James Dyson Foundation Undergraduate Bursary 2019/20

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Outreach Report – Supporting KS2 Teachers to Deliver Integrated STEM in Primary Schools

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During this project, an avenue for a resource was identified to increase engagement of STEM skills at primary or secondary level. Through conversation with Mrs Tessa Shercliff, the teacher that I was working with at St. Mary's Junior School in Cambridge, a selection of activities around the theme of engineering drawing was identified in order to address a weakness that Mrs Shercliff had observed in her classroom; often students struggle to see or draw objects from alternative perspectives, e.g. the side view of a coin is a rectangle shape. The proposed activities, linking to mathematics and design technology curriculum criteria, could involve:

- Section drawing through disassembly of objects
- Using a light box/torch and shadows to introduce projection drawings
- 'Hole in the wall' activity to increase understanding of dimensions in different orientations of an object
- Room planning - introducing plan and side views of everyday objects

This outreach activity is focused on the first point above – section drawing through disassembly of objects. The activity was made possible due to Emma Lindsey's fourth year project, Product Disassembly and Analysis, in which she cut open an inhaler that will be needed for this activity, outlined below.

1. *Ask the students to have a look at an inhaler (one that has not been cut open) and discuss how it might work.*

This might be best done in small groups or as a class (if less than 10 or so). Defining the following words might be helpful to use to encourage discussion:

Valve – A small flap or device that allows a fluid to move in one direction only

Cannister – A storage area for a liquid or gas

Dose – Amount of medicine released

Casing – Outer layer of plastic to protect the inner workings

2. *Within each group, discuss and draw what you think is inside the casing – i.e draw a diagram of how the mechanism works*

If struggling, a design method might be helpful here. You could introduce the topic of *abstraction* – removing details from the design to figure out what the exact function of the inhaler is. E.g. "A device to release a dosage of medicine to the patient's lungs". Tell the students that often engineers and designers use this when coming up with a new solution to a problem. It helps them not focus on existing designs/mechanisms and allowing them to come up with a new innovation but making sure they do not lose sight of the function that they want the design to have. The student then, instead of guessing what's inside the inhaler from what the outside looks like, can design their own mechanism.

3. *Next, show the students the (stuck together) version of the cut open inhaler and discuss how the mechanism works.*

This is what the internals look like (see figure 1). When the canister is pushed down by the user, it pushes the plastic stem inside the cannister, where it can fill up with a dosage of the gas through a tiny hole. The gas can then be breathed in through the mouthpiece, which has a lid for hygiene reasons.

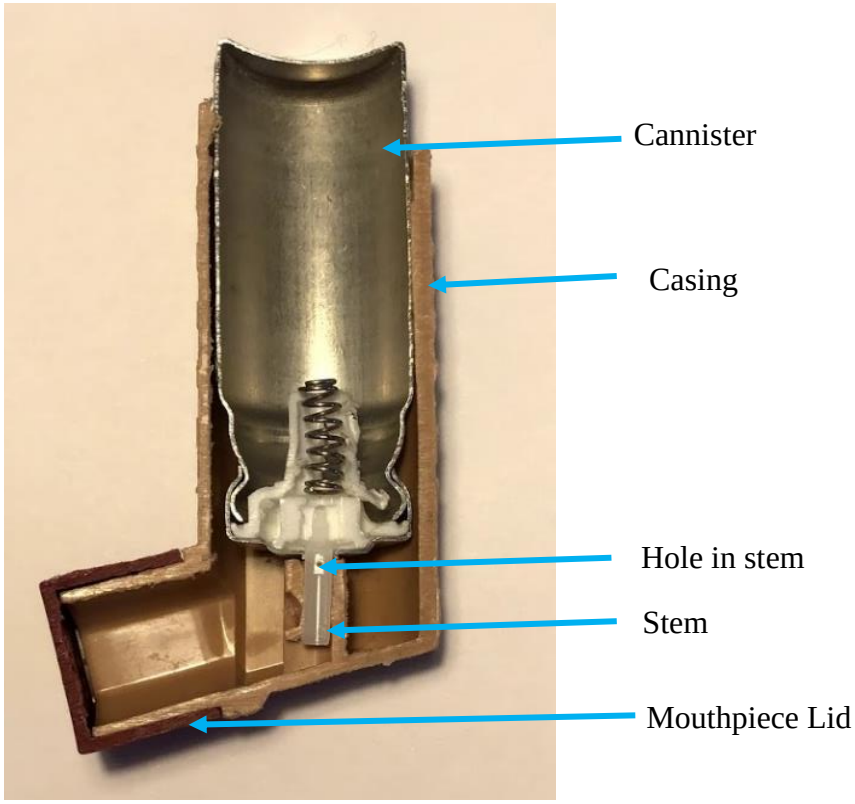

Figure 1 – Inhaler Cross Section

4. *Take each part in turn and talk about the geometry of the disassembled inhaler. Hold a part inside the shadowbox (using tweezers for the smaller parts) and take note of the shapes that each part makes from various angles.*

Figure 2 shows how the shadow box is set up (prior to the session). It is made up of a projector (or bright lamp) with side panels that direct the light towards a paper screen (fixed vertically). Placing an object between the box and the screen should illuminate the shadow the object makes on the screen, best seen from the other side. This works best in a dark room.

