their legs to stop the cycle. But this was very unsafe. *Necessity is the mother of inventions*, and hence an inventor came up with coaster brakes which stopped the bike when the rider back pedaled. Over a period of time with bikes gaining popularity, the brake technique evolved. Modern bikes are thankfully equipped with an efficient **brake system**.

Let's find out how the brake system works.

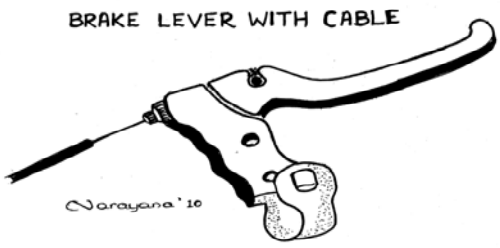
Newton's Laws of Motion have special significance for bikers. As per one of the laws a moving bike will continue to move at the same speed unless subjected to some force that tends to change the situation.

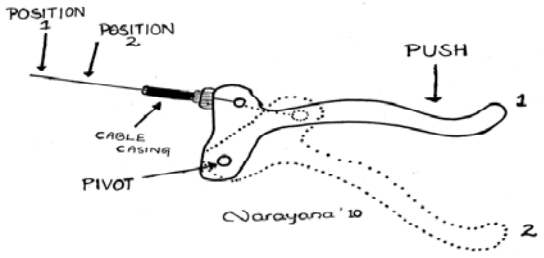
In a standard bicycle, the Brake system consists of three parts:

- ***Brake Lever***
- ***Brake Cable***
- ***Brake Caliper***

When I want my bicycle to stop, I apply a force on the **brake lever.** It is mounted on the handle bars within easy reach of my hands. There are two brake levers, made of either iron or plastic. The right one is for the front wheel and the left one for the rear wheel. They are both connected to the brake cables.

"I fell, got up and tried again."

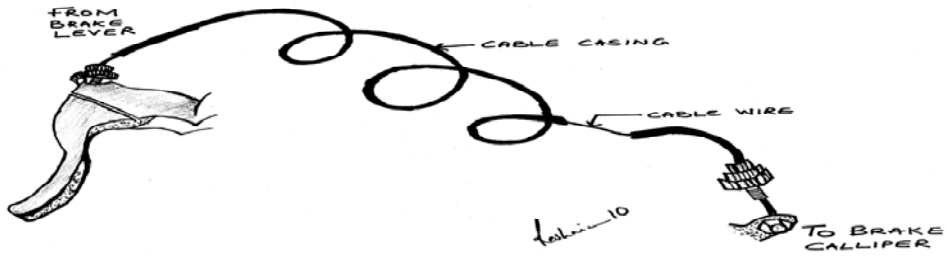




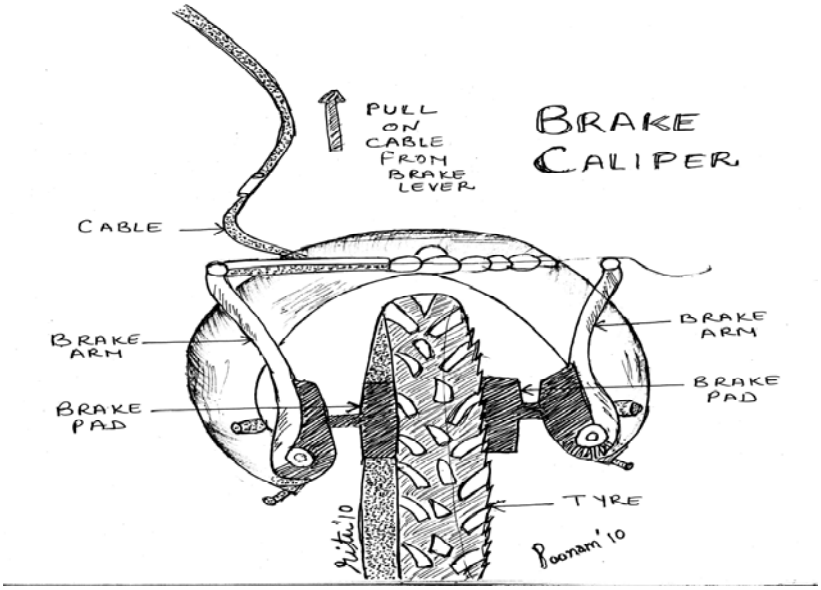
The brake cable is attached to the brake lever. When the rider pushes the brake lever, it rotates about its pivot point, from position 1 to position 2.

The **brake cable**, humble as it is, being just a metal wire housed in a casing, serves an important purpose.

I apply a force, or an effort to bring my bike to a halt. Since it is the wheels that have to stop moving, the force has to be transferred to the wheels. The brake cable carries the compression generated due to applying force on the brake lever to the brake caliper that will eventually arrest the motion of the wheels. Two brake cables begin from the two brake levers, and go all the way down to the rim of the front and rear wheels, close to which the brake calipers are positioned.



"I dared, so I succeeded."



The **brake caliper** is the part of my bicycle which is the soul of my safety while riding it. As I press the brake lever, the cable leading to the caliper is pulled up. This causes the brake arms with brake pads, like hands, to come closer together and touch the rim of the bicycle wheels, thus, slowing them down. This happens because the mechanical energy of the tyres converts into heat energy due to friction and dissipates in the air. The bicycle comes to a stop. When the lever is released the return springs bring the brake arms back to their original positions.

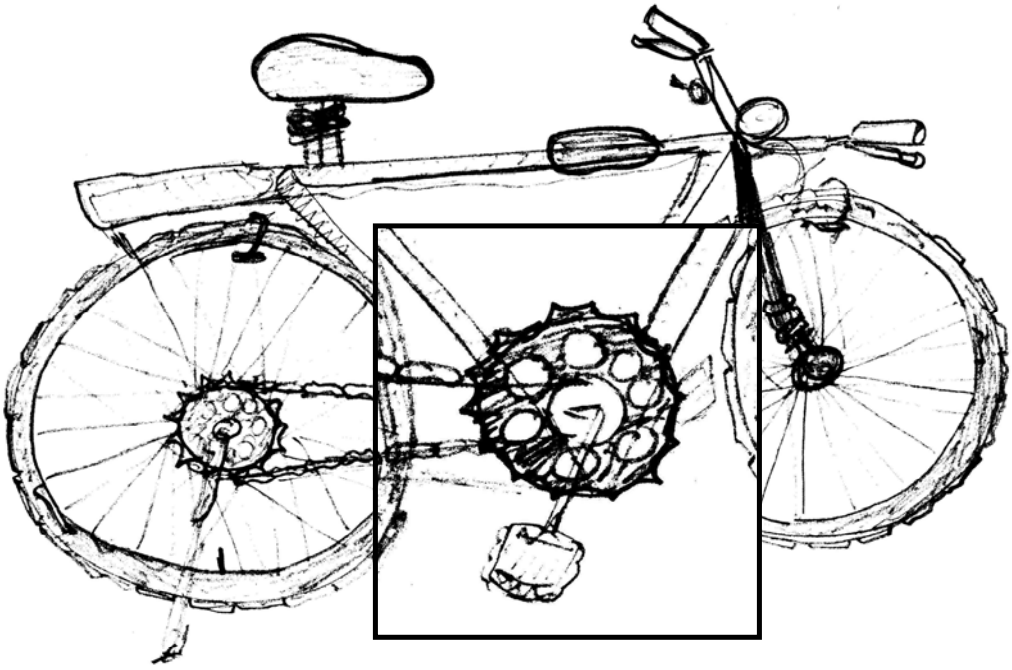
Mr. Brakes has some questions for you

- What will happen if you are biking at a high speed, and by mistake apply brake only to the front wheel?
- Which of the following do you think will be a better choice for a brake pad:
  A soft rubber piece or a hard rubber piece
  A larger rubber piece or a smaller one?

