Pedagogy of Learning, Vol. 3 (2) April 2017, 27-36

PEDAGOGY OF LEARNING (POL)
International Refereed Journal of Education
E-ISSN: 2395-7344, P-ISSN: 2320-9526
Abstracted and indexed in: Google Scholar, Research Bib, International Scientific Indexing (ISI), Scientific Indexing Services (SIS), WorldCat, Cite Factor, Impact Factor: 0.787(GIF)
UGC (India) Approved Journal
Journal Website: http://pedagogyoflearning.com

Revisiting Popular Folk Tales for Science Classroom Transactions

Tulika Dey
NERIE-NCERT,Umiam, RiBhoi District, Shillong-793103, Meghalaya, India
Email: dey_tulika@rediffmail.com

Arnab Sen
NERIE-NCERT,Umiam, RiBhoi District, Shillong-793103, Meghalaya, India

Corresponding Author: Tulika Dey
E-mail: dey_tulika@rediffmail.com

Article History:
Received 13 March 2017
Received in revised form 20 March 2017
Accepted 28 March 2017
Published online 18 April 2017

Abstract

Many of our most basic and conventional values are still passed on through the collection of myths and stories which we heard as a child. Fables can be used to provide an introduction to, and stimulate learning in young children. This article is an attempt to examine the scientific basis of some of the famous fables/tales that weave dreams, values, love for animals in the minds of young children of our society. Through these tales, the students, when exposed to abstract scientific concepts without being related to nature of objects, ideas and processes, will be able to bridge the gap.

Keywords: *Tales, Learning, Panchatantra, Aesops' Fables, Scientific concepts*

Introduction

Storytelling as an art form has been an unavoidable element of our societies for centuries. Maintained by the oral traditions of ancient cultures, stories were passed down through generations by elders, pundits, preachers, etc. Stories enable us to

strengthen our cognitive domain apart from enhancing the knowledge base of one's culture, history, traditions, and values. Story telling is one of our major modes of communication and relationship building efforts with children. A story, no matter what its content, will always tell us something about the teller, both in the way that it is told, and in the reason for telling. Listening to and telling stories in the classroom could be a constructive technique for enlivening science teaching. A few tales of Panchatantra and Aesop's fables has been taken as effective tools in Science classroom.

The ***Panchatantra*** meaning, 'Five Principles or Techniques' is an ancient Indian inter-related collection of animal fables in verse and prose, in a frame story format. The original Sanskrit work, which some scholars believe was composed around the 3rd century BC, is attributed to Vishnu Sharma, a scholar of immense repute then. It is based on older oral traditions, including "animal fables that are as old as we are able to imagine"(Lessing, D, 1999).

It is "certainly the most frequently translated literary product of India, and these stories are among the most widely known in the world.The*Panchatantra* is an inter-woven series of colourful fables, many of which involve animals exhibiting animal stereotypes. According to its own narrative, it illustrates, for the benefit of three ignorant princes, the central Hindu principles of *nīti*. While *nīti* is hard to translate, it roughly means prudent worldly conduct, or "the wise conduct of life". Apart from a short introduction — in which the author, Vishnu Sharma, is introduced as narrating the rest of the work to the princes — it consists of five parts.

Aesop's Fables or the **Aesopica** is a collection of fables credited to Aesop, a slave and story-teller believed to have lived in ancient Greece between 620 and 560 BC. Of diverse origins, the stories associated with Aesop's name have descended to modern times through a number of sources. They continue to be reinterpreted in different verbal registers and in popular as well as artistic mediums. He was a keen observer of both animals and people. Most of the characters in his stories are animals, some of which take on human characteristic and are personified in ways of speech and emotions. However, the majority of his character retains their animalistic qualities like tortoises are slow, hares are quick, tigers eat bird, etc. Aesop uses these qualities and natural tendencies of animals to focus on human traits and wisdom. Each fable has an accompanying moral to be learned from the tale.

