BULLOCK-CART: A LABORATORY FOR SCIENCE TEACHING

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Science has been made a basic component of our school education, but in the absence of its relation to the life and environment of the learner it has degenerated into a dogma. It is emphasised in the books that "Science is Doing" but it is actually taught in the classroom in the style of history and civics. The teaching of science in school is largely bookish and theoretical. Teachers tell the facts and students note them down, or students read out some passages from the book in the presence of the teacher. In the rural areas the condition is still worse as far as the facilities for teaching science are concerned.

But a resourceful and imaginative teacher can still do better if he or she carefully observes and makes use of a variety of materials and apparatus available in the rural environment. To me, a bullock-cart can be a very good laboratory for explaining and demonstrating a number of principles involved in the teaching of physics.

In the rural areas it is a challenging job for a teacher to introduce scientific concepts to the learner without audio-visual aids or a laboratory. The school conditions in villages are not very encouraging for science teaching. Still, a skillful teacher, conscious of the environment, can clarify scientific concepts and principles to the children by using the objects around.

Under such unfavourable circumstances, a teacher can select the objects, tools and many other things which are easily available in the adjoining areas for teaching science.

In the villages there are many things which can be used as focal points for teaching scientific principles. The bullock-cart is the commonest among them. In it, a number of scientific concepts and principles are hidden. If these are exposed and explained properly to the students, their learning will be facilitated. At least the following concepts can be taught with ease by using the bullock-cart.

(i) Force

Force is defined as that which changes or tends to change the position of rest or of uniform motion of a body along a straight line, i.e., it produces or destroys a motion. This can be introduced to the class easily. The bullocks apply muscular force to the cart and the cart starts moving in their direction. If during the motion the bullocks stop, the cart will also stop, i.e., the

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bulls apply a force
which produces or destroys the motion of the cart.

(ii) Principle of Work

The work done by a force is defined as the displacement of a body in the direction of a force when the force is applied to it. Here the bullocks apply a force in a forward direction, and the effect
is a displacement of the cart in the forward direction. The force (pull of the bullocks) acts on a body (cart) and the cart is displaced in its (force) direction.

This is an example of work done by a force on a body.

Work done = Force × Distance

(iii) Wheel Axle

Surface dragging is very difficult and it requires great force. To economise the use of force, a wheel is made to rotate around a fixed axle. This means that even a small force can rotate a wheel more easily than the force required to drag the same body. In a rolling cart friction is much smaller than a sliding one. Rotatory motion helps the cart move very smoothly.

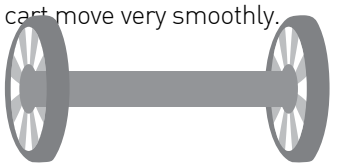


Fig. 1 Wheel axle

(iv) Friction

Sometimes the wheel of the cart does not rotate very smoothly round the axle. Then the cart driver drops some oil in between the wheel and axle. This lubrication helps the wheel move smoothly. The heaviness of the movement is due to the opposing force in between the surfaces of the inner portion of the wheel and the axle. Actually, these surfaces become rough and oppose the motion over each other. This opposing force between the two surfaces is known as frictional force and the phenomenon is called friction.

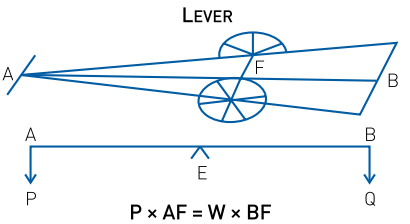
(v) Type of Motions

There are two types of motion and these can be demonstrated very effectively with the help of the bullock-cart. The bullock-cart is a unique example in which we can find both the motions, i.e., rotatory as well as translatory.

When the bullocks pull the cart, the wheels start rotating and the body of the cart moves in a straight line, i.e., it possesses a translatory motion. A relation between the rotatory motion and translatory motion can be established. The cart will move in a straight line equal to the perimeter of the wheel.

