SASTA OLIPHANT SCIENCE AWARDS

SOUTH AUSTRALIAN SCIENCE TEACHERS ASSOCIATION

Prize Winner

Scientific Inquiry

Year R-2

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St Andrew's School

Efficiency of sports balls

QUESTION

What are some of the main factors that affect a ball's bouncing efficiency and what are the effects?

Factors that I think may affect the bouncing efficiency are:

- What material the ball is made up of
- The height at which the ball is dropped.
- How much energy do we put in to drop the ball?
- The surface the ball is bouncing from.
- The air resistance
- The effect of gravity
- The size of the ball
- Air pressure in the ball

Etc.

After careful consideration of what is available, measurable, and safe to use, I decided that I would test the following types of sports balls:

- Bouncy ball
- Basketball
- Football
- Tennis ball

Dropping them from three different heights (0.5m, 1m and 1.5m) to see the effect of height on three different types of floors- Concrete, grass and wood to see the effects of the types of surfaces on the bounce of the sports balls.

HYPOTHESIS

I believe that the bouncy ball will have the maximum bounce on the concrete surface when dropped from 1.5 m height.

PLANNING

Equipment and material needed:

- Bouncy ball
- Basketball
- Soccer ball
- Tennis ball
- iPad/phone (to take videos to accurately measure the height of the bounces)

- Measuring tape
- Step ladder
- Access to floors- Concrete, grass and wood

Method:

1. Get the measuring tape and stick it to the wall.
2. Set a camera to record the bounce height.
3. Get one of the balls (bouncy ball, basketball, soccer ball and tennis ball) and drop it from one of the heights- 1.5 meters (150 cm), 1 meter (100 cm) and 0.5 meters (50 cm).
4. After you see the bounce, go to the device and find the bounce height.
5. Record it and put it in a table like this:

Height:

Ball Type	Trial 1 bounce height (cm)	Trial 2 bounce height (cm)	Average bounce height (cm)

6. To get the average, add the two bounce heights and divide it by 2.
7. Repeat the steps 1-6 above for three different drop heights- 1.5m, 1 m and 0.5 m.
8. Repeat the procedure above for all the different balls- bouncy ball, soccer ball, basketball and tennis ball.
9. Repeat the steps above on different surfaces- grass, concrete and wooden floor.

CONDUCTING

The bounce heights of the bouncy ball on different surfaces are recorded in Table 1 below. I have trialed twice and taken the average ((trial 1+trial 2)/2) of the bounce.

Bouncy Ball				
Type of surface	**Trials**	**Drop height**		
		Bounce height from 0.5 m (cm)	Bounce height from 1 m (cm)	Bounce height from 1.5 m (cm)
Concrete	1	48	97	142
	2	49	95.5	139.5
	Average	48.5	96.25	140.75
Grass	1	24	42	62
	2	21	44.5	65
	Average	22.5	43.25	63.5
Wood	1	45	87	125
	2	43	87	133
	Average	44	87	129

Table 1

The bounce heights of the basketball on different surfaces are recorded in Table 2 below. I have trialed twice and taken the average of the bounces.

Basketball				
Type of surface	**Trials**	**Height**		
		Bounce height from 0.5 m (cm)	Bounce height from 1 m (cm)	Bounce height from 1.5 m (cm)
Concrete	1	42	79	120
	2	45	83	122
	Average	43.5	81	121
Grass	1	18	33	51
	2	18.5	33.5	52
	Average	18.25	33.25	51.5
Wood	1	35	72	117
	2	37	75	108
	Average	36	73.5	112.5

Table 2

The bounce heights of the Football on different surfaces are recorded below in Table 3. I have trialed twice and taken the average of the bounce.

Soccer ball				
Type of surface	**Trials**	**Height**		
		Bounce height from 0.5 m (cm)	Bounce height from 1 m (cm)	Bounce height from 1.5 m (cm)
Concrete	1	38	61	81.5
	2	35.5	63	80
	Average	37.25	62	80.75
Grass	1	15	27	33
	2	14	26	37
	Average	14.5	26.5	35
Wood	1	30	59	76.5
	2	31	58	74.5
	Average	30.5	58.5	75.5

Table 3

The bounce heights of the tennis ball on different surfaces are recorded below in Table 4. I have trialed twice and taken the average of the bounce.