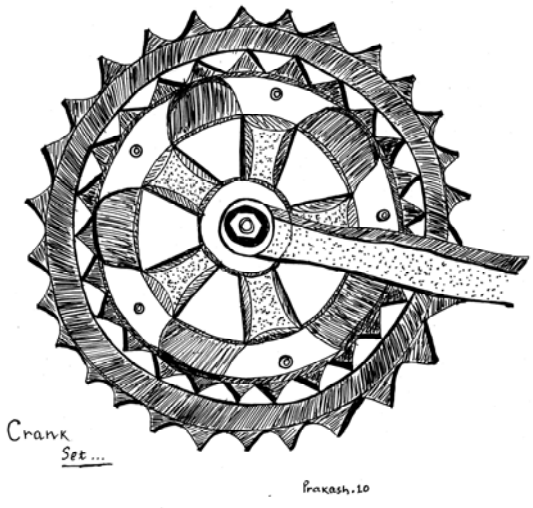
"It must have been a genius who invented the bicycle."

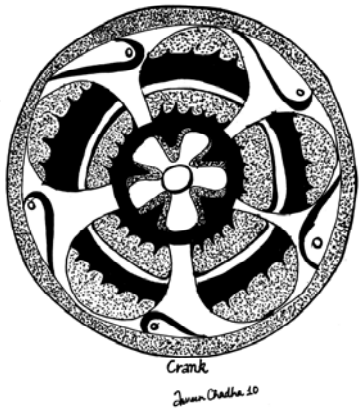
THE CRANK – SYSTEM

A crank system has three main parts – the crank set, crank arms and two pedals. The Crank set consists of the two cranks, one on either side of the bicycle. The cranks are wheel like structures with a centre point to which a crank arm is attached. The crank arm is further attached to the pedal.



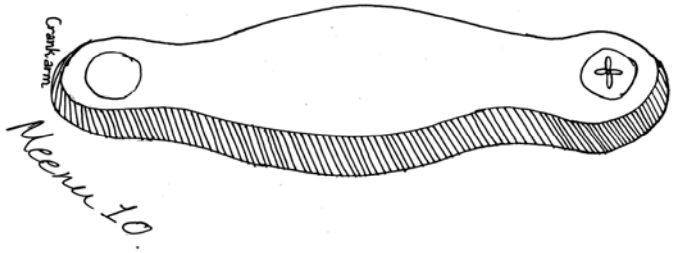
THE CRANK SET





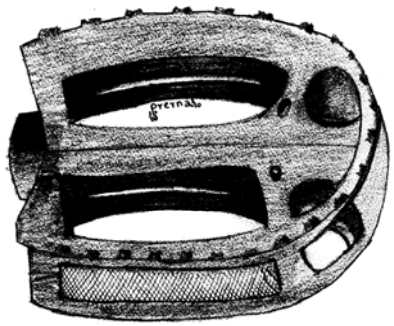
The Crank set, also known as CHAINSET in UK, is an important part of the crank system that converts the clockwise motion of the rider's legs into anti-clockwise motion of the chain. Thus it results in the rotation of the rear wheel. The crank set is made up of chain rings and a crank arm that is fixed to the bottom axle of the crank. It is generally constructed of less expensive steel. However, there are numerous materials available for the same such as aluminium alloy, titanium, carbon fibre, steel, etc.

THE CRANK ARM

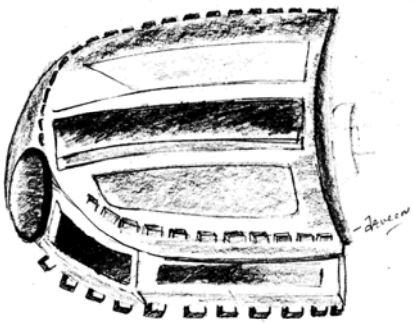


The Crank arm is like a rod and has a hole (or eye) at its outer end to accommodate the pedal spindle that makes it move. Adult cycle cranks have a 9/16 inch hole, whereas child cycle cranks have a 1/2 inch hole. The two ends of the crank arm are hinged and made movable so that the rod moves backward and forward as the wheel rotates.

THE PEDALS



PEDAL



A bicycle pedal is the part of a bicycle that the rider pushes with his or her foot to propel the bicycle. When you sit on a bike and pedal, you essentially perform a circular motion with your legs and feet. It provides the connection between the cyclist's foot and the crank allowing the leg to turn the crank axle.

Modern bicycle pedals are made of many different materials. The kind of the pedal you choose should match your need. If you are a casual rider, a common metal and plastic platform would be fine and easily available. If you plan on racing or doing fast club rides, a clipless pedal is durable, and light weight materials might be what you need so that the pedal is light enough to push. Mr. Manish Ghalot, Co – founder of 'Pedal Yatri' suggests that the metal pedals are better if you have the right kind of footwear and some rubber pedals can be very slippery.

A pedal bears a great amount of endurance and can be complimented for its ability to take the pressure from the rider's feet and rotate flexibly around the axle.

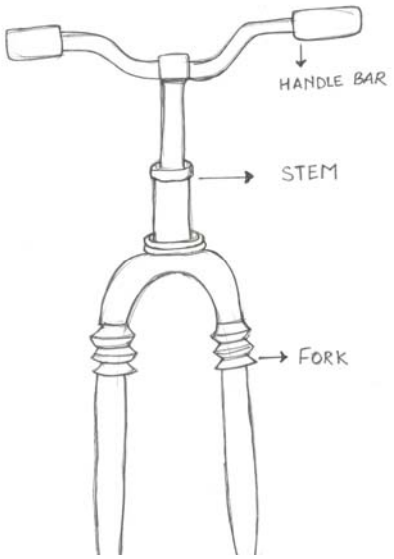
> *"When I started biking, I thought I will drop out after sometime.*
> *But now I know, I will bike forever... as long as I am alive!"*
>
> - Mr. Manish Gahlot; Co – founder, www.pedalyatri.in

INTERESTING FACT!

Sheldon Brown – The Bicycle Lover. Also known as "Cranky"

"As a kid, I used to gather discarded bicycle parts and put together bikes to sell for pocket money. I have been tinkering with bicycles ever since, sometimes as a business, always as a hobby. I am Webmaster and general Tech Guru of Harris Cyclery in West Newton, Massachusetts. I have also written extensively about bicycles, for *Bike World*, *Bicycling* and *American Bicyclist* magazines, both under my own name, and the nom-de-plume "Christopher Joyce".

STEERING SYSTEM

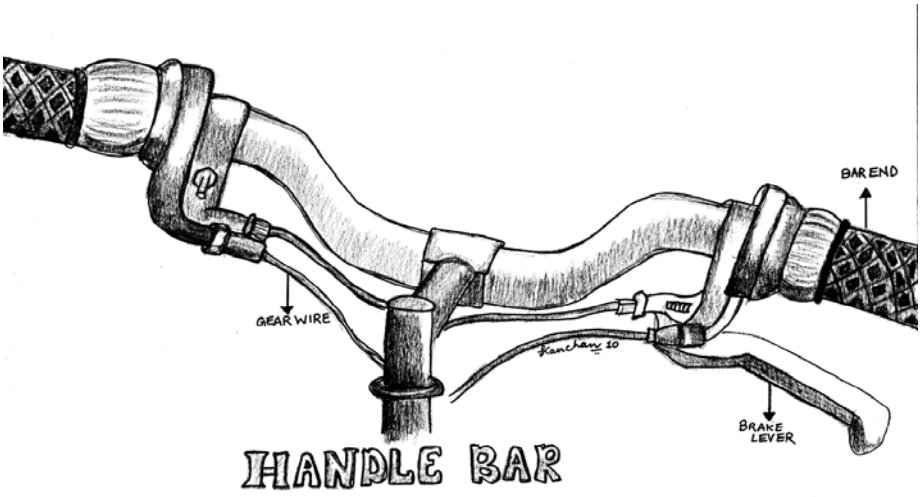


HANDLE BAR

I am…..