Scholars have noted the strong similarity between a few of the stories in *The Panchatantra* and *Aesop's Fables*. Examples are 'The Ass in the Panther's Skin' and 'The Ass without Heart and Ears' (Edgerton, Allen and Unwin, 1965). "The Broken Pot" is similar to Aesop's "The Milkmaid and Her Pail", "The Gold-Giving Snake" is similar to Aesop's "The Man and the Serpent" and "Le Paysan et Dame Serpent" by Marie de France (*Fables*). Other well-known stories include "The Tortoise and The Geese" and "The Tiger, the Brahmin and the Jackal". Similar animal fables are found in most cultures of the world, although some folklorists view India as the prime source (Upadhyaya, 2009) (Pearson, 1996). India is described as the "chief source of the world's fable literature" in *Funk and Wagnall's Standard Dictionary of Folklore Mythology and Legend* (1975).However, through this article the authors try to put forward an approach wherein some famous fables/ tales can be used to explain certain

scientific concepts. Such an approach will help to build the pedagogical link making with the content. According to Scott *et al.,* (2011), pedagogical link – making is concerned with the ways in which teachers and students make connections between ideas in the ongoing meaning – making interactions of classroom teaching and learning. Examining the scientific base of the popular tales will help the students in developing a deep understanding of the scientific concepts. The teacher in the process makes links to encourage a positive emotional response from students to the ongoing teaching and learning. This is referred to as pedagogical link – making to encourage emotional engagement and develop our ideas around this area (Scott *et al.,* 2011). Such approaches can ease the fright of children when it comes to understanding science. It is also said that, "Scientific knowledge is not obtained only through experiments and observations. To some extent, it is obtained as a result of all human imagination and inferences. There is a consensus among scientists that scientific knowledge depends on observations and experiments, but which is not totally…" (Erten Sinam, Ahmet Sen-Gumiis, 2013).

REVIEW OF THE FABLES

The Crow and the Pitcher / The thirsty Crow (A Panchatantra tale/ Aesop's Fables)

One day a crow was feeling very thirsty. On a hot summer day, she flew here and there in search of water but in vain. She continued to search hard but couldn't find any water to quench her thirst. Then after a long time, she found a pitcher, with a little water in it.

The neck of the pitcher was too long and the water level too low. The crow could not reach the water with her beak. She saw many pebbles around. Suddenly, the crow had an idea. She picked the pebbles one by one and dropped them in the pitcher. And lo! The level of water slowly rose to the top. The crow drank it thirstily. She was very happy.

The Scientific Explanation

The tale can be scientifically explained as, the pebbles or small pieces of stones as seen by the crow around the pitcher are generally heavier than water and insoluble too. When dropped into water, these pebbles will displace water exactly equal to their volume, and resulting in the increase of water level in the pitcher.

When a body is fully or partially submerged in water, there is buoyant force being exerted upon the body. The magnitude of the buoyant force is equal to the weight of the displaced water but acts upward, which helps the body to float on the water (Fig. 1). This is known as **Archimedes' principle**.

When the weight of the pebbles is sufficiently high (thus, having much more density than water), they will be immersed completely in the water causing rise of the water level in the pitcher.

When the density of a body is not sufficiently high (not so heavier than water), it will submerge partially; and water will be displaced by the submerged portion of the body. This won't increase the water-level much.

When a body is lighter than water (density is less than water), it will float on the surface of the water and will only displace negligible amount of water.

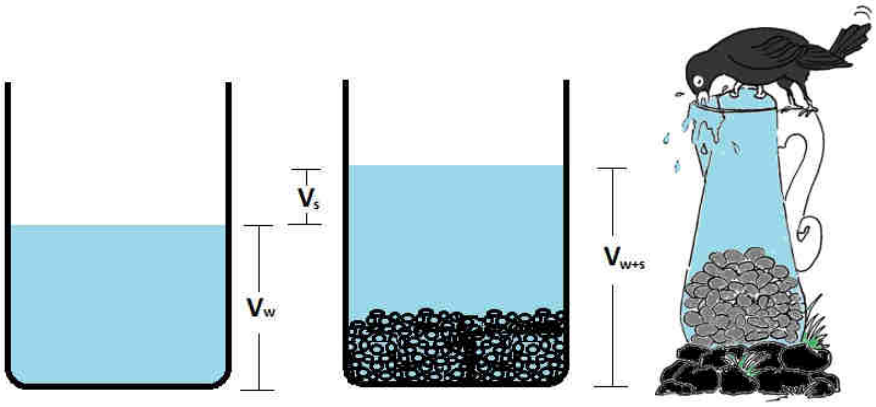

Fig.1: The pebbles are much heavier than water thus submerged completely leading to increase of level of water. The combined volume of water and pebbles (V_{w+s}) = Volume of water (V_w) + volume of pebbles (V_s)