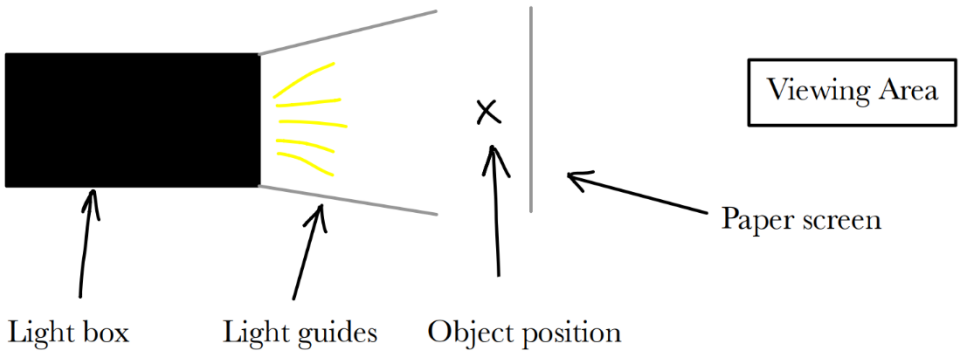

Figure 2 – Shadowbox configuration

Start by using some simple shapes such as coins:

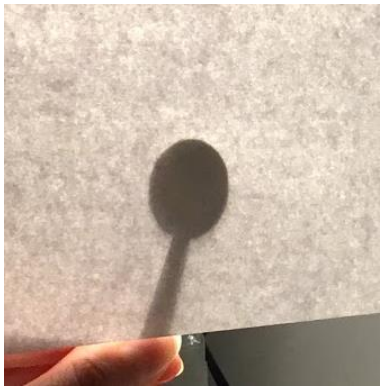

Figure 3

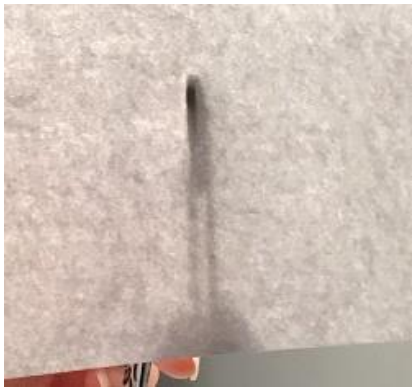

Figure 4

From the front side of a coin, it is circular… and from the side, it is rectangular.

The main parts of the inhaler that we should focus on are the casing, lid, cannister, and stem (labelled in figure 1).

5. *By looking at each piece inside the shadow box and examining the cut open inhaler, each student will produce a scale drawing of the cross-section view of the inhaler.*

An example of the scale drawing can be found in figure 5. Make sure the students draw the casing, lid, cannister and stem, labelling each piece. Each part should be drawn with a ruler, and the areas that have been cut open should be hatched.

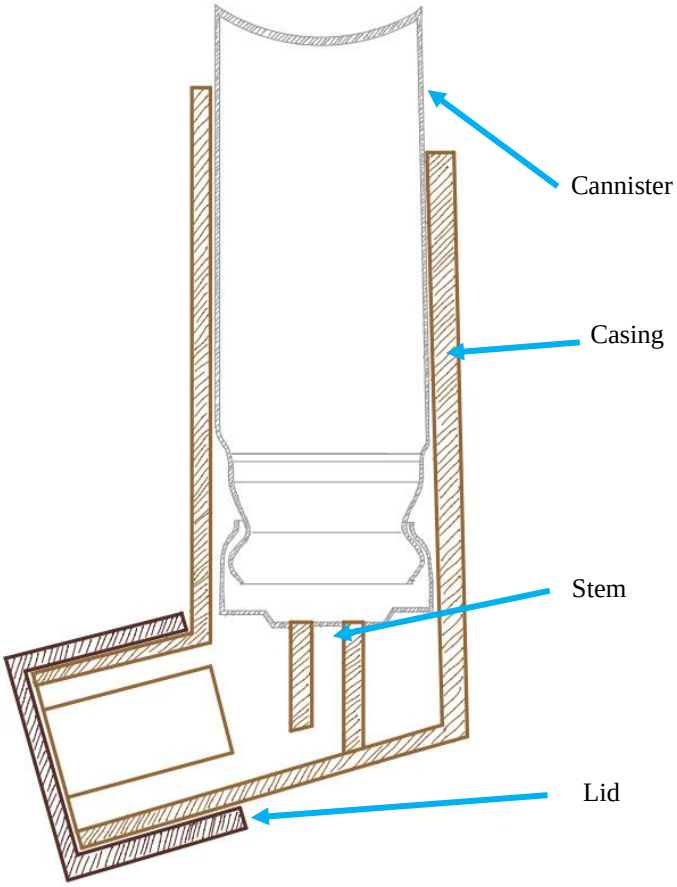

Figure 5 – Section drawing of an inhaler

6. *Reflect on how cutting open the inhaler has aided their understanding of the mechanism inside the inhaler.*

By seeing the mechanism inside, they can easily guess how an inhaler works. By performing this activity, students may be surprised by how many small parts are inside everyday objects, but for the purposes of the exercise, should focus on the main parts of the mechanism.

Remind students that they should not cut open medical equipment at home – an inhaler is particularly dangerous to cut open as the cannister has pressurised gas inside.