Friction Lab

Challenge - move your wooden block from start to finish with the least amount of force.

Procedure - 1. Make sure your spring scale pointer is zeroed - if not see your teacher.
2. You will drag a wooden block by hooking the spring scale to it at one end and pulling it across the surface for 40cm. You must keep the largest area surface of the block in contact with the friction surface at all times.
3. The block must be dragged at an even pace over each surface. You can tell if you are dragging evenly over the surface by looking at the spring scale. As you drag, the force should measure about the same for the entire 40cm. This may take some practice.

Materials:

<table>
<thead>
<tr>
<th>Materials:</th>
<th>wooden blocks</th>
<th>wooden dowels</th>
<th>tape</th>
<th>meter sticks</th>
<th>spring scales</th>
</tr>
</thead>
<tbody>
<tr>
<td>wax paper</td>
<td>sand paper</td>
<td>paper towels</td>
<td>linen</td>
<td>other surface?</td>
<td></td>
</tr>
</tbody>
</table>

Question - How much of an effect will the different surfaces have on the force requirements to pull the block across them?

What is the independent variable in this experiment? _________________

What is the dependent variable in this experiment? _________________

a. Measure 40cm of length on the lab table surface with the meter stick and mark the start and finish with masking tape.
b. Start with the surface that was assigned to your group. Make sure you record your data in the correct place on the data table throughout the lab.
c. Place the block at the beginning of the 40cm, attach the spring scale and begin dragging
d. If you complete a station before Burns says switch go onto the multiple choice and short answer section.
e. Pay extra attention to the force required to get the block moving - record the initial force required to move the block in the data table.
f. Next record the constant frictional force - this is the force that remains constant while dragging for 40cm. You will then find the average of the constant force.
g. Complete trials and record data at least 3 times for each station.
Data Table -

<table>
<thead>
<tr>
<th>Surface Type</th>
<th>Trial 1 Friction Force (N)</th>
<th>Trial 2 Friction Force (N)</th>
<th>Trial 3 Friction Force (N)</th>
<th>Average Constant Frictional Force</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Initial</td>
<td>Constant</td>
<td>Initial</td>
<td>Constant</td>
</tr>
<tr>
<td>Lab Table</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sand Paper</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Linen</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dowels</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wax paper</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paper towels</td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Analysis and conclusion questions –

1. What surface requires the greatest amount of force to move the block? Explain quantifiably using the data you collected. Quantifiably - means to measure and then explain numerically.

2. What surface requires the least amount of force to move the block? Explain quantifiably using the data you collected. How much less force was required compared to the highest friction surface. Give a number.

3. If we were to add water to the surface of the lab table, explain which type of frictional force would be created.

4. If you were to recreate this experiment what type of surface would you choose to examine low friction and which type might you choose to examine high friction?

5. Explain another way you could find the force required to pull the block across a surface using Newton’s Second Law.
**Friction Basics**

Friction is a **force** that holds back the movement of a sliding object. That's it. Friction is just that simple.

You will find friction everywhere that objects come into contact with each other. The force acts in the opposite direction to the way an object wants to slide. If a car needs to stop at a stop sign, it slows because of the friction between the brakes and the wheels. If you run down the sidewalk and stop quickly, you can stop because of the friction between your shoes and the cement.

What happens if you run down the sidewalk and you try to stop on a puddle? Friction is still there, but the liquid makes the surfaces smoother and the friction a lot less. Less friction means it is harder to stop. The low friction thing happens to cars when it rains. That's why there are often so many accidents. Even though the friction of the brakes is still there, the brakes may be wet, and the wheels are not in as much contact with the ground. Cars hydroplane when they go too fast on puddles of water.

**Friction and Gases**

Friction technically only happens with solid objects. When it involves liquids or gases, we refer to it as resistance to motion. This doesn't involve sliding surfaces like friction does, but is instead the kind of resistance you get if you try to push your way through a crowd. It's a colliding situation, not a sliding one. If the gas is air, this is referred to as air resistance.

If you were in the space shuttle and re-entering the atmosphere, the bottom of the shuttle would be getting very hot. The collisions that occur between the molecules of the air being compressed by the shuttle, heat up the air AND the shuttle itself. The temperature on the top of the shuttle is also warm, but nowhere near the temperatures found on the bottom.

**Friction and Liquids**

Although liquids offer resistance to objects moving through them, they also smooth surfaces and reduce friction. Liquids tend to get thinner (less viscous) as they are heated. This is like the *viscosity* of the oil you put in your car. Car engines have a lot of moving parts, and they rub on each other. The rubbing produces friction and the result is heat. When oil is added to a car engine, the oil sticks to surfaces, and helps to decrease the amount of friction and wear on the parts of the engine. An engine that runs hotter requires a more viscous oil in order for it to stick to the surfaces properly.
Measuring Friction
Measures of friction are based on the type of materials that are in contact. Concrete on concrete has a very high coefficient of friction. That coefficient is a measure of how easily one object moves in relationship to another. When you have a high coefficient of friction, you have a lot of friction between the materials. Concrete on concrete has a very high coefficient, and Teflon on most things has a very low coefficient. Teflon is used on surfaces where we don’t want things to stick; such as pots and pans. Scientists have discovered that there is even less friction in your joints than in Teflon! It is one more example at how efficient living organisms can be.

1. _____ Friction is a force that resists the movement of objects in contact with one another. This force acts in a specific vector to the direction of motion. Which way is it?
   A. Opposite   C. The direction of push
   B. The same   D. The direction of pull

2. _____ This is what can happen when a car or something similar moves at a high rate of speed over a wet surface?
   A. hydraulics   C. friction increases
   B. hydrofracking   D. hydroplaning

3. _____ When friction involves fluids it is referred to technically as ______________ rather than friction.
   A. inert force   C. resistance
   B. opposition force   D. water cohesion

4. _____ Car engines that run hotter tend to have higher coefficients of friction between their moving parts. To reduce friction they need _____________________________
   A. less viscous oil to lower the coefficient of friction between moving parts.
   B. less viscous oil to increase the coefficient of friction between moving parts.
   C. more viscous oil to lower the coefficient of friction between moving parts.
   D. more viscous oil to increase the coefficient of friction between moving parts.
5. List three surfaces on which we would want to lower the coefficients of friction.

________________, ___________________, ___________________.

6. Consider the image at right. Strictly speaking, if we compare the magnitudes of both vector force arrows in both diagrams do both boxes appear balanced or unbalanced?

A. balanced  B. unbalanced  C. both  D. neither

7. Assuming the mass is the same for each box which will require greater force to move?

A. Box on smooth  B. Box on rough  C. same force  D. we need a balance to calculate

Reference

For the following, circle the captions 1. or 2. that best fit the above images and is correct.

1. In image A (skier), weight force (gravity) is greater than the force of friction resulting in motion.
2. In image A, the weight force is less than the force of friction resulting in motion.
3. In image B the friction, normal and weight force have a resultant net force which is unbalanced.
4. In image B the friction, normal and weight force have a resultant net force of zero.
5. There is no frictional force in image A, resulting in motion from the force of gravity.
6. There is frictional force in image B balancing out with weight and normal force.
7. Select anyone of your surface types. Write it here: ___________ Record block mass: ______

Find the approximate acceleration of your block while pulling it over the surface. Use average N.

Write formula, show work, include units

Provide a witty caption for the young girl being pulled by the boy. Relate it to friction of course.