Note that the teacher must explain that the buoyant force depends on the area of contact surface of the body with the water. Buoyant force will be more when the contact surface is more. In this case the pebbles are high density small objects thus completely submergible in water. Also note that the solid should be submerged in a liquid in which it is not soluble.

The Greedy Dog (A Panchatantra tale)

While roaming around one day, a dog found a bone lying around. He picked it up and quickly looked around him. Finding no one there to claim the bone, he ran away with it.

He then looked for a calm and quiet place to enjoy the bone. He reached a river and began crossing it by walking over a wooden bridge.

As he was crossing the bridge, he happened to look into the river and saw his own image in the water. He mistook his reflection to be another dog with a bone in his mouth.

He became greedy and wanted to snatch the other dog's bone as well. In order to challenge the other dog, he barked at the image. In the process, as soon as he opened his mouth to bark, the bone in his mouth fell into the river. He tried to retrieve it but it was swept away by the current.

Thus, he lost even his own bone due to his greed of wanting more and trying to claim the other bone too.

The Scientific Explanation

The scientific explanation in this tale isthe **'principle of reflection'** of light**. Reflection** occurs when light is incident upon the interface of two different media and returns back to the first medium from which it originated.

In our daily life we generally see mixture of two different kinds of reflection. Most of these are diffuse reflections, where the light bounces off from imperfect surface at all possible angles randomly. Most of the things we see around are result of **diffuse reflection** (Fig.2)

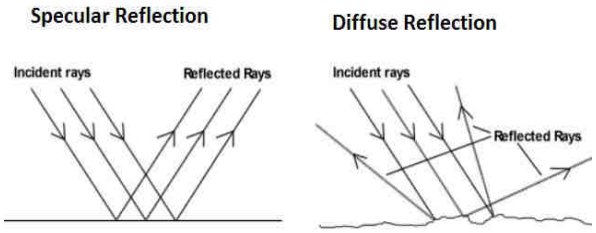

Fig.2A: Specular reflection occurs from a flat mirror or mirror like surface; Diffuse reflection occurs from irregular surface

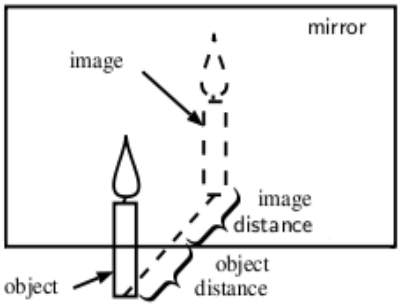

Fig.2B: The image formed by specular reflection is always identical to the object and at the same distance from the mirror

But when the surface is super smooth, **specular reflection** occurs. Mirrors and mirror like surfaces exhibit specular reflection. Reflections on still water are also an example of specular reflection. Parallel rays get reflected parallel when incident upon the smooth interface. The virtual image formed by such reflection is identical to the object with left-right reversal and at the same distance of object from the mirror. The dog sees its image on the water and it's identical as him though virtual; he misunderstands it as another dog. Since there was current in the river the image may not have been very clear but adequately provoking to the dog (Fig.3)

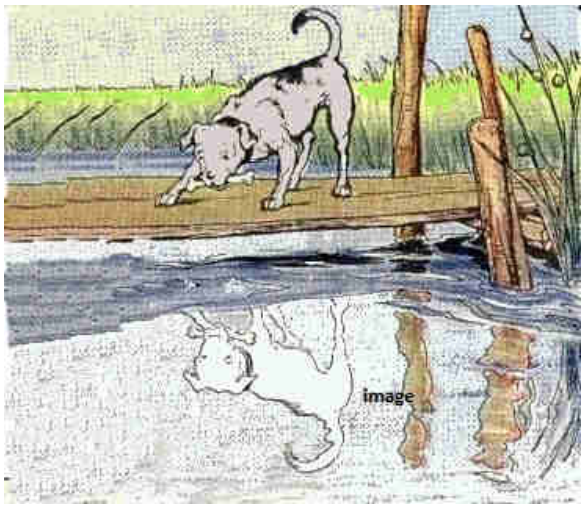

Fig.3: Water surface acts like plane mirror and forms an image of the dog. Because of the tides in the water, the image shakes and the dog misunderstood it as another dog

