SASTA OLIPHANT SCIENCE AWARDS

SOUTH AUSTRALIAN SCIENCE TEACHERS ASSOCIATION

Prize Winner

Science Investigation

Year 3 - 4

Ethan Chao

Scotch College - Junior School

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SOUTH AUSTRALIA

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SASTA South Australian Science Teachers Association

Egg Odyssey

Can Non-Newtonian Fluids reduce damage caused by force?

Introduction

Gravity is everywhere in your daily life which pulls objects toward Earth. When something falls, it gets faster before it hits the ground. Some materials can take in this force better than others and help stop fragile things from breaking.

I enjoy snowboarding and wear protective pads to protect myself when I fall. This made me wonder whether there are smarter materials that could provide better protection during impacts.

I learned about non-Newtonian fluids and discovered that they can behave like both liquids and solids. This made me curious about whether they could absorb impact energy and reduce damage.

Purpose

The purpose of this experiment was to find out which material best protected an egg from cracking after a drop. I also investigated how drop height and landing surface affected the amount of damage. This helps show how different materials absorb impact force.

Research Question

Which material protects an egg best when it is dropped from different heights and surfaces?

Hypothesis

I predict oobleck will protect the egg better than water and bubble wrap because it becomes harder when hit quickly. I also predict the egg will be safer on grass because grass is softer than concrete.

Background Research

Oobleck is made from cornflour and water. It is a non-Newtonian fluid because its viscosity can change when force is applied. Viscosity means how thick or runny a fluid is.

When oobleck is moved slowly, it flows like a liquid. When it is hit quickly, it becomes harder and acts more like a solid. This happens because the cornflour particles are pushed together.

Gravity is important because it pulls the egg down. The higher the egg is dropped, the more potential energy it has. When it lands, this energy becomes impact force.

Force can be shown as: F = ma, Potential energy can be shown as: PE = mgh
This experiment tests whether oobleck can absorb impact force and protect an egg better than water and bubble wrap.

Variables

Independent Variable

Independent variable	**What I changed**	**Why I changed it**
Protection material	Water, bubble wrap and oobleck	To find out which material protected the egg best
Drop height	I dropped the egg from different heights, such as 100 cm, 140 cm, 180 cm and 400 cm	To see if a higher drop caused more damage
Surface type	I tested soft surface (grass) and hard surface (concrete)	To see if the landing surface changed how much the egg cracked

Table 1.1 The Independent Variable I changed and why

Dependent Variable

In this experiment, the dependent variable was the damage to the egg after each drop.

I checked whether the egg had:

Result	**Meaning**
No crack	The egg had no visible crack
Small crack	The egg had a small visible crack but did not break apart
Cracked	The egg had clear cracking or larger damage
Broken	The egg shell broke apart or leaked

Table 1.2: Egg damage categories

Controlled Variables

Controlled variable	**How I kept it the same**	**Why it was important**
Type of egg	I used the same type of egg for each test	Different eggs may have different shell strength
Plastic bag	Each egg was placed inside a plastic bag	This kept the setup similar for each test
Dropping method	I dropped the egg instead of throwing or pushing it	Throwing the egg would add extra force and make the test unfair
Person dropping the egg	The same person dropped the egg where possible	Different people may drop it in slightly different ways

Amount of liquid/material	I used 350 ml of water for the water test. For oobleck, I used 1 cup of cornflour and ½ cup of water, which made a similar material level.	This helped keep the amount of protection material similar for each test.
Checking method	I checked the egg using the same result categories each time	This made the results easier to compare

Table 1.3: Controlled variables used to make the experiment fair

Fair Test Explanation

To keep the experiment fair, I kept the egg type, plastic bag, material amount and dropping method the same. I dropped the egg without pushing or throwing it so I could compare the materials clearly.

Materials

- Eggs
- Plastic bags
- Water
- Bubble wrap
- Cornflour
- Water for making Oobleck
- Measuring cup
- Spoon
- Measuring tape
- Ruler
- Phone
- Paper or table to record results
- Notebook/logbook

Method

1. Label three containers: water, bubble wrap and oobleck.
2. Make oobleck using 1 cup cornflour and ½ cup water. Use 350 ml of water for the water test so the material level is similar.
3. Place one egg in a plastic bag with each material.
4. Measure the drop height with a measuring tape.
5. Drop the egg without pushing or throwing it.
6. Test on grass at 100 cm, 140 cm, 180 cm and 400 cm.
7. Test on concrete at 100 cm with bubble wrap, 100 cm and 400 cm with oobleck.
8. After each drop, check whether the egg had no crack, small crack, cracked or broken.
9. Record the results in a table and compare the materials.

Photo 1: Measuring 1 cup of cornflour.