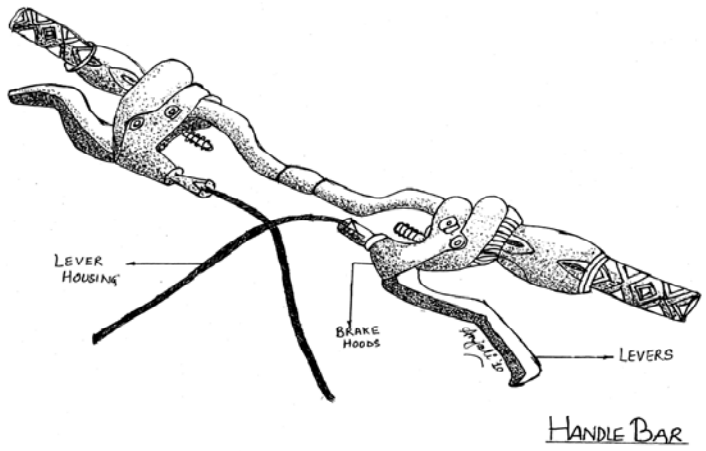
I am a handle bar, the most important system in the bicycle. I help the cycle to decide which way to go. If I ever stop working it's a big trouble for my rider, so it is very important for me to be fit and working and never let my rider down. I can't have a mind of my own and must listen to my master. So you see, I have an important job to do.

I carry a lot of responsibility on my shoulders as I provide a mounting place for the bell, the brake levers and the gears. I also provide them support. But that's not all!! I also bear the burden of the rider's weight.



I do….

I have a tough job to do. When the rider turns me left or right I pass it to my team mate, the stem, who has a rotating device within, which turns the fork and the front wheel and.... lo and behold!!! We have the cycle turning where it has to go.



I look....

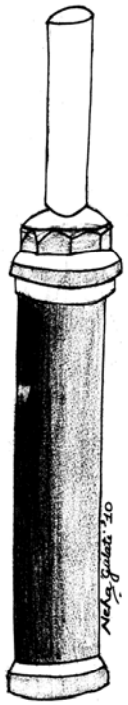
I provide a lot of style to the look of the bike. My design depends upon the intended use of my rider. It depends on....

- providing leverage to steer the bicycle and generate power
- negotiating terrains as in mountain bikes
- maneuvering obstacles
- assuming an aerodynamic position

I am made of steel and aluminum and come in different shapes and sizes. I need to follow national/international standards when it comes to my width, within the range of 350mm to 1000mm.

I am proud to be the one who shoulders a lot of responsibility.

STEM



I am...

I am the stem. People have nicknamed me gooseneck. I provide support to the bicycle. On one end I hold the handle bars and on the other I fit inside the headset.

Hey!! Be careful while selecting a bicycle. The top of the stem should be slightly lower than the top of the seat. The bent-over riding position increases pedaling power and decreases wind resistance. Make sure that you have the right frame size.

I do....

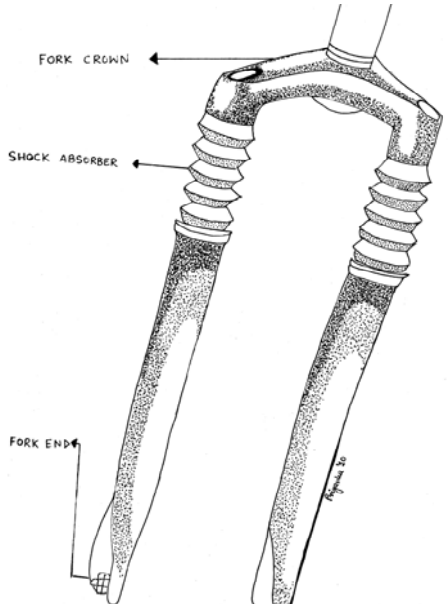
One of my ends sticks down into the head tube of the frame and rotates freely turning the front wheel back and forth. (see first diagram)

FORK

I am….

I am a fork and I do many important things. I begin from the base of the stem of the handle and branch out like arms holding the hub of the front wheel. I enjoy doing it as I give a lot of freedom to the front wheel to rotate. Most of my modern counterparts have 100mm spacing.

I am sometimes stiff or flexible. I hold the rod best and waste less of the riders' energy when I am stiff. When I am flexible I give a more comfortable ride, and riders often like the springy feeling they get.



I do…..

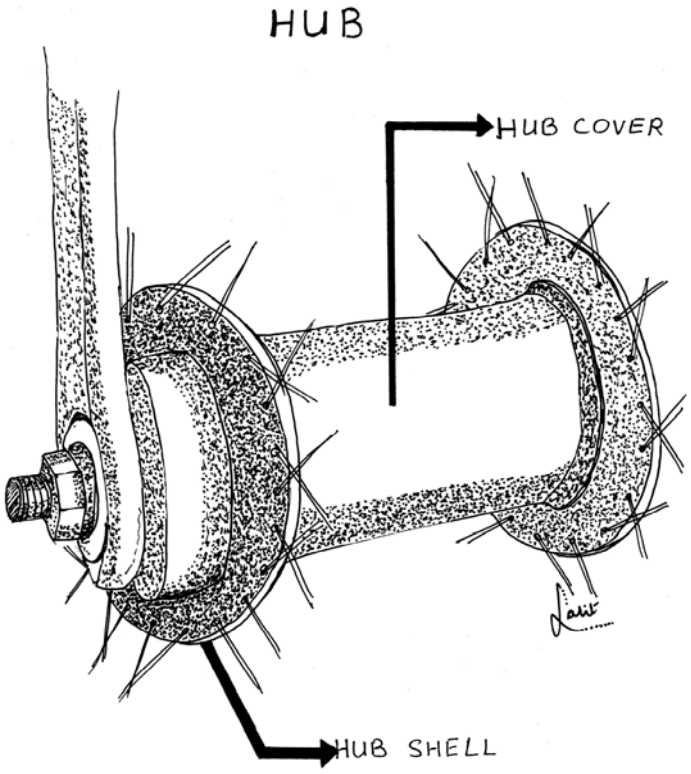
Apart from connecting the front wheel to the rest of the bike and allowing the rider to steer and balance the bicycle, I provide cushion to the rider when the bicycle is jolted or tossed and double up as a shock absorber.

Power under my Feet!!!!!

Rear Wheel System

The rear wheel system is the backbone of a bicycle. The front wheel system helps in maneuvering the cycle, whereas the rear wheel bears most of the weight. The crank system is also connected to the rear wheel.
The rear wheel system is comprised of a hub, rim, spokes, tyre, tube and valve.

Hub- The heart

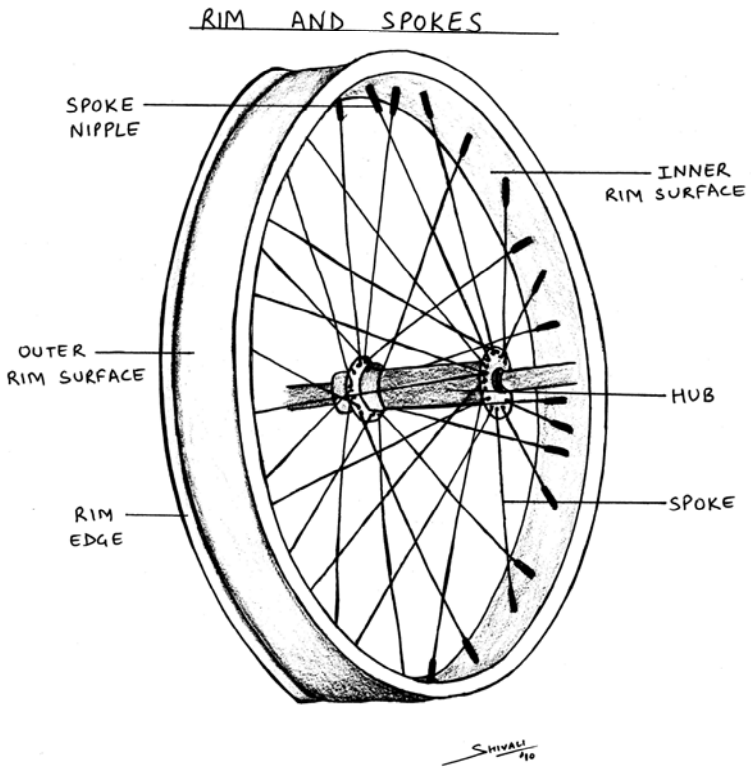


"I discovered some of the nicest places ……..now I have a completely different picture of Gurgaon. It is beautiful."