The Ass and the Load of Salt (Aesop's Fable)

A Merchant driving his Ass homeward from the seashore with a heavy load of salt came to a river crossed by a shallow ford. They had crossed this river many times before without accident, but this time the Ass slipped and fell when halfway over. And when the Merchant at last got him to his feet, much of the salt had melted away. Delighted to find how much lighter his burden had become, the Ass finished the journey very gaily.

Next day the Merchant went for another load of salt. On the way home the Ass, remembering what had happened at the ford, purposely let him fall into the water, and again got rid of most of his burden.

The angry Merchant immediately turned about and drove the Ass back to the seashore, where he loaded him with two great baskets of sponges. At the ford the Ass again tumbled over; but when he had scrambled to his feet, it was a very disconsolate Ass that dragged himself homeward under a load ten times heavier than before.

The Scientific Explanation

The scientific explanation in this tale is **'Dissolution of salt in water and capillary action of water in the sponge'**

Dissolution is the process by which a solute forms a *solution* in a *solvent*. The solute, in the case of solids, has its crystalline structure disintegrated as separate ions, atoms, and molecules form. For liquids and gases, the molecules must be adaptable with those of the solvent for a solution to form. Solutions are formed when the solute particles have dimension between 0.1 to 2 nm (1 nm = 1.0×10^{-9} m = 10Å). When the particle size is between 2-1000 nm, colloids are formed (e.g., Milk). For particle size greater than 1000 nm, the mixtures are called suspensions.

In the case of the present situation, the salt in the sack is the solute and the river water is the solvent. Thus, the salt was dissolved in water and there was loss in weight. Dissolution process is of fundamental importance to the description of numerous natural processes on earth.

On the other hand, when the merchant loaded the Ass with two great baskets of sponges, capillary action of fluids played the role.**Capillary action** is the ability of a liquid to flow in narrow spaces without the assistance of, and in opposition to, external forces like gravity. It occurs because of intermolecular forces between the liquid and surrounding solid surfaces. If the diameter of the tube is sufficiently small, then the combination of surface tension (which is caused by cohesion within the liquid) and adhesive forces between the liquid and container act to lift the liquid. In short, the capillary action is due to the pressure of cohesion and adhesion which cause the liquid to work against gravity (Fig. 4). The small pores of a sponge act as small capillaries, causing it to absorb a large amount of fluid.

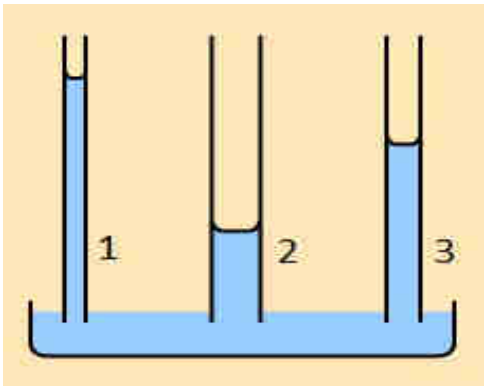

Fig.4: The narrower tube shows more capillarity. The pores of the sponge being very small shows more capillary action and thus become wet in water

The Geese and the Tortoise (A Panchatantra tale)

Once upon a time there lived a pair of geese and a tortoise and all three were great friends. One day they faced a huge drought and the lake in which they lived was drying up. They decided to leave the lake and look for a new lake. But the tortoise could not fly. So the geese thought of a plan, whereby the tortoise would have to hold a piece of stick by its mouth which would be carried by the two geese. The only condition was that the tortoise should not speak or it will fall from the stick to death. The tortoise agreed to be silent.