(vi) Lever

If we observe a bullock-cart, it can be seen that the axle of the wheel serves as a fulcrum and the distances of rods on either side of the fulcrum are unequal. This type of arrangement represents the first principle of lever. The rod towards the bullocks is longer than the body of the cart on the other side of the axle. The distance being longer towards the bullocks, even lean and thin bullocks can pull a heavy load.



P × AF = W × BF

Fig. 2

(vii) Parallel Forces

Forces, the lines of action of which are parallel, are called parallel forces. If two equal parallel forces are applied to a rigid body in the same direction, the resultant of them will be a sum of the magnitudes of the two in the same direction.

Parallel Force

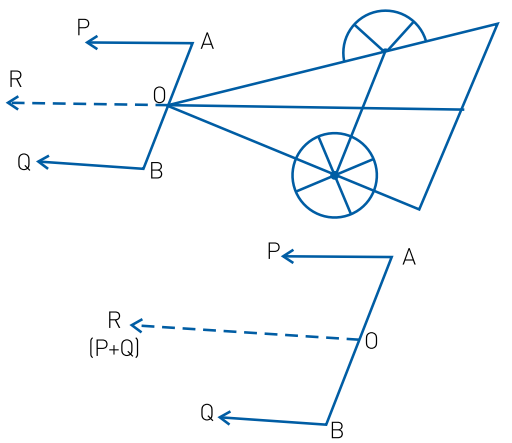


Fig. 3

In the bullock-cart, two bullocks, nearly of the same strength, are used to pull the cart in the forward direction. The cart is pulled forward with a force equal to the sum of the forces applied by the two bullocks and is applied to the centre of the body of the cart.

(viii) Resoluton of Forces

The bullocks pull the cart in the forward direction; on resolution, the force at right angles, as shown in Fig. 4, one component has upward direction while the other has forward direction. The upward component nullifies the weight of the body and the force of the friction. The effect is that the cart becomes somewhat lighter and can be pulled easily by the bulls. So pulling is easier than pushing the cart.

Resolution of Forces

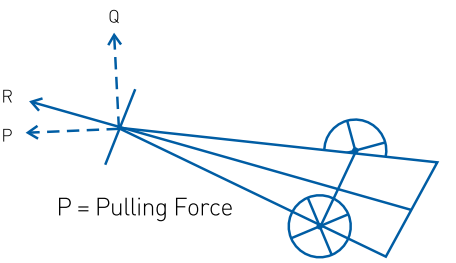


Fig. 4

Idea of Centre of Gravity

The bullocks pull the cart through a wooden rod which is connected at the centre of the body as shown in Fig.5 at C. Instead of pulling the whole body from all sides it is easier to pull it through a point in the middle of the body. It is supposed that the mass of the cart is functionally located at this point. In Fig. 5, O is such a point. The point is called C.G. of the cart. By applying a force, the line of action of force passes through O (C.G. of the cart) and the whole cart is pulled.

Centre of Gravity

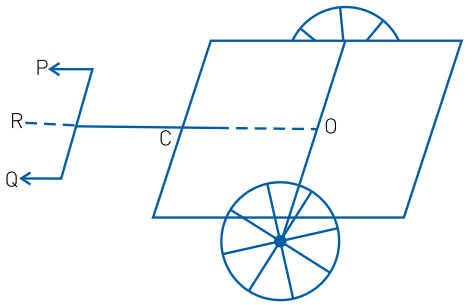


Fig. 5

Heating Effect

The heating effect on a body can be shown very easily. A cart-wheel has two parts, the iron tyre and the wooden structure. In practice the diameter of the iron rim is some what less than that of the wooden wheel. On heating, the iron tyre expands and the diameter becomes equal to the diameter of the wooden wheel. Now the iron tyre is fixed on the wooden wheel and cooled. On cooling it contracts and grips the wooden wheel well. Thus heating and cooling effects can be demonstrated without any apparatus.

Here an attempt has been made to illustrate a few concepts and principles of physics with the help of the bullock-cart. The conscientious teacher can further explore his environment to use other objects to teach science concepts.