The hub is the central part of a bicycle wheel. It is made up of an axle, bearings and hub shell.
The hub shell is the part of the hub to which the spokes are attached. The hub shell of spoked-wheels generally has two flanges extending outward from the axle. Each flange has holes or slots to which spokes are fixed.
An axle is a large iron rod that goes through the hub and is attached to a wheel or a crank case.
Ball bearings – these nine little balls allow the hub shell and rest of the wheel parts to rotate freely about the axle.

"Riding is refreshing and infectious ……I want to speak to schools so that they insist children come on their bikes to school."

Rim and spokes- strength in unity



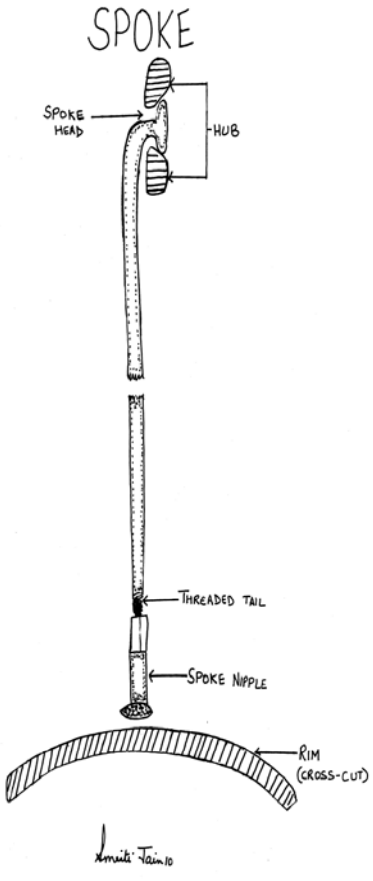
"My biggest lifestyle change – now I wake up at 4 am to ride the bike for 30 km. everyday and then go for work."

Rim and spokes remind us of the roots of a plant. On their own, they are very thin and fragile, yet together they miraculously hold the round shape of the wheel. Without them it would be impossible for a bicycle to imagine undertaking its journey. However, early cycles used solid wheels and later spoked wheels were introduced to make the structure lighter.

Spokes are straight long wires that hold the thin rim in a round shape. The head of the spokes fit into the hub and the threaded tail of the spoke fits into the spoke nipple. The spoke nipple is then attached to the rim. About 24-36 spokes emerge from the hub and make beautiful geometric patterns .It is important that all spokes are of equal length and tightness so that they are able to maintain the shape and balance of the wheel.

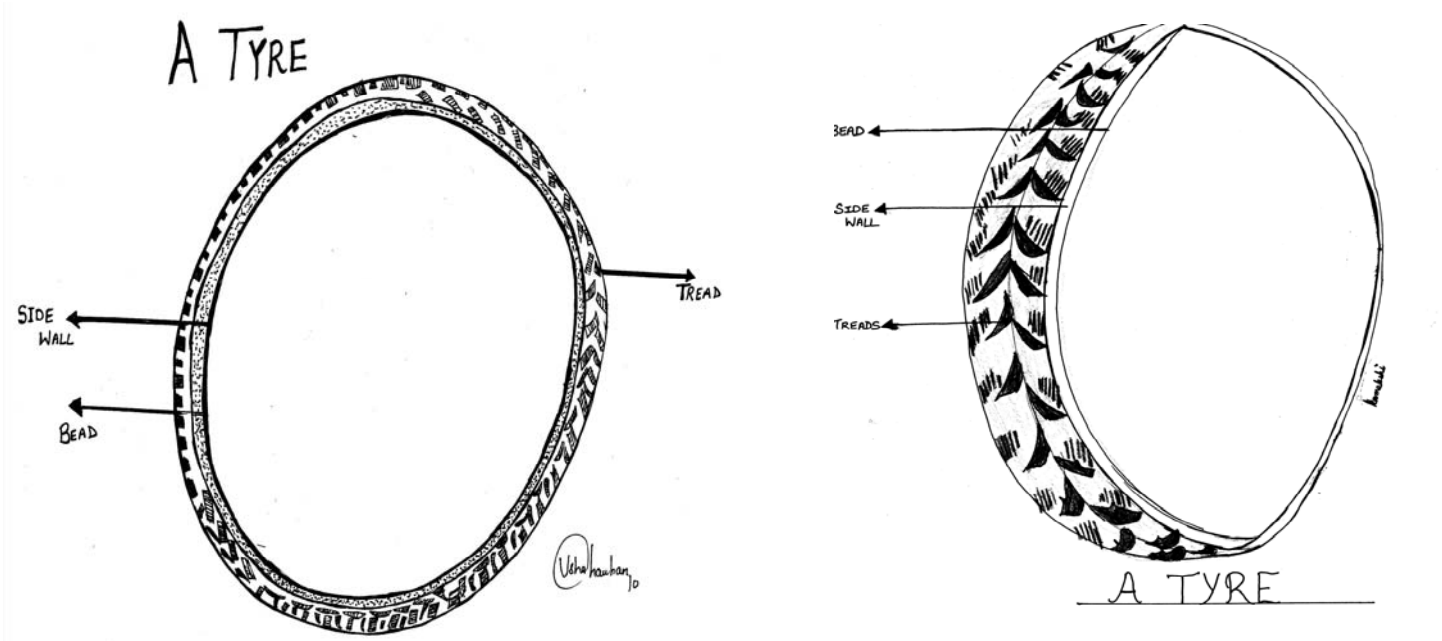
The rim is the circular metallic frame which holds the spokes on the inner surface and the bead of the tyre at the outer surface. One of the problems encountered by the rim could be rim wobbling. Perfectly round or true rims are rare. Rims usually develop bends and a big bend can cause the wheel to wobble. This would need professional repair for smooth running of the bicycle.

Spokes with the rim make the wheel a rugged structure capable of withstanding pressure as high as 400 pounds. Wheels with fewer spokes minimize the friction caused by the air but require a more durable rim and high maintenance. Wheels with more spokes are sturdy even with less durable rims and require low maintenance.`



Tyre and tube- the most resilient

A circular rubber device, Rough and strong
Me the tyre, I provide strength to the bike.



A tyre is a circular rubber device which goes around the rim. There are three main parts of a tyre. They are – bead, sidewall, and treads. Inside the tyre there is an inner rubber tube.

The basic function of a tyre is to serve as a contact point between the bike and the riding surface. It allows a smooth, comfortable and steady ride. More emphasis is given on reducing the width of the tyre as less contact of the tyre with the surface enables more reduction in Friction and Resistance.

Parts of a Tyre -

1.Bead – It is the inner edge of the tyre. The design of the bead allows it to hook up to the inner edge of the rim. This also helps in keeping the inner tube in the tyre secure.
2. Side Wall – This protects the tube and controls expansion of the tube.
3. Tread – The pattern is designed to meet specific riding conditions. Deep treads are designed for better gripping in muddy conditions or metal studs for ice.
4. Inner Tube – Tube when filled with air protects the rider by absorbing shocks and increasing or decreasing the rolling resistance.

There are two types of tyres – tyres with tube and tyres without tube (tubeless tyres).

"Riding…….freedom to go to newer places which you wouldn't do otherwise."