Tennis Ball				
Type of surface	**Trials**	**Height**		
		Bounce height from 0.5 m (cm)	Bounce height from 1 m (cm)	Bounce height from 1.5 m (cm)
Concrete	1	29	63	82
	2	36	62	83
	Average	32.5	62.5	82.5
Grass	1	14	24	33
	2	12	25.5	35.5
	Average	13	25.75	34.25
Wood	1	23	54	75
	2	26	56	74
	Average	24.5	55	74.5

Table 4

PROCESSING

Calculating efficiency

Efficiency= (Output/ Input) x 100

The efficiency of the ball is calculated by dividing the average bounce height (cm) by the height the ball was dropped from (cm) times by 100. It is represented in percent (%)

The efficiency of the bouncing balls= (Average bounce height/Drop height) x 100

Efficiency of the bouncy ball (%)			
Type of surface\Drop height	0.5 m	1 m	1.5 m
Concrete	(48.5/50) x 100= 97	(96.25/100) x 100= 96.25	(140.75/150) x 100= 93.83
Grass	(22.5/50) x 100= 45	(43.25/100) x 100 = 43.25	(63.5/150) x 100= 42.33
Wood	(44/50) x 100= 88	(87/100) x 100= 87	(129/150) x 100= 86

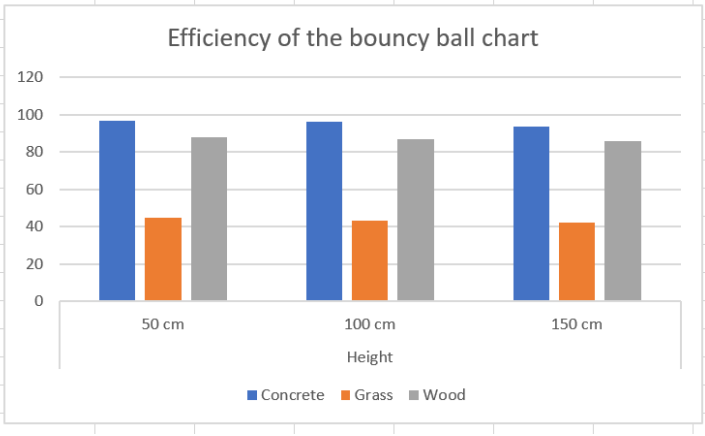
Efficiency of the basketball			
Type of surface\Drop height	0.5 m	1 m	1.5 m
Concrete	(43.5/50) x 100= 87	(81/100) x100= 81	(121/150) x 100= 80.66
Grass	(18.25/50) x 100= 36.5	(33.25/100) x 100= 33.25	(51.5/150) x 100= 34.33
Wood	(36/50) x 100= 72	(73.5/100) x 100= 73.5	(112.5/150) x 100= 75

Efficiency of the soccer ball			
Type of surface\Drop height	0.5 m	1 m	1.5 m
Concrete	(37.25/50) x 100= 74.5	(62/100) x 100= 62	(80.75/150) x100= 53.83
Grass	(14.5/50) x 100= 29	(26/100) x 100= 26	(35/150) x 100= 23.33
Wood	(30.5/50) x 100= 61	(58.5/100) x 100= 58.5	(75.5/150) x 100= 50.33

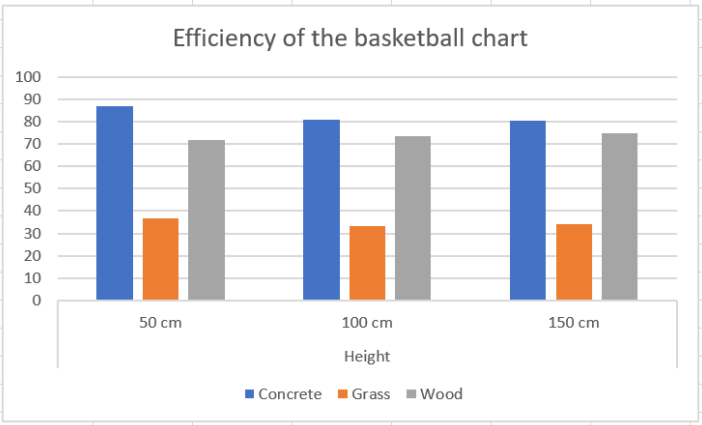
Efficiency of the tennis ball			
Type of surface\Drop height	0.5 m	1 m	1.5 m
Concrete	(32.5/50) x 100= 65	(62.5/100) x100= 62.5	(82.5/150) x 100= 55
Grass	(13/50) x 100= 26	(25.75/100) x 100= 25.75	(34.25/150) x 100= 22.83
Wood	(24.5/50) x 100= 49	(55/100) x 100= 55	(74.5/150) x 100= 49.67

