Shuffleboard Activity – Teacher Notes

Aim

The aim of this KS3 shuffleboard activity is to provide a hands-on and engaging experience for students to investigate the effects of friction on motion. Through practical experimentation, students will explore how different surfaces impact the distance a shuffleboard puck travels, directly observing the varying levels of friction. This activity will enable students to develop their "working scientifically" skills by planning, conducting, and analysing a simple experiment, focusing on data collection and interpretation. Ultimately, the goal is to deepen students' understanding of the concept of friction, its role as a force opposing motion, and its influence on everyday movement, while also reinforcing their measurement and data handling abilities.

Relevance to National Curriculum

The shuffleboard activity is a practical and engaging way to reinforce key concepts from the KS3 science curriculum, while also providing opportunities to develop mathematical and physical skills. It allows students to experience scientific principles in a hands-on and memorable way.

Learning Outcomes

Students will be able to:

- Define friction as a force that opposes motion between surfaces in contact.
- Identify that friction can slow down or stop an object's motion.
- Understanding that different surfaces create different amounts of friction.
- Predict how changing the surface or the puck would affect the distance travelled.

Additional Observations

- Surfaces are complex and sliding occurs between the points that are in contact.
- Understand the difference between apparent and real contact area.
- Friction force is proportional to applied load.
- Fewer points in contact (smaller real contact area) results in less friction.

Warm-Up Activity Answers

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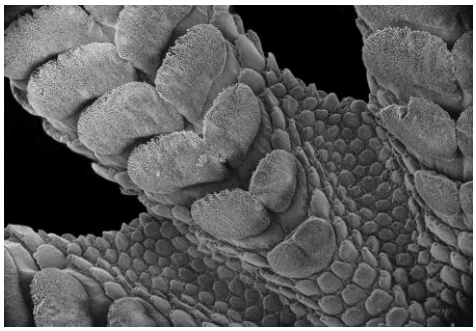

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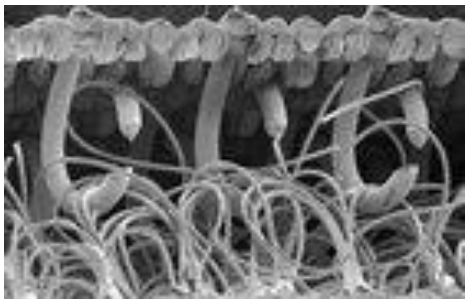

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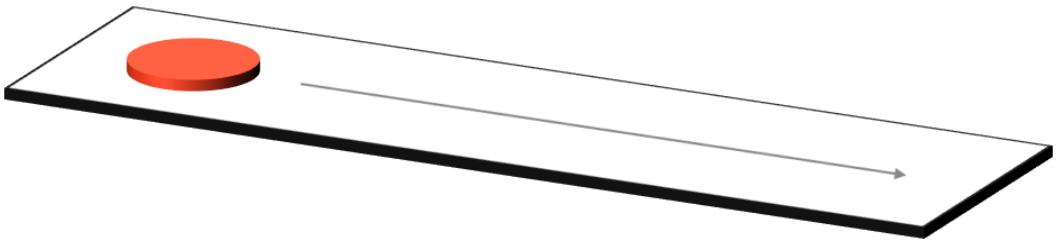
Activity Overview

Systematically slide pucks along a desk to explore how friction is affected by load and surface texture.