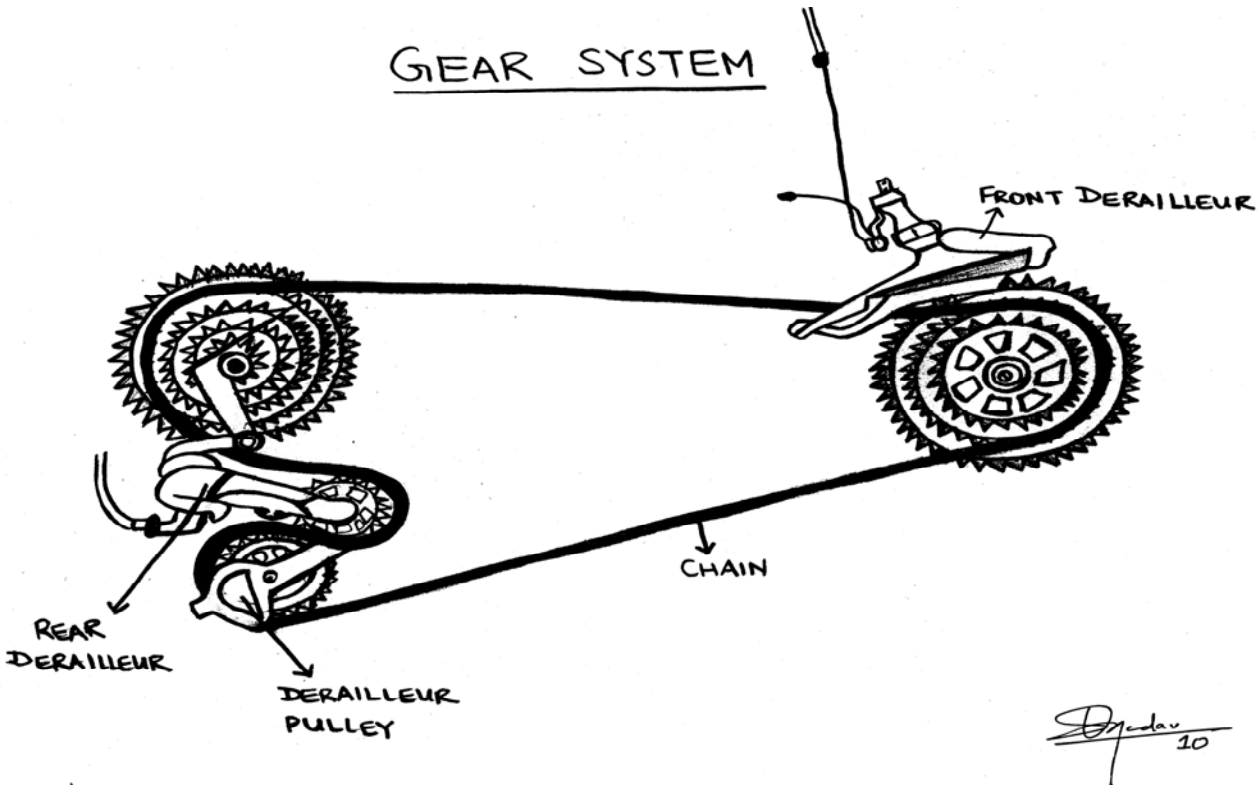
GEAR! GEAR! GEAR!

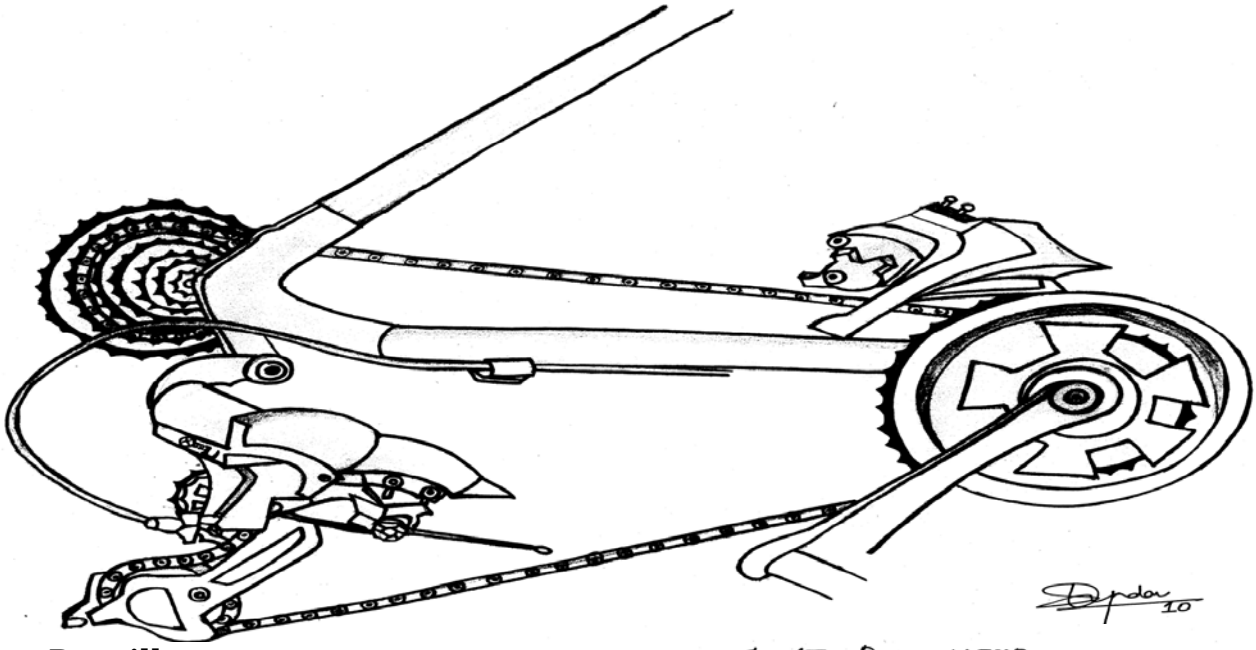
Riding! Riding! Riding!
Riding my Bike,
I am tired.
What do I do, Oh! Dear
May be I need a Gear.....

Gears
Gears are two toothed wheels of different sizes that intermesh either directly or through a chain. When one wheel rotates, it creates a rotation in the other.

How do Gears Work
When gears move, one gear wheel turns faster or slower than the other or moves in a different direction. The force required to rotate the small wheel is less than the force required to rotate the larger wheel but the distance traveled during one rotation of larger wheel is more than distance traveled during one rotation of smaller wheel.

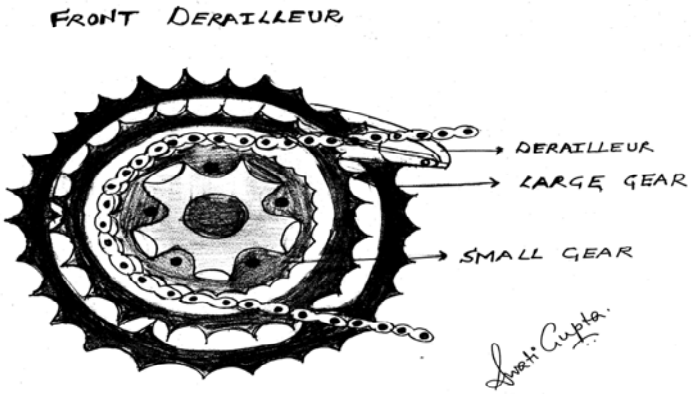
Gears in a Bicycle
Gears in a bicycle are known as Derailleur Gears because they derail the bicycle chain from one chain ring to another .They help the cyclist to pedal comfortably while going uphill or down hill.





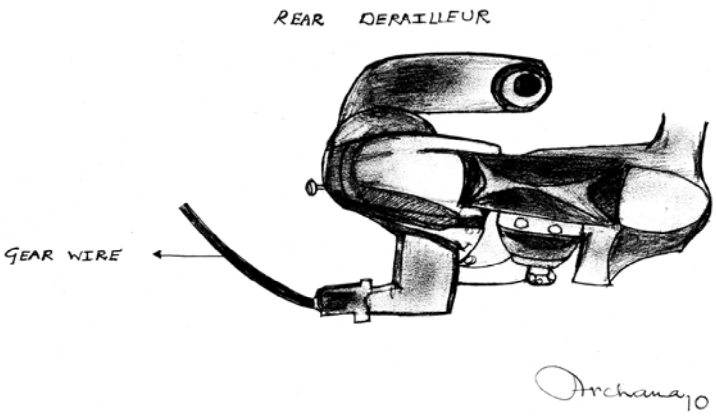
Front Derailleur

It pushes the chain from a larger gear to the smaller Gear.