But on seeing this strange arrangement, people on the way started laughing at the tortoise. Unable to control his anxiety, he spoke out "What are they laughing about?", and so he fell on his head to death. If he had kept quiet he could have saved his own life.

The Scientific Explanation

It is easier for the two geese to lift the tortoise than one goose. In Fig.5, the two geese were applying an upward force *F* each at the end. So, the total upward force to lift the tortoise of weight ***W*** (weight is always downward) is 2F. So, $2F = W$ (considering the stick has negligible weight). If one goose would have carried the tortoise, it would have to apply double force, i.e., ***2F***.

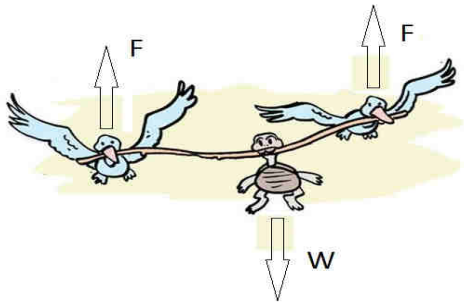

Fig.5: The upward force applied by each goose to lift the tortoise is F. This reduces the workload of onegooseby half (F=W/2) compared to only one goose carrying the tortoise.

When the tortoise was at height '*h*', the potential energy associated with it was '*mgh*'. There was no downward velocity at that time. As soon as the tortoise started falling the potential energy started decreasing (as the height reduces) resulting in the increase of kinetic energy. Just before hitting the ground, the tortoise will have the maximum kinetic energy and zero potential energy. Then the final velocity would be $=\sqrt{2gh}$. So, more the height more is the velocity at the time of hitting ground. After collision, the object (in this case, tortoise) stops over a very short distance, which means the stopping acceleration (one may call it as deceleration) is very high; the formula for acceleration is $a=\frac{v^2}{2d}$, where the stopping distance '*d*'is very small, generally of the order of *few centimeters* or *0.1m.* The acceleration is thus huge and so is the reaction force on the object by the ground, according to *Newton's Third Law of motion*. The value of the force ($F = ma$) can be obtained from *Newton's Second Law of motion.* Note that, the value of the force is also proportional to the mass of the object. Thus, the impact on heavier body will be more.

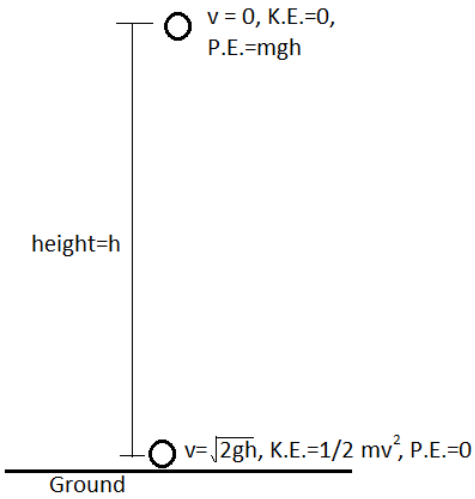

Fig.6: Change of energy and velocity with height; the object attains maximum velocity before hitting the surface

So, the tortoise will literally crash on the ground and suffer from '**blunt force trauma'** which is the injuries resulting from an *impact* with a dull, firm surface or object. The severity of injuries inflicted as a result of blunt force trauma is dependent on the amount of *kinetic energy* transferred and the tissue to which the energy is transferred. In general, a somewhat lighter object traveling at high speed will cause more damage than a heavier object traveling at low speed (DiMaio, DiMaio, 2001) (Dolinak, Matshes Lew, 2005) (Friede ed, 2003).

Equally important, however, are the characteristics of the blunt object and the surface that is impacted. Impacts involving a large surface area - either with regard to the impacting object or with regard to the tissues being impacted - will result in a greater dispersion of energy over a larger area and less injury to the impacted tissues. Likewise, an impact on a small area of a curved surface, such as the head, will cause

greater damage than would be caused were that same impact to occur on a flat surface, such as the back, since there will be a more concentrated point of impact on the head.