Materials

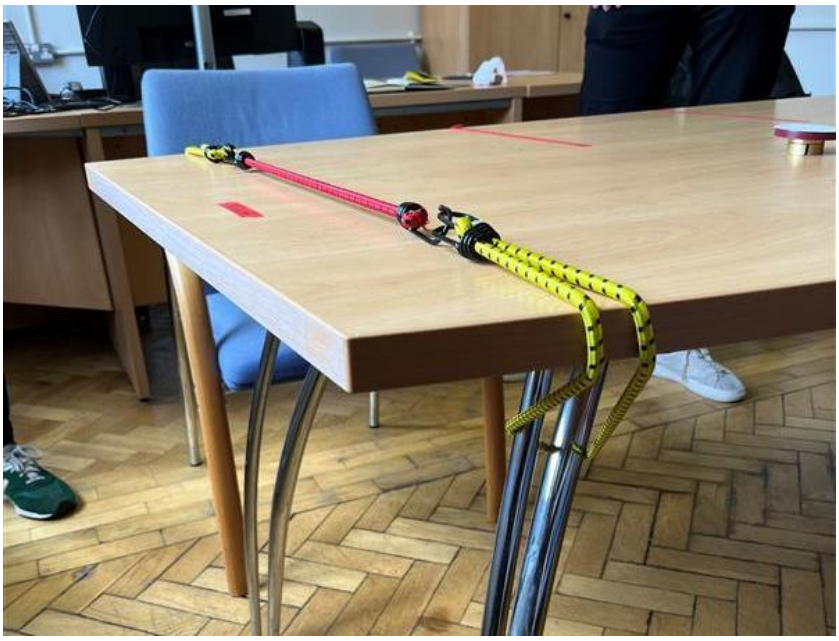
Items	Link / Alternatives	Use	Notes
Bungee cords	Link	Launch mechanism	
Masses		Applying load	100g increments
Tape measure	Metre ruler	Measuring distance	
Pucks	Cosmetic tub lids / plastic petri dishes (link)		See puck section
Adhesive putty	Blu / White Tac	Secure masses to pucks	Potential choking / ingestion hazard.
Masking tape	Electrical tape	Mark launch line and target point.	
Velcro tape	Link	Change the texture of puck surface	Should cover most of the puck surface.
Washing up liquid	water	To lubricate the desk	For the stretch activity. Cleaning / drying products required.

Launch Mechanism

Use 3 bungee cords and wrap the outer lengths around the table legs, as shown in Figure 1a.

Add a launch marker, as shown in Figure 1b. Its position will vary based on the table's length. Test the setup using a puck loaded with one 100g mass and Velcro tape – the configuration is expected to slide the furthest.

(a)



(b)

Figure 1 – The launch mechanism used to slide the pucks.

Puck

The pucks should have a diameter wide enough so that 3 masses can lie flat within them, as shown in Figure 2, Additionally, the sides of the pucks should be at least 16 mm tall.

Figure 2 – A puck loaded with 3 x 100g masses.

The pucks could be various household items, such as cosmetic or food tub lids. The IMechE promotes recycling whenever possible; however, if suitable materials are unavailable, plastic petri dishes could be used.

Secure the masses to each puck with an adhesive putty – E.g. Blu Tack.

Experimental Procedure

Activity One:

Slide with one weight, record the distances travelled.

- Repeat this process three times and calculate an average value.

Activity Two:

Slide with three weights, record the distances travelled.

- Repeat this process three times and calculate an average value.

Activity Three:

Slide with three weights + Velcro, record the distances travelled.

- Use multiple strips of Velcro tape (3-4) to ensure the sliding contact occurs between the hooks of the Velcro tape and the table.
- Repeat this process three times and calculate an average value.

Activity Four:

Slide with whichever loading / surface configuration and try to get as close to the marker as possible.

- The activity could be made into a competition, with the marker positioning varying on the students' shoes size multiplied by 6cm, for example.
- Repeat three times, noting the minimum/smallest value as the final result.

An overview of the expected relative sliding distances is given in Figure 3.