ANALYSING DATA AND INFORMATION- I have used Microsoft Excel to graph my results.

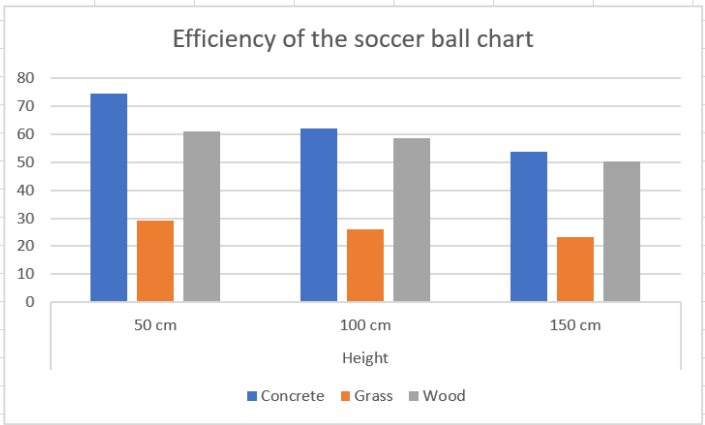
Efficiency of the bouncy ball (%)			
	Height		
Type of surface	50 cm	100 cm	150 cm
Concrete	97	96.25	93.83
Grass	45	43.25	42.33
Wood	88	87	86



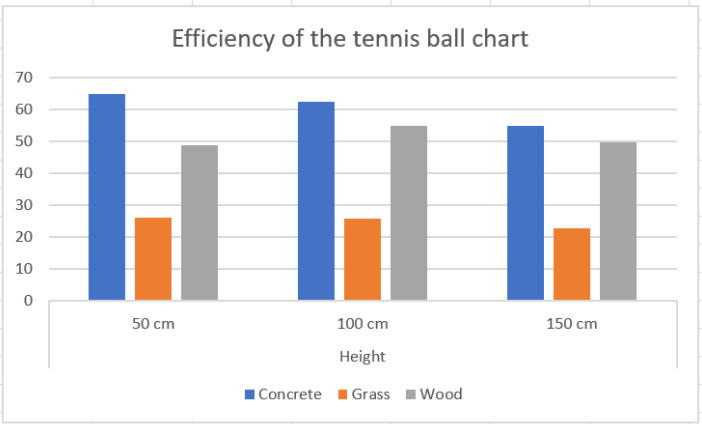
Efficiency of the basketball (%)			
	Height		
Type of surface	50 cm	100 cm	150 cm
Concrete	87	81	80.66
Grass	36.6	33.25	34.33
Wood	72	73.5	75



Efficiency of the soccer ball (%)			
	Height		
Type of surface	50 cm	100 cm	150 cm
Concrete	74.5	62	53.83
Grass	29	26	23.33
Wood	61	58.5	50.33



Efficiency of the tennis ball (%)			
	Height		
Type of surface	50 cm	100 cm	150 cm
Concrete	65	62.5	55
Grass	26	25.75	22.83
Wood	49	55	49.67

