SASTA OLIPHANT SCIENCE AWARDS

SOUTH AUSTRALIAN SCIENCE TEACHERS ASSOCIATION

Prize Winner

Scientific Inquiry

Year 3-4

Patrik Porter

Scotch College - Junior School

Scientific Inquiry: The Fastest Freestyle

Question

What element of swimming technique should I focus on to swim the fastest freestyle?

Hypothesis

I think that head position will contribute the most (and make the most difference) followed by starts, streamline, kick, fingers, and swimming in the middle of the lane.

Background

I thought about what elements or techniques of freestyle could contribute to speed, including:

- Streamline
- Kick (assessing no kick and fast kick)
- Lane Position
- Arms (testing fast arms and slow arms)
- Starts (testing no dolphin kick after pushing off)
- Head position
- Fingers
- Number of strokes before breath (added later, evaluating every five and every two strokes)

Then I did some research into propulsion and drag.

Newton's Laws of Motion

Isaac Newton discovered that every movement/action obeys three key rules which are known as Newton's Laws of Motion. They are described below.

An object (for example a swimmer) cannot move unless something forces it to. It will keep on moving unless forced to change. This known as inertia, and it is Newton's First Law.

The greater the mass of the object, the more force must be applied to make it move, speed up, or change in direction. This is Newton's Second Law.

For every action, there is always an equal and opposite action pushing against it. For example, if you are driving a car up a hill, engine power is making the car go upwards and friction is making the car go slow down or go down. This is Newton's Third Law.

Propulsion and Drag

If you are pushing a toy car, the force your hand supplies propel it in the direction you push it in. If you pushed a toy car parallel to the wall, then, it would slow down and eventually stop. The force that helps the car do that is called drag.

Forces in Swimming

Here are some examples of propulsion and drag forces in swimming. The propulsion in swimming is when you push off the wall, when you kick and, when you dive. The drag in swimming is when you swim against the lane rope, when you are not in a correct streamline body position, and when you separate your fingers.

Planning and Conducting

These are the elements and techniques that I am testing to see which one I should focus on to swim the fastest freestyle!

- Streamline: Do incorrect streamline position (arms bent)
- Kick: Test freestyle kick at different speeds (fast and slow)
- Swimming in the middle of the lane: Test freestyle with your arms brushing the lane rope.
- Arms: Test freestyle arms (with normal kick) at different speeds (fast and slow). See the difference to the speed of the arms.
- Starts: Test how far each of the things (dive or push off wall) can propel you, and how quickly
- Head Position: Do correct streamline position with chin on chest, an& also test incorrect streamline position with head looking straight head. Compare the two times.
- Fingers: Swim 25m of normal, correct freestyle with fingers together and do correct freestyle with fingers apart. Compare the results.

Method

The experiment will be conducted in an indoor, twenty-five metre pool. I will swim laps as shown below in Table 1, and each lap will be timed. The first lap is the Control, where I will swim a normal lap of freestyle. The next laps will test one variable per lap, and the time for each lap will be compared to the Control lap time. I will then be able to rank them and find out which variable makes the most difference and makes the fastest freestyle!

Table 1: List of variables tested for each lap of 25m freestyle; red shows the test variable for each lap

	Variables						
Lap name	**Streamline**	**Kick**	**Lane**	**Arms**	**Starts**	**Head**	**Fingers**
Control