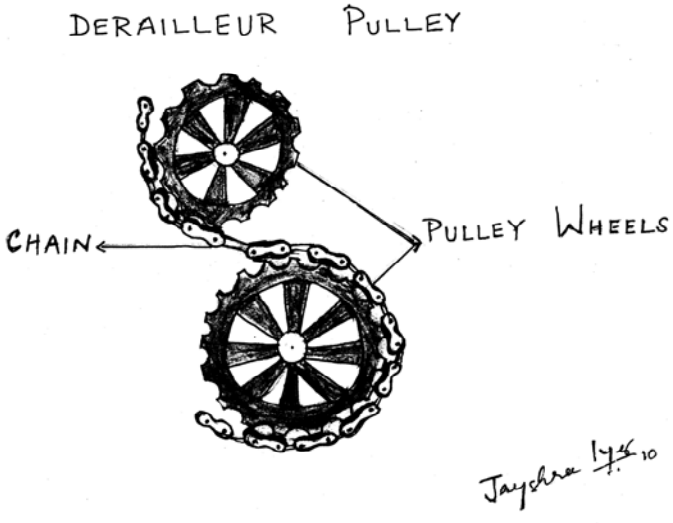
Rear Derailleur

It pushes the chain from a smaller gear to the larger Gear.



Derailleur Pulley

It enables the smooth movement of the chain from one Gear wheel to another.

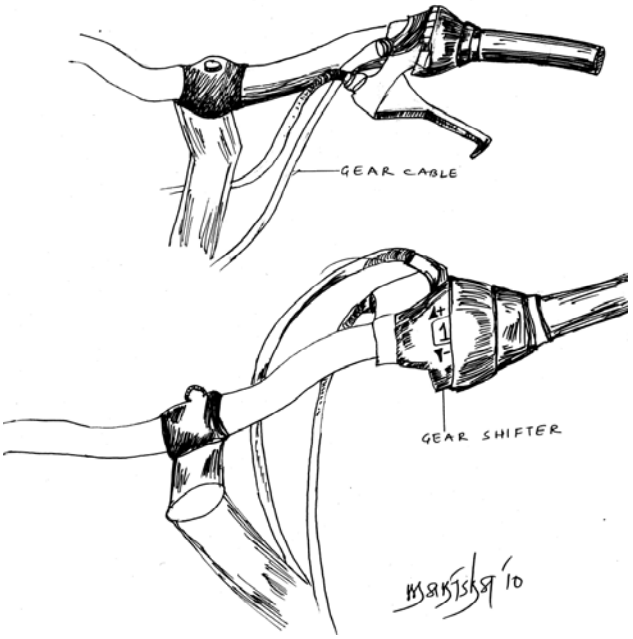


Oh! My Dear Gear,
I am confused using you
At times, I am at ease, at times not so pleased
Come and help me,
Tell me what to do

Gear Ratio
Gear Ratio is the ratio of the number of rotations of rear wheel to the number of revolution of pedals.

Uphill
To climb uphill the gear ratio should be low. The chain should be on the larger wheel of the rear gear wheel.

Down hill
To come down hill the Gear ratio should be high.The chain should be on the smallest wheel of the rear gear wheel.



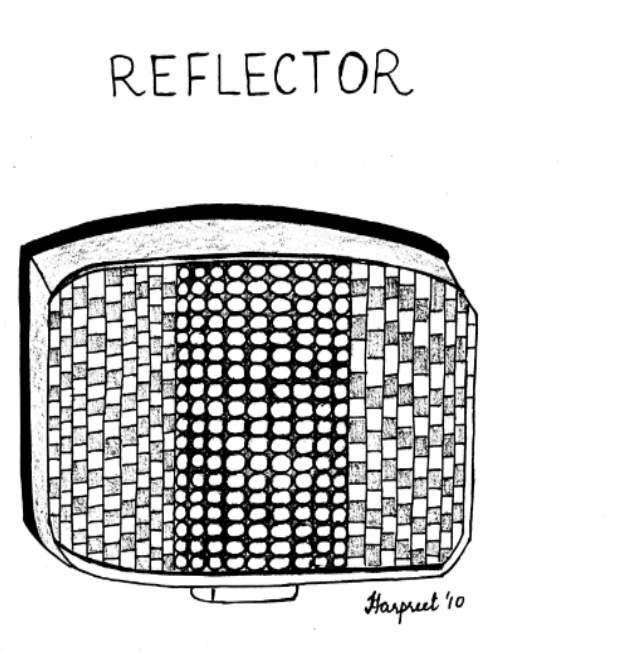
Wait! Wait!!
I have a solution to my confusion
But how do I control you???
SHIFTERS on the handle bar are your cue…….

"Joy of cycling was so much that I would create excuses to ride again and again."

SAFETY, COMFORT AND SUSPENSION

SAFETY WITH REFLECTORS

With a trail of ruby red light,
Glowing in the dark gloomy night,
I come to life, with the fall of the light,
You need to keep me squeaky clean,
To make you visible, safe and be seen.



What am I made of?

Reflectors are in the form of moulded, transparent plastic tile. The outside surface is smooth, allowing light such as from a car's headlight to enter.

How do I work?

The rear side of the plastic tile is moulded with hundreds of tiny pyramidal shapes. When light enters the reflectors through the plastic, the angled side of the pyramids act as tiny mirrors to reflect the light back in different directions.

ONE BIG QUESTION?

Why should a reflector malfunction, even though they don't have any electrical component?

THE ANSWER

Reflectors work only under specific conditions. These conditions happen to prevail during night time driving so we get an impression that they work all the time. The conditions are:-

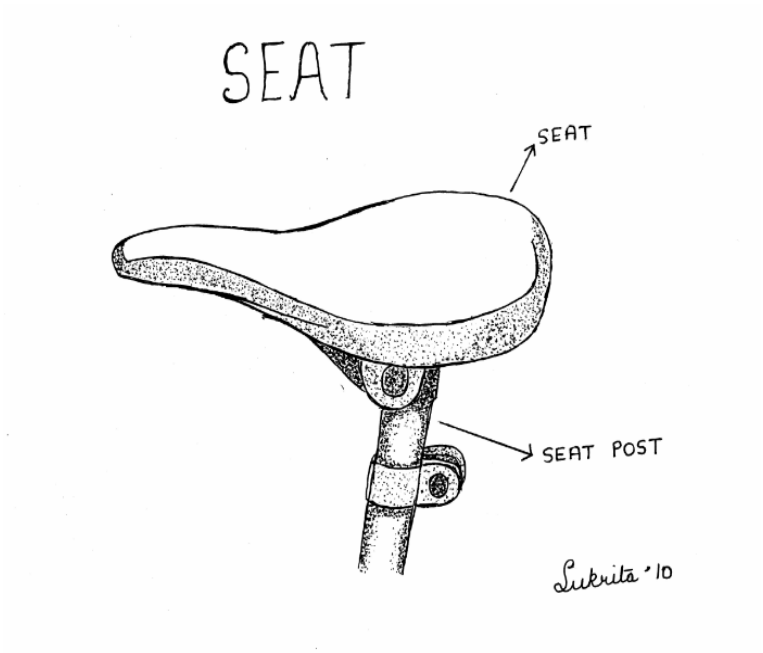
1. The beam of a driver's headlight should fall on the reflector.
2. It should be tilted at the right angle for optical performance.
3. Reflectors have to be free from moisture or dust.

"Pedal your way to health and happiness."