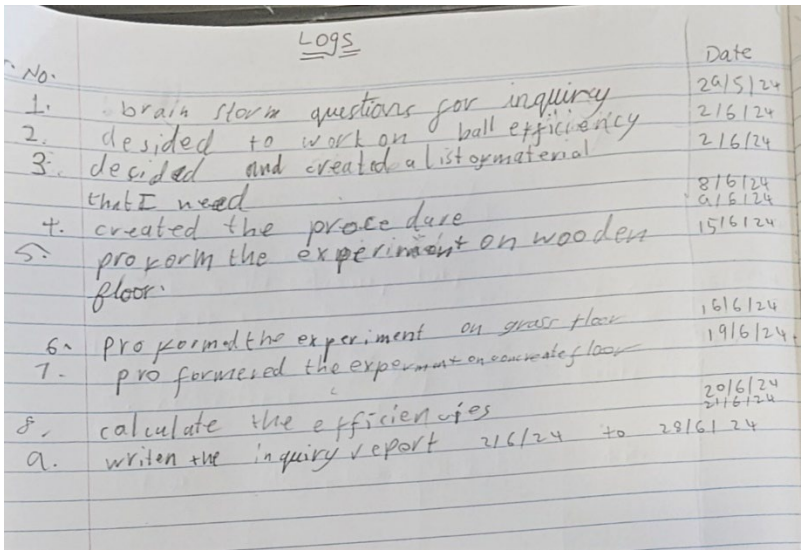


EVALUATING

By looking at the above graphs, I can say that the bouncy ball has the highest efficiency of all the balls tested on all the surfaces. But the efficiency very slightly decreases as the drop height increases. The trend of decrease in the efficiency as the drop height increases is followed by almost all of the other balls on different surfaces except the tennis ball where on grass and wood there is a slight increase in the efficiency at 1 meter followed by a decrease again as the drop height changes to 1.5 meters. Also, the basketball on the wooden floor doesn't follow the principle. These irregularities could be the result of errors in data reading.