Photo 2: Measuring ½ cup of water.

Photo 3: Mixing the cornflour and water together.

Photo 4: Finished approx. 350ml oobleck ready for the egg drop test.

Data Collection

At first, I planned to measure the crack length. However, this was difficult because each egg was inside a plastic bag. Some eggs were already broken or hard to check clearly when I opened the bag.

Because of this, I used simple damage categories to record the results.

Damage Scale

Score	Description
0	No damage
1	Small crack
3	Medium crack
5	Completely broken

Table 2.1: Damage score guide

Results Table

Test	Height	Surface	Surface type	Protection material	Result	Scale	Comment
1	100 cm	Grass	Soft	Water	Broken	5	The egg broke even though it landed on grass
2	100 cm	Grass	Soft	Bubble wrap	No crack	0	The egg survived the drop
3	100 cm	Grass	Soft	Oobleck	No crack	0	The egg survived the drop
4	140 cm	Grass	Soft	Bubble wrap	No crack	0	The egg survived the drop
5	140 cm	Grass	Soft	Oobleck	No crack	0	The egg survived the drop
6	180 cm	Grass	Soft	Bubble wrap	No crack	0	The egg survived the drop
7	180 cm	Grass	Soft	Oobleck	No crack	0	The egg survived the drop
8	400 cm	Grass	Soft	Bubble wrap	No crack	0	The egg still survived on grass
9	400 cm	Grass	Soft	Oobleck	No crack	0	The egg still survived on grass
10	100 cm	Concrete	Hard	Bubble wrap	Medium crack	3	The egg had a medium crack after the drop
11	100 cm	Concrete	Hard	Oobleck	No crack	0	The egg survived the concrete drop
12	400 cm	Concrete	Hard	Oobleck	Medium crack	3	Oobleck protected the egg at 100 cm but not at 400 cm on concrete

Table 2.2: Results from different materials, heights and surfaces

Results Summary

The results showed that water was the least effective protection material. The egg broke at only 100 cm on grass. This means water did not protect the egg well enough during the impact.

Bubble wrap worked well on soft surface. It protected the egg at all different heights. However, when the surface changed to concrete, the bubble wrap egg had a medium crack at only 100 cm. This shows that bubble wrap worked better when the landing surface was soft.

Oobleck was the strongest material overall. It protected the egg on both grass and concrete. It also protected the egg at higher heights on grass. However, when the oobleck egg was dropped from 400 cm onto concrete, the egg cracked. This shows that oobleck can absorb impact well, but it still has a limit when the force is too strong.

Discussion

I expected oobleck to protect the egg best because it becomes firmer when it is hit quickly. The results matched my hypothesis. Water gave the least protection because it stayed as a liquid and did not become firm during impact.

The surface also made a big difference. On grass, both bubble wrap and oobleck protected the eggs. On concrete, the impact was stronger. Bubble wrap caused a medium crack at 100 cm, but oobleck had no crack at the same height. This shows that oobleck worked better on a hard surface. However, oobleck still had a limit. This shows that even strong protective materials may fail when the force is too high.

This connects to real life because protective gear, such as snowboarding knee pads, needs to be soft enough to move in but strong enough to protect during a fall.

Conclusion

The best protection material was oobleck. It protected the egg on grass and protected it some heights on concrete. Bubble wrap worked well on grass but not as well on concrete. Water was the least effective material.

The experiment supported my hypothesis. It showed that oobleck can absorb impact well, but the landing surface and drop height also change how much damage happens.

Evaluation Table

Evaluation Area	**What I Found**	**Improvement or Next Step**
Fair testing	I used the same dropping method for each test.	I could measure the amount of each material more carefully.
Results	The damage categories made the results easy to compare.	I could use a more detailed damage scale in future tests.
Materials	Oobleck, water and bubble wrap gave different results.	I could test thinner and thicker oobleck mixtures.
Drop height	Higher drops caused more damage.	I could test more heights to find when each material starts to fail.
Landing surface	Grass and concrete gave different results.	I could test more surfaces such as carpet, tiles or rubber matting.
Accuracy	Some eggs were hard to check inside the plastic bag.	I could photograph each egg after opening the bag.
Technology	I only observed the impact by eye.	I could use slow motion video to study how the material moved.
Future research	Oobleck may help protect fragile objects from impact.	I could test whether oobleck protects glass or other fragile objects.

Table 3.1: Evaluation of the investigation

Real World Applications

Non-Newtonian materials can be useful in real life because they can change when force is applied. They can stay soft and flexible during normal movement but become harder during a sudden impact.
These materials may be useful in:

- Bicycle helmets
- Snowboard padding
- Knee and elbow pads
- Phone protection

Some real products use materials that act a bit like oobleck. One example is D3O. It is used in sports gear, work safety gear, military protection and phone cases. These materials are soft and bendy when people move normally. But when there is a sudden hit or crash, they help absorb the impact and spread out the force.