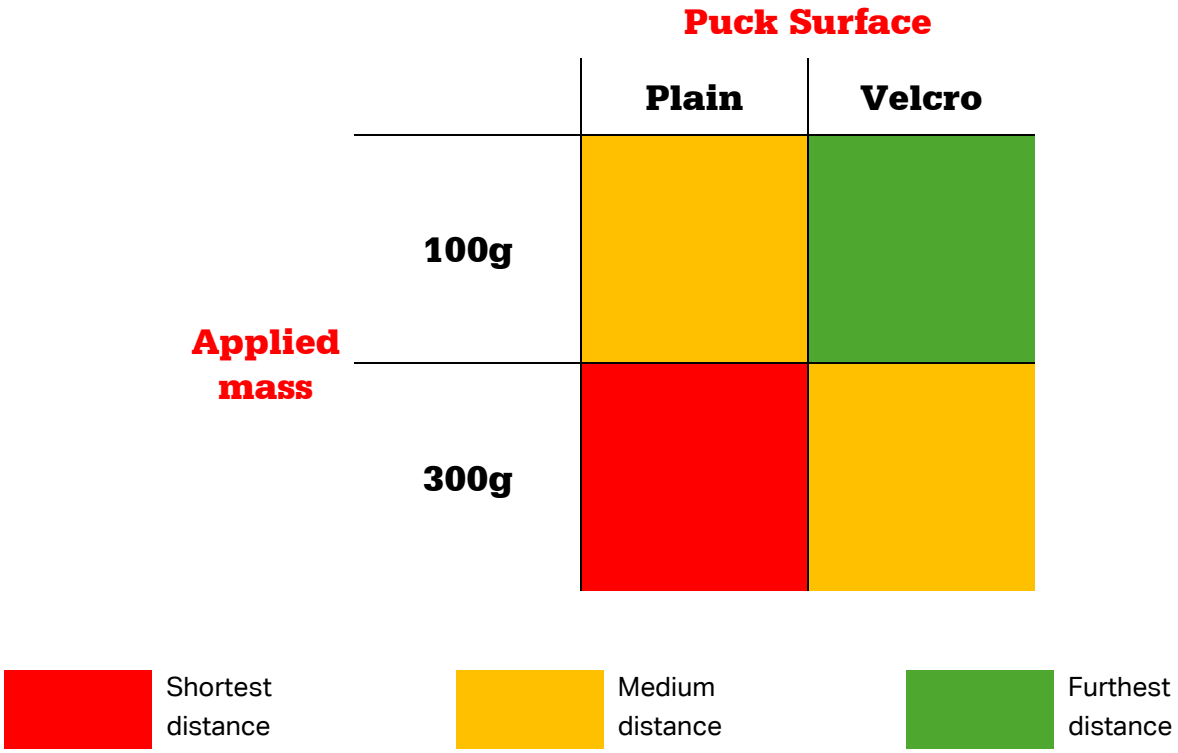


Figure 3 – An overview of the expected relative sliding distances.

Stretch Activities

Reducing resistance: Lubrication

- All of the items listed are lubricants
- Add a small amount of washing up liquid to the desk
- Compare the distance between the lubricated and non-lubricated results. This could be done with the entire class present, or just with those who finish testing / the quiz early.
- The addition of washing up liquid should result in pucks sliding further than when unlubricated.
- The addition of a lubricant separates the puck and desk surfaces, resulting in less friction.

Quiz Answers

Did the pucks slide further with more or less mass / load?

- Pucks should slide further with **less** mass / load.
- The force of friction is directly proportional to the applied load.

What was the difference in average sliding distance between a puck loaded with one and three masses?

- Students should compare their answers from activities one and two.
- Results from activity one should be greater than activity two.

Based on the above, do you think there is a link between friction and applied mass / load? (yes / no)

- **Yes**
- The force of friction is directly proportional to the applied load.

Which surface has more contact with the desk – The plain puck surface or Velcro surface?

- **The plain puck surface**
- Contact only occurs at the tips of the Velcro hooks.

Which surface has the bigger real contact area with the desk – The plain puck surface or Velcro surface?

- **The plain puck surface**
- Contact only occurs at the tips of the Velcro hooks.

What was the difference in average sliding distance between a plain puck surface (activity two) and Velcro surface (activity 3)?

- Students should compare their answers from activities one and two.
- Results from activity one should be greater than activity two.

Based on the above, do you think there is a link between friction and real contact area? (yes / no)

- **Yes**
- Greater real contact area = more points in contact = greater resistance to sliding = more friction.

Which of the following affect friction?

Yes	**Mass / load**	**Yes**	**Surface material**
No	Type of launch mechanism	No	Size of desk
No	Sliding speed*	**Yes**	**Number of contact points**
No	Time of day	No	Colour of puck
Yes	**Surface roughness**	**Yes**	**Prescence of a liquid**

**Kinetic friction is independent of the sliding speed.*

Name a scenario in which friction is desirable and undesirable?

Some examples could include:

Desirable:	**Undesirable:**
Walking and Running - friction between the soles of our shoes and the ground provides the traction necessary to move forward without slipping. **Gripping objects** - friction between our fingers and objects allows us to hold and manipulate them. (Crucial for surgeons and chefs gripping knives)	**Energy loss in engines** - friction converts kinetic energy into heat, leading to energy loss in machines and other systems. **Friction burns** - excessive friction can generate unwanted heat, leading to friction burns. This is particularly noticeable when skin rubs against surfaces like slides or ill-fitting shoes