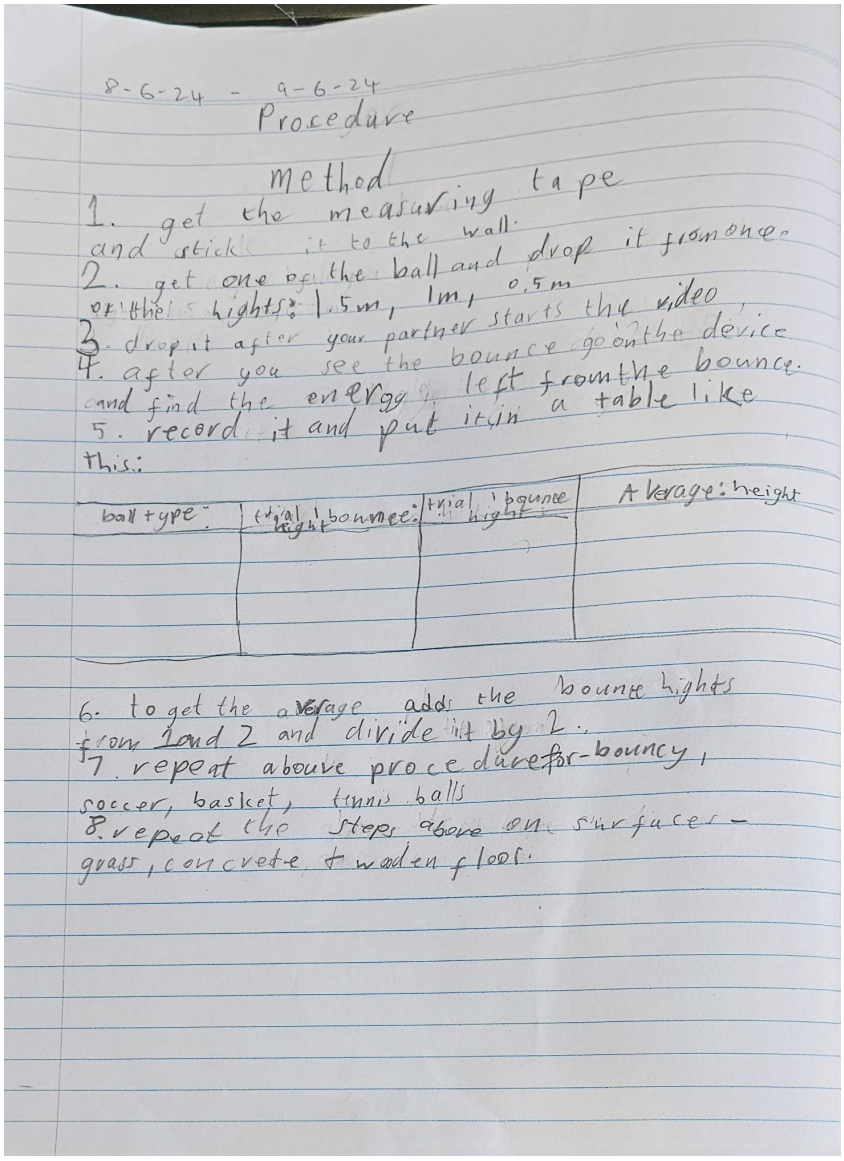
APPENDIX

Raw data/logs



Logs

No.		Date
1.	brain storm questions for inquiry	29/5/24
2.	desided to work on ball efficiency	2/6/24
3.	decided and created a list of material that I need	2/6/24
4.	created the procedure	8/6/24 9/6/24
5.	proform the experiment on wooden floor.	15/6/24
6.	proformed the experiment on grass floor	16/6/24
7.	proformed the experiment on concrete floor	19/6/24
8.	calculate the efficiencies	20/6/24 21/6/24
9.	writen the inquiry report 2/6/24 to 29/6/24	



8-6-24 - 9-6-24

Procedure

Method

1. get the measuring tape and stick it to the wall.
2. get one of the ball and drop it from one of the hights: 1.5m, 1m, 0.5m
3. drop it after your partner starts the video
4. after you see the bounce go on the device and find the energy left from the bounce.
5. record it and put it in a table like this:

ball type	trial 1 bounce height	trial 2 bounce height	Average height

6. to get the average add the bounce hights from 1 and 2 and divide it by 2.
7. repeat aboove procedure for bouncy, soccer, basket, tennis balls
8. repeat the steps above on surfaces - grass, concrete & wooden floor.

15-6-2024 Wooden floor

1.5m

	T1	T2	Average
bouncy ball	125 cm	133 cm	$\frac{125+133}{2}=129$
basket ball	117 cm	108 cm	$\frac{117+108}{2}=112.5$
soccer ball	76.5 cm	74.5 cm	$\frac{76.5+74.5}{2}=75.5$
Tennis ball	75cm	74cm	$\frac{74+75}{2}=74.5$

1m

	T1	T2	A
bouncy ball	87 cm	87 cm	$\frac{87+87}{2}=87$
basketball	72 cm	75cm	$\frac{72+75}{2}=73.5$
soccer ball	59 cm	58 cm	$\frac{59+58}{2}=58.5$
tennis ball	54 cm	56 cm	$\frac{56+54}{2}=55$

0.5m

	T1	T2	A
bouncy ball	45 cm	43cm	$\frac{45+43}{2}=44$
basket ball	35cm	37cm	$\frac{35+37}{2}=36$
soccer ball	30cm	31	$\frac{30+21}{2}=30.5$
tennis ball	23	26	$\frac{23+26}{2}=24.5$