'SEAT' OF POWER

Imagine an elephant riding a bicycle. Oops!! That's uncomfortable. He needs a place to support all his weight.

A cycle seat crafted of leather or plastic is where the rider sits. It is attached by a heavy wireframe and a metal bracket by tightening nuts to the seat post. The Seat bracket that fits on the top end of the seat post is of standard dimension 7/8 inch. Often they are calibrated on a meter scale.



Seats come in three different styles - mesh, hard shell, and combination.

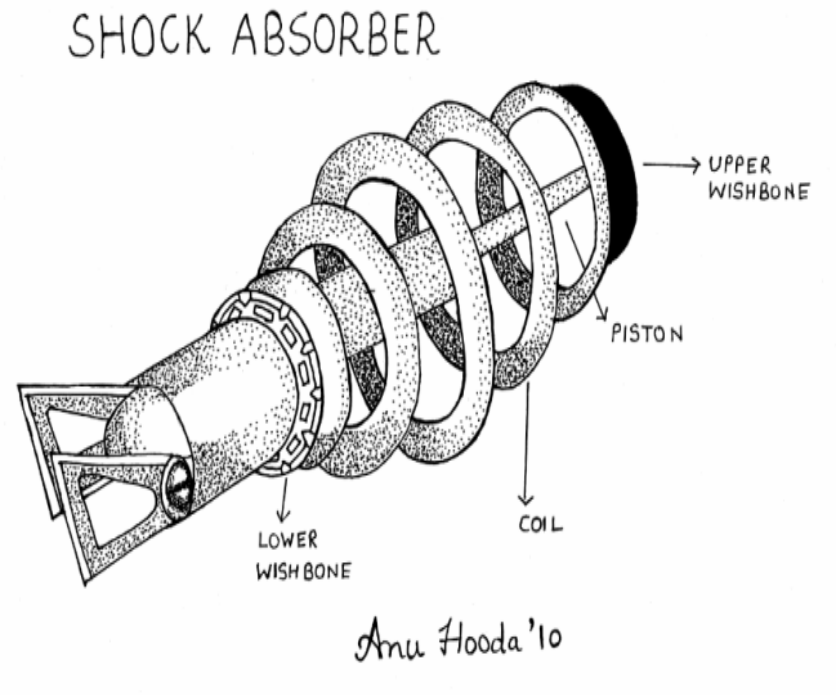
Riders often face problems if the seat tilts forward and backward or if the seat swivels from side to side. Do not fret!! Get an open end, box end, crescent wrench and tighten the mischievous screws.
HURRAY! Mr. Elephant, you are now ready to bike away into eternity....

"You don't have to be a superhero to save the planet, just start cycling."

ABSORBING SHOCKS

Going for a bumpy ride...
Do you know the cycles were known as Boneshakers because they did not have Shock Absorbers?! If you are cycling on a bumpy road, make sure your shock absorbers are ready to take all the bumps and jolts so that you have a smooth ride.

Where I am and how do I work?
Shock absorbers are placed above the front and back wheels. The front wheel shock absorber is inside the fork, the part that joins the handlebar and the front wheel. Shock absorbers are cylindrical devices that consist of a rubber spring coil with two metal plates called wishbones to hold this coil and a piston inside the coil. When the bicycle goes down a bumpy road or on a speed breaker, the lower wishbone transfers the shock to the coil. The coil absorbs the shock and thus it does not transfer it to the upper wishbone.



Now you know how they act to keep your bones intact!!!

Who thought of me first?
He, the smart one, who after a fall probably thought about me and we all should thank thee...
In 1898, J.M.M. Traffault introduced the very first Shock Absorber on his bicycle. Next year he, along with an American auto enthusiastic Edward Harford collaborated on the first adjustable shock absorber. In 1901, M.A. Yeakly built on their effort with an early independent suspension design in which each wheel was supported independently.

"Positive way of moving around."

DESIGN DIMENSIONS AND DYNAMICS

Probably the most fascinating and intriguing aspect of the bicycle is its structure. We are sure it invokes several curious questions. Why does the cycle look the way it does? What were the different inventors thinking? What different modifications did the bicycle go through?

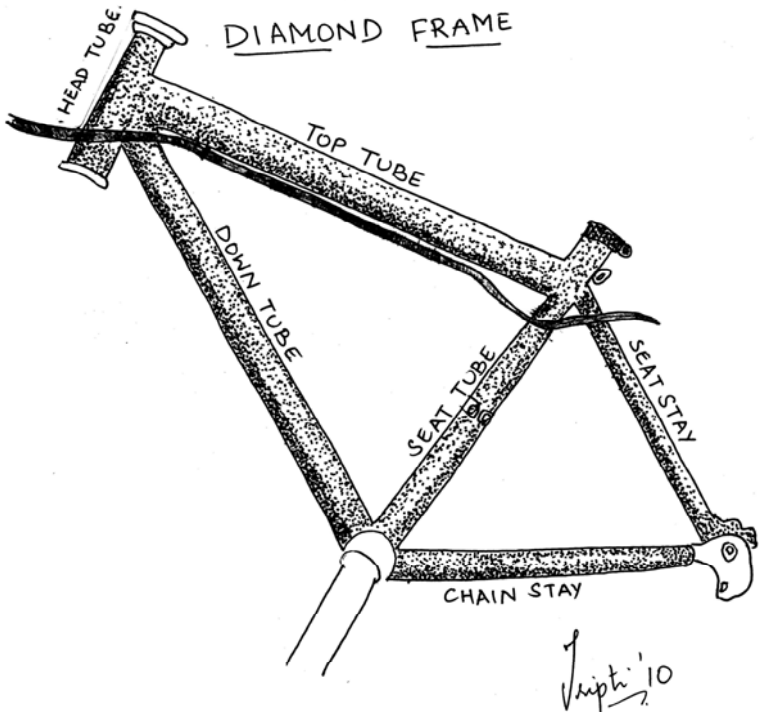
A triangle is the simplest geometrical figure that will not change shape when the lengths of the sides are fixed.

What possibly strikes you most about the bike is the predominance of the humble triangle. Come to think of it, the triangle seems to be everywhere around us. Little ones, big ones, lone ones and many triangles together. In fact, we seem to find triangles in places where we need to provide strong structures.

Hmmm... We wonder why that is... Lets look at the bicycle through our triangular lenses.

Framing Fun

The early frames were made of wood which slowly graduated to metal frames. Our hero, the triangle, made its first appearance as part of frame design with the advent of the safety bicycle in 1885. During this period, working with metals wasn't very advanced, so the designers of the day had to think about devising a strong frame. And hence, they resorted to the strongest geometrical structure they could successfully utilize for building the bicycle.



The frame of the bicycle is the skeleton of the bicycle. The wheels and other parts of the bicycle are attached to it.

Can you think of the shapes that can be seen in the frame of the bicycle?

The modern and the most common frame design for a bicycle consists of two triangles. This is known as the diamond frame**.** You can see this in the illustration.

In a diamond frame, the main triangle consists of a head tube, top tube and seat tube. The rear triangle consists of the seat tube and paired chain stays and seat stays. A frame must be perfectly straight and strong before any other part is attached to it.

It is the single most significant part in determining the quality of a bike and hence structure and shape is of utmost importance.

Frame Material

Historically, the most common material for the tubes of a bicycle frame has been steel. Frames can also be made from aluminium alloys, titanium, carbon fibre, and even bamboo. Materials that have been used in these frames are wood, thermoplastic and magnesium. Several properties of a material help decide whether it is appropriate in the construction of a bicycle frame.

The frame is also the single most difficult part to repair.