The Bundle of Sticks (Aesop's Fable)

A certain father had a family of sons, who were forever quarreling among themselves. No words he could say did the least good, so he cast about in his mind for some very striking example that should make them see that discord would lead them to misfortune.

One day when the quarreling had been much more violent than usual and each of the sons was moping in a surly manner, he asked one of them to bring him a bundle of sticks. Then handing the bundle to each of his sons in turn he told them to try to break it. But although each one tried his best, none was able to do so.

The father then untied the bundle and gave the sticks to his Sons to break one by one. This they did very easily.

"My sons," said the father, "do you not see how certain it is that if you agree with each other and help each other, it will be impossible for your enemies to injure you? But if you are divided among yourselves, you will be no stronger than a single stick in that bundle."

The Scientific Explanation

The phenomenon is similar to bending of beams. One has to bend the stick by applying shear force on two ends of the stick to break it. When the stress (force/area of cross section) is large enough, the strain becomes much more causing permanent deformation (beyond the elastic limit) of the stick and finally it breaks. Within elastic limit, the *Young modulus* of the stick is Y=stress/strain. Young modulus is also the characteristic of the material of the stick.

Now, if identical sticks are put together, the area of cross-section will be more (number of sticks X cross-section of a single stick). Then, to cause similar strain the force to be applied should be much bigger as stress= force per unit area.

Fig.7: The force to be applied on the bundle of stick (force at each end is F' to bend it and break it finally is much more than the force (F) applied on single stick ($F' \gg F$)

The bundle of sticks could not be broken by the sons as they could not strain the bundle sufficiently for a crack to develop. However, the sticks break one by one, because one can easily apply the force (thus stress) required for generating sufficient strain within the stick to break it.

Conclusion

The students often are exposed to abstract scientific concepts without being related to nature of objects, ideas and processes. The introduction of popular tales in science classroom will make learning science joyful and enhance the ability to analyze information and solve problems on a complex, thought-based level which is sometimes referred to as abstract reasoning. It will also develop understanding subjects on a complex level through analysis and evaluation. In storytelling, we just need to talk, connect and express more. We need to be more attached to people than gadgets.When students read stories and analyse the scientific bases it helps the teacher to assess if students can apply what they have learned to solve practical problems and the emotional engagement of the students with the concepts.

References

101 Panchatantra Stories. Om Books International. (2013), 121P. ISBN 978-93-80070-77-3.

DiMaio VJ, DiMaio D. (2001). *Blunt trauma wounds and blunt trauma injuries of the trunk and extremities. Forensic Pathology*. 2nd ed. Boca Raton, Fla: CRC Press; Chapters 4-5.

Dolinak D, Matshes EW, Lew EO. *Blunt force injury.Forensic Pathology: Principles and Practice*. (2005) Burlington, Mass: Elsevier; Chapter 5.

Erten Sinam ,Kiray Ahmet S.,Sen-Gumiis B. *(*2013). I*nfluence of scientific stories on students ideas about Science and Scientist. Int. Jour of Education in Maths, Science and Technolog. 1*(2), 122-137.

Franklin, E., George, A. and Unwin, L. (1965). *The Panchatantra translated in 1924 from the Sanskrit* ("Edition for the General Reader"), p. 13

Friede R.C, ed. (2003) Blunt force injury. *Handbook of Forensic Pathology*. 2nd ed. Northfield, Ill: College of American Pathologists; Chapter 14.

Pearson, A.M. (1996). *Because it gives me peace of mind': ritual fasts in the religious lives of Hindu women*, SUNY Press, p. 279, *Funk and Wagnalls Standard Dictionary of Folklore Mythology and Legend* (1975), p. 842.

Scott P, Mortimer E, and Ametller, J. (2011). *Pedagogical link – making: a fundamental aspect of teaching and learning scientific conceptual knowledge.* Studies in Science Education Vol. 47 No. 1, March 2011,pp. 3-36.

The Aesop's Fables. Quixot Publications. ISBN 978-93-82463-13-9.

Upadhyaya, K. D. (2009). *The classification and chief characteristics of Indian (Hindi) folk-tales*: Fabula, 7 (1), 225–229,DOI: https://doi.org/10.1515/ fabl.1965.7 .1.225.

***