



## TACTILE DIAGRAMS IN SCIENCE FOR VISUALLY IMPAIRED STUDENTS AT UPPER PRIMARY STAGE

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**ABSTRACT** Braille books are available for visually impaired students without any illustrations, diagrams and activities. The absence of diagrams and illustrations has been a challenge in a subject like Science. This challenge has been addressed by NCERT, DESM to overwhelm such limitations. DESM has taken the inventiveness of providing tactile books for Science at the upper primary stage. It will help in learning science for visually impaired students. Science textbooks are available in Braille for visually impaired students without diagrams which top to the necessity to develop tactile form of diagrams in science for these students in collaboration with IITD (CoETG) using 3D technology. In this manuscript, we are carrying the progression of tactile books for NCERT Science textbook at upper primary stage (VI, VII, and VIII).

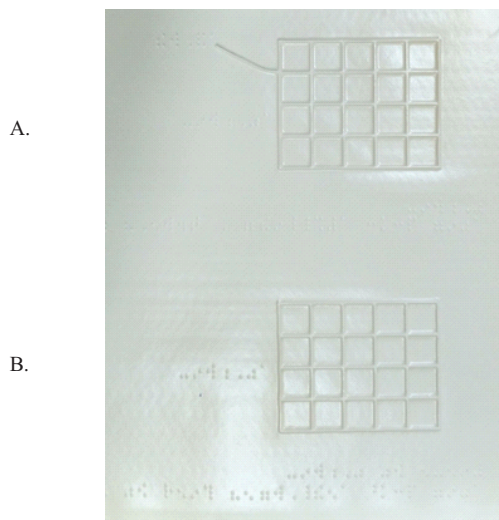
### KEYWORDS :

#### Introduction

Allowing to "The Rights of Person With Disabilities act, 2016 inclusive education is as follows:" Inclusive education where students with and without disability learn together and the system of teaching and learning is suitably adapted to meet the learning need of different types of students with disabilities. Inclusion means removing difference between visually impaired students and students with vision regardless of their prominence, communal strength and flaws since it has been perceived that mainstream of students drop out from Science stream. They must be included in mainstream education for the real implementation of inclusive education tactile books plays a significant role.

NCERT had designed tactile books for visually impaired student to provide accessible versions of illustrations and diagrams. These tactile illustrations are perceived by touch.

Some examples of tactile representations.



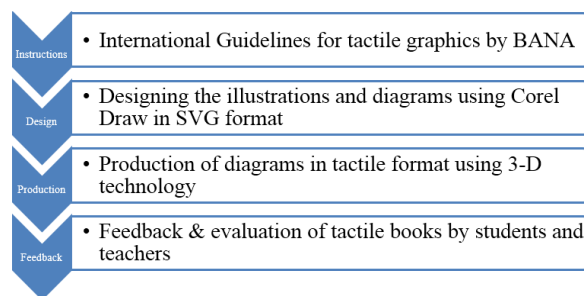
**Figure 1 (A) Enlarge view of a piece of fabric**  
**Figure 1 (B) Pulling a thread from a fabric**



**Figure 2 Different threads of a fibre.**

#### Tactile Books and Graphics...

The design cycle for tactile books are prepared in the following sequence as shown in figure 3:



**Figure 3 Design cycle for tactile graphics**

In directive to envisage the textual information given in Braille textbooks, tactile books are introduced in science for visually impaired students.

Tactile books will generate the stand of equal opportunity for all students irrespective of visual impairments. These tactile books will help visually impaired students to understand systematic perception in a better way and also encourage them to take interest in science. Tactile books are established to offer books which include tactile diagrams, illustrations and give parallel experience as sighted students to children with visual impairments. Interpretation ability is achieved through the accessibility of right books at the right time. Tactile illustrations mainly are subject to on the texture, size and sequence of the concept. The texture of the pictures emphasizes and replicates the qualities of the content.

#### Designing of Tactile Graphics

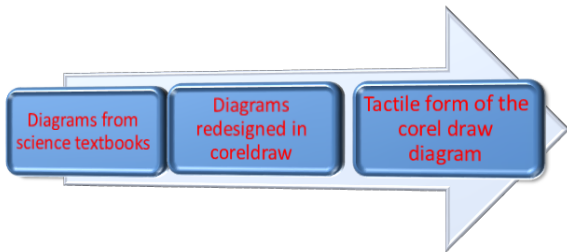
Braille Authority of North America and Royal National Institute for the blind, UK has developed international guidelines and standards for the incorporation, design and presentation of tactile graphics.

The following principles and guidelines were followed before creating the design of tactile graphics:

1. The first and foremost criteria are that there should be a need for tactile graphic, i.e., unnecessary graphics must be avoided.
2. The graphical representations must be presented in the tactile form.
3. The format of tactile graphics and Braille code needs to be same.
4. Positions of the tactile graphics should be according to the Braille code or should be placed near left margin of the books.
5. The content which is to be used should be identified and simplified so the information conveyed should be useful to the reader.
6. The information must not be given in the tactile form if it is more meaningful than the text.