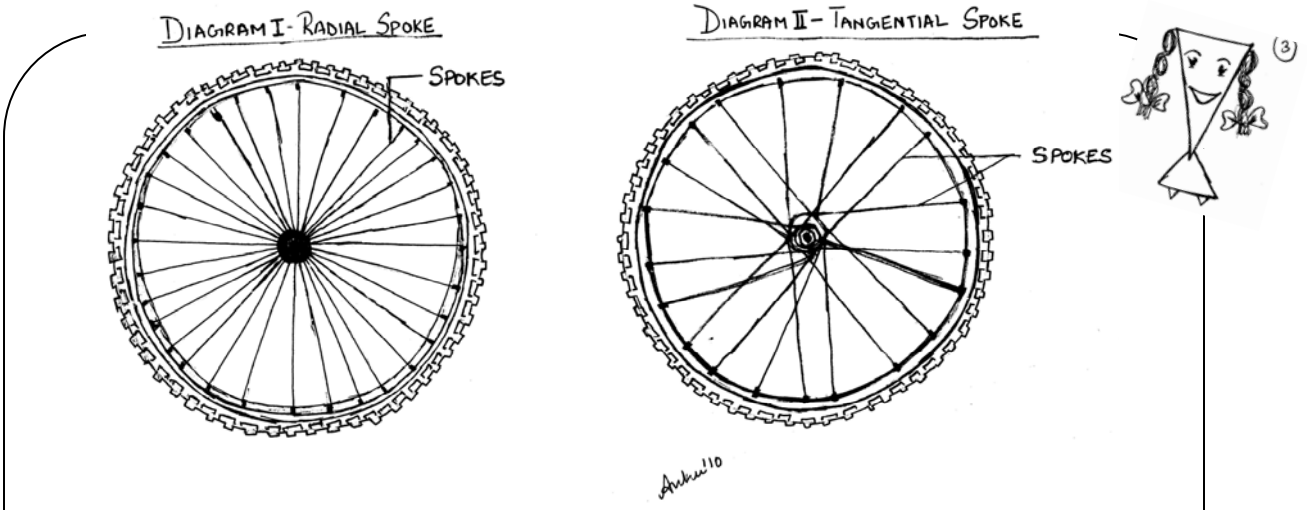
Some tips

- Keep the original paint on a frame as long as possible.
- Keep the bicycle out of the rain and if it gets wet then dry your bicycle with a piece of cloth.
- Touch-up scratches with auto touch-up paint to prevent rust.

Now here's something cool to do. Look around you. Try and find as many triangles as you can. These can be in buildings, furniture, in your house and other roadside structures.

Spooky Spokes!

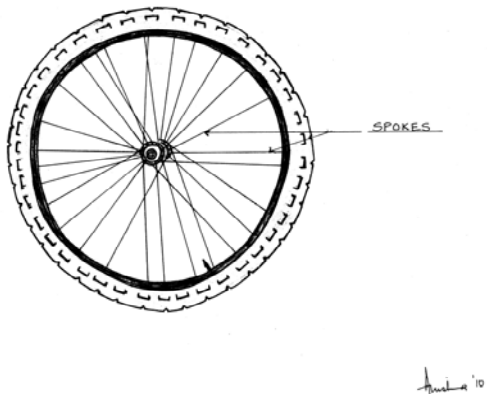
Spokes are a number of thin rods that miraculously hold the metal rim of the wheel in a perfect round shape. Just like the rays of the sun, the spokes radiate from the centre of the wheel (the hub). They firmly connect the hub to the rim of the wheel.
In the early years, spokes were made of wood. Gradually, steel replaced wood, and today, designers even use aluminium. Depending on the nature of the force the spokes are subjected to, designers decide the type of material to be used.



What difference do you observe in the arrangement of the spokes in the above two diagrams?

The spokes are slanting in diagram II. Identify the shape they are forming. Have you ever wondered why the spokes need to be arranged in this manner?

When you ride a bicycle, there are a lot of forces acting on the front and back wheels. These forces need to be equally distributed throughout the rim of the wheel, or else the circular structure of the wheel may collapse!! Tangential spokes are beautifully weaved together, forming numerous triangles. Such an arrangement helps in distributing the strong forces equally to all the parts of the wheel.



Why Spokes?

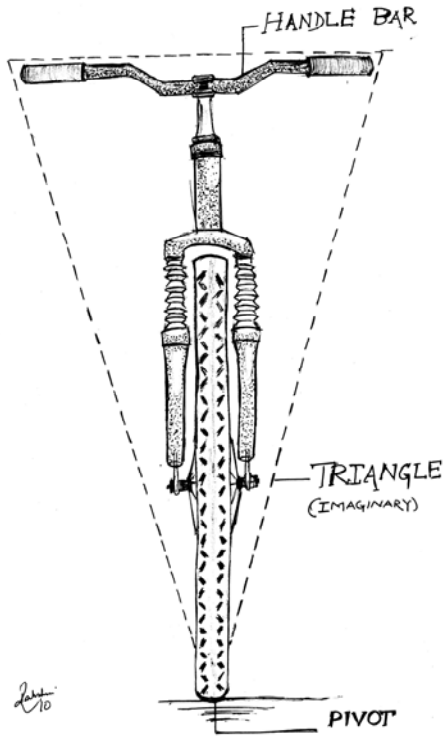
i. Spokes add strength to the rim of the wheel.
ii. They transfer your leg power from the hub to the wheel
iii. They support your weight on the wheel

When '*spoking*' the wheel of the bicycle, we must keep the following things in mind.....
Spokes must be of the correct length. They should, in fact, be of exactly the same length. If the length of the spokes of a wheel is unequal, the longer spoke may puncture the inner tube of the tyre! Now how bad can that be!!!!!

With the help of the straws, create 3 shapes
a) circle
b) square
c) triangle
Gently press the shape between the fingers of your right hand. Which shape collapses the most easily? Which shape takes the maximum force to distort?

Have you ever seen '***spokeless'*** bikes? Where are they used?

Hearty Handles



Starting from its humble beginnings as a steering mechanism for the bicycle to be able to change directions, it has come a long way to the Deda Newton shallow handles which are placed below the seat level in order to provide for the crouching speed rider.

Look at the handle bar assembly in the diagram. Hiding under the T – shaped assembly is an imaginary inverted triangle with its vertex at the wheel and handle as the base. The design provides for a comfortable position for the rider to rest her hands on the handle bar. The quick rider seated on a high seat also transfers approximately 20 – 25% of her body weight onto the handle. The handle assembly is designed to support this weight.

It certainly seems worthwhile to explore the role of this imaginary triangle. In this case, the triangle hero probably doesn't contribute as much to the strength of the structure as it does in providing leverage. It pivots around the vertex to steer through roads and by lanes.

Glossary

Aerodynamic: having a shape which reduces the drag from air moving past.

Axle: a rod or spindle passing through the centre of a wheel.

Bead: the inner edge of the tyre.

Brake lever: a device that holds the brake wire.

Corrosion: a gradual destruction.

Crank: a wheel-like structure that rotates.

Derail: to come off track.

Durable: able to stand wear and tear, damage and pressure.

Endurance: the capacity of something to last or withstand wear and tear.

Fissures: grooves on a tyre.

Force: push or pull

Fork: a fork-shaped part which joins the handle bar to the front wheel.

Friction: a force that opposes motion.

Gear: A toothed wheel that works with others to alter the relation between the speed of the driving wheel and the speed of the driven part.

Intermesh: interlocked; the teeth of gears lock with each other as they move.

Lug: a frame joint.

Maneuvering: to carefully guide or manipulate in order to drive a bicycle.

Mechanical energy: the energy possessed by a body on account of its position or its motion.

Metal flanges: hub shells.

Mounting: a step from which a rider mounts a cycle.

Propel: drive, push, typically forward.

Resistance: the power of a body which acts in opposition to the pressure of another.

Rolling resistance: resistance that occurs when a round object such as a tyre rolls on a flat surface. It is caused mainly by deformation of the object or surface and depends mainly on the material of the tyre and the sort of ground.

Saddle: a seat with a raised ridge at the front of the bicycle.

Shock absorber: a device for absorbing jolts and vibrations, especially on a vehicle.

Traction: attraction, drawing towards.

Wrench: box end, open end, and crescent are all wrenches, a tool used to open or loosen screws.