16/6/24 Grass floor

1.5m

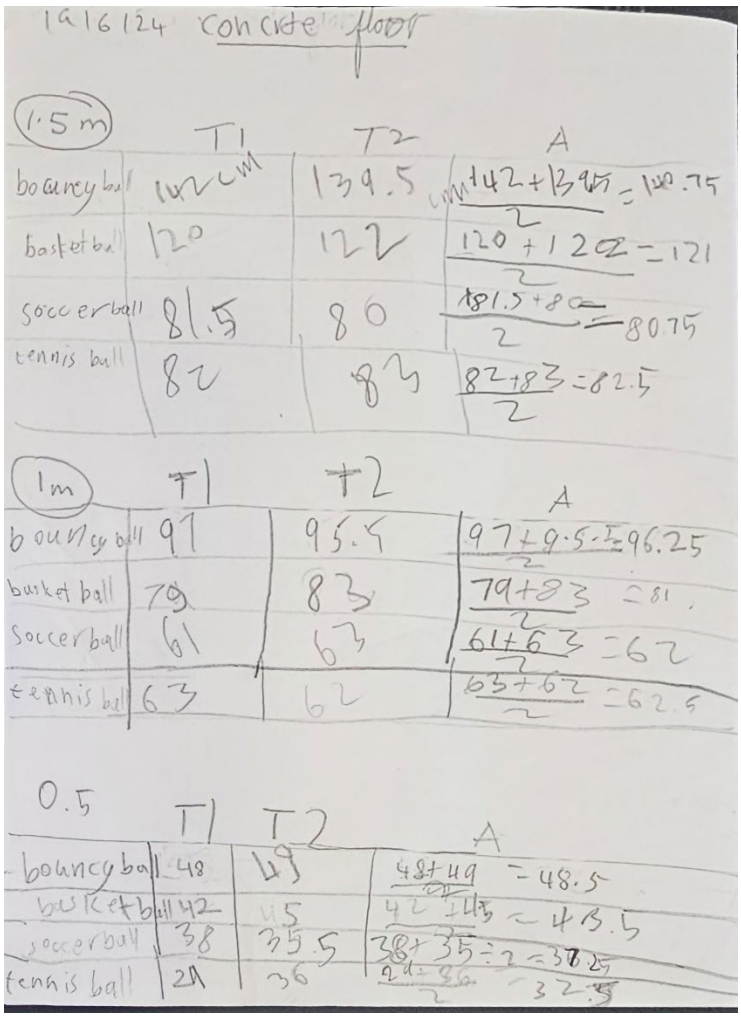
	T_1	T_2	Avg.
bouncy ball	62	65	$\frac{62+65}{2}=63.5$
basketball	51	52	$\frac{51+52}{2}=51.5$
soccer ball	33	37	$\frac{33+37}{2}=35$
tennis ball	33	35.5	$\frac{33+35.5}{2}=34.25$

1m

	T_1	T_2	Avg.
bouncy ball	42	44.5	$\frac{42+44.5}{2}=43.25$
basket ball	33	33.5	$\frac{33+33.5}{2}=33.25$
Soccer ball	27	26	$\frac{27+26}{2}=26.5$
tennis ball	24	25.5	$\frac{24+25.5}{2}=24.75$

0.5m

	T_1	T_2	Avg.
bouncy ball	24	21	$\frac{24+21}{2}=22.5$
basket ball	18	18.5	$\frac{18+18.5}{2}=18.25$
soccer ball	15	14	$\frac{15+14}{2}=14.5$
tennis ball	14	12	$\frac{14+12}{2}=13$



1.5m

	T1	T2	A
bouncy ball	142 cm	139.5 cm	142+139.5/2 = 140.75
basketball	120	122	120+122/2 = 121
soccer ball	81.5	80	81.5+80/2 = 80.75
tennis ball	82	83	82+83/2 = 82.5

1m

	T1	T2	A
bouncy ball	97	95.5	97+95.5/2 = 96.25
basket ball	79	83	79+83/2 = 81
soccer ball	61	63	61+63/2 = 62
tennis ball	63	62	63+62/2 = 62.5

0.5

	T1	T2	A
bouncy ball	48	49	48+49/2 = 48.5
basketball	42	45	42+45/2 = 43.5
soccer ball	38	35.5	38+35/2 = 36.25
tennis ball	29	36	32.5

Figure 1- Alex dropped the ball from 1.5 meters.

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: Alexander Chhokar ID: 0611-005

SCHOOL: Saint Andrew's School

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

I have planned to find the effeciency of different sports balls dropped from differnt heights on different surfaces.

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
1. Climbing to drop balls from heights 2. Getting hurt if ball bounces uneven 3. Device use 4. Snakes in outdoor grass	1. Use the step-ladder to stand on for dropping the balls from different heights. Seek help from an adult to transport ladder. 2. Be careful and drop the balls from safe height. 3. Use ipad/phone safely and only for taking videos for inquiry purpose. 4. wear closed shoes when going to the grass area.

(Attach another sheet if needed.)

Risk Assessment indicates that this activity can be safely carried out

RISK ASSESSMENT COMPLETED BY (student name(s)): Alexander Chhokar

SIGNATURE(S): Alex Chhokar

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

TEACHER'S NAME: Tracey Billington

SIGNATURE: _____ DATE: 10/6/2024