7. There should always be a tactile graphic when there are questions asked about an image which cannot be answered by text.
8. The representation of tactile graphics must not be repeated.
9. The graphics transcriptions should be consistent with each other.
10. Considering the content, textures, symbols and labels when planning and editing the transcription. So as to provide logical and undeviating resemblance between the graphics.
11. Documentation of the information must be done.

The images from science textbooks are redesigned using Corel draw graphics software. Corel draw is a professional vector based illustrations which edit two-dimensional images in SVG (scalable vector graphics) format. In SVG format the images can be scaled to any size while accommodating the original quality of the image. The step by step scheme for designing of tactile illustrations is shown below:



**Figure 4 Procedure map of tactile image formation**

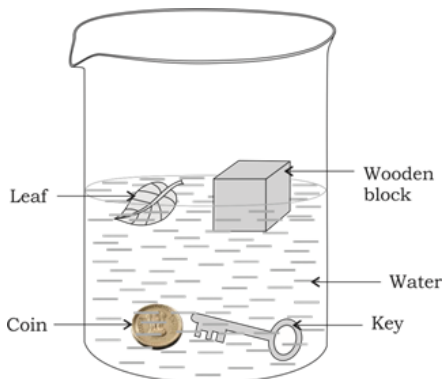
Tactile diagrams are not an exact replica of a visual image to a raised diagram. It must be known that a tactile graphic is not automatically meaningful to students with visually impaired students. The students must have an understanding of that which is being represented. These books are developed keeping in mind that a visually impaired student will have same experience as sighted student since these books communicate through touch. A tactile diagram generally includes tactile representations of pictures, diagrams and a visually impaired student can feel these raised lines or diagrams to get information.

Images from science textbooks are converted into SVG format using Corel Draw.

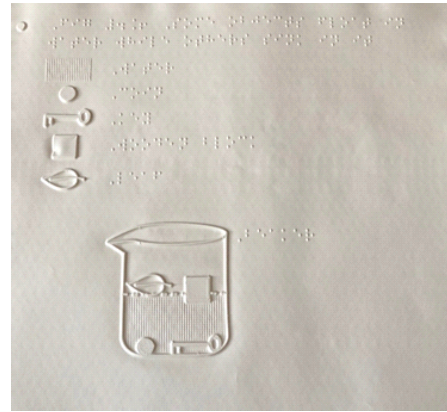
Some of the examples are shown:



**Figure 5 Image in pdf format from NCERT textbook**

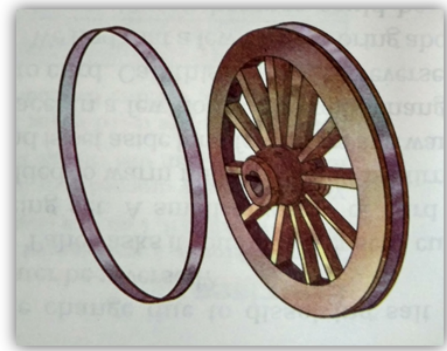


**Figure 6 Image in SVG format**



**Figure 7 Image in Tactile Form**

Second example:



**Figure 8 Cart Wheel with metal rim fixed to it(image in pdf format)**

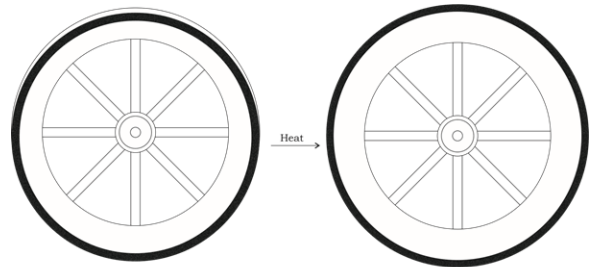
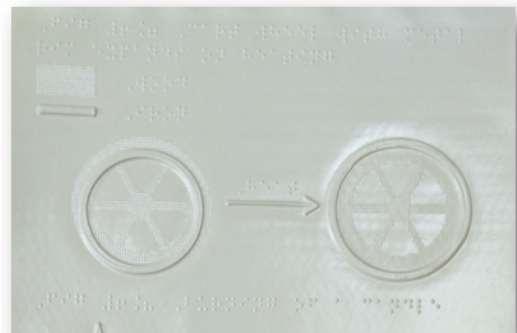


Fig. 6.7

**Figure 9 Image in SVG form**



**Figure 10 Image in Tactile format**

Corel draw can open and edit original layout and design tactile diagrams can be created on thermoforming sheets easily, which leads to low cost and make this procedure cost effective. The 3D technology is used to emboss the essential diagrams and pictures.

The main objective in making these embossed diagrams is to make it easy to feel and understand for visually impaired students.

### Conclusions

Science Textbooks are available in Braille format for visually impaired students but lacks the pictorial information and diagrams, so to overawe this restraint Tactile Books in science were introduced. The aim of tactile books and diagrams is to generate equal opportunities for students with visually impairments. Tactile books are available along with a transcriber's note which would to understand the diagrams easily.

### References

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