This is useful for things like snowboard padding, knee pads, elbow pads, bicycle helmets and phone cases. It means the material can be comfortable to wear but still help protect the body or an object during an accident.

Photos of Test

Photo 5 & 6: Measuring Different Heights (100cm, 140cm, 180cm and 400cm)

Photos 7 to 10 show examples of the egg drop experiment being tested

Acknowledgements:

I would like to thank my parents for helping me with the egg drops, measuring the heights and keeping the testing area safe. I would like to thank my sister for helping me take photos, organise my results, make my report tidy and create the tables.

AI Acknowledgement:

ChatGPT was used to help brainstorm ideas, organise the report and improve grammar. All experiments, observations, results and conclusions were completed by me.

Word Count: 1067 (headings, titles, figure captions, tables, references and logbook/journal are not included in the word count).

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Trail		Material	Height	Egg cracked	Damage Score
1	Soft	water	100cm	Yes	5
2	V	bubble wrap	100cm	No	0
3	V	Oobleck	100cm	No	0
4	V	Bubble wrap	140cm	No	0
5	V	Oobleck	140cm	No	0
6	V	Bubble wrap	180cm	No	0
7	V	Oobleck	180cm	No	0
8	V	Bubble wrap	4.5m	No	0
9	V	Oobleck	4.5m	No	0
10	Hard floor	bubble wrap	1.8	Yes	5
11	Hard floor	Oobleck	1.8	No	0
12	Hard floor	Oobleck	4m	Yes	5
13	V	bubble wrap	1m	Yes	3
14					
15					

Damage score guide

Score	Crack length
0	No crack
1	<5mm
2	5mm-15mm
3	16-30mm
4	>30mm
5	Egg shell broken

OSA RISK ASSESSMENT FORM

for all entries in (✓) ☐ Models & Inventions and ☐ Scientific Inquiry

This must be included with your report, log book or entry. One form per entry.

STUDENT(S) NAME: Ethan Chao ID: 0584-025

SCHOOL: Scotch College

Activity: Give a brief outline of what you are planning to do.

Egg Odyssey investigates whether a non-Newtonian fluid called oobleck can protect a fragile object from impact. The experiment will compare eggs dropped into oobleck, water and bubble wrap from the same height. The damage to each egg will be measured using a damage scoring system and crack length measurements. The investigation aims to determine whether oobleck provides better protection against impact and explore possible real-world applications in protective equipments.

Are there possible risks? Consider the following:

- Chemical risks: Are you using chemicals? If so, check with your teacher that any chemicals to be used are on the approved list for schools. Check the safety requirements for their use, such as eye protection and eyewash facilities, availability of running water, use of gloves, a well-ventilated area or fume cupboard.
- Thermal risks: Are you heating things? Could you be burnt?
- Biological risks: Are you working with micro-organisms such as mould and bacteria?
- Sharps risks: Are you cutting things, and is there a risk of injury from sharp objects?
- Electrical risks: Are you using mains (240 volt) electricity? How will you make sure that this is safe? Could you use a battery instead?
- Radiation risks: Does your entry use potentially harmful radiation such as UV or lasers?
- Other hazards.

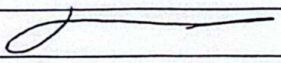
Also, if you are using other people as subjects in an investigation you must get them to sign a note consenting to be part of your experiment.

Risks	How I will control/manage the risk
Slippery spills	Clean spills immediately so no one slips
Dropping from higher places	Stand safely and do not lean too far when dropping the egg
Falling containers	Use a stable flat surface when preparing the eggs
Broken eggs	Clean up broken shells carefully
Mess from splashes	Use a tray or do the experiment outside

(Attach another sheet if needed.)

Risk Assessment indicates that this activity can be safely carried out

RISK ASSESSMENT COMPLETED BY (student name(s)): Ethan Chao

SIGNATURE(S): 

☑ By ticking this box, I/we state that my/our project adheres to the listed criteria for this Category.

TEACHER'S NAME: David Pace

SIGNATURE:  DATE: 19/01/26

OSA RISK ASSESSMENT FORM

for all entries in (✓) ☐ Models & Inventions and ☐ Scientific Inquiry

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Risk Assessment indicates that this activity can be safely carried out

RISK ASSESSMENT COMPLETED BY (student name(s)): Ethan Chao

SIGNATURE(S):

☑ By ticking this box, I/we state that my/our project adheres to the listed criteria for this Category.

TEACHER'S NAME: David Parr

SIGNATURE: DATE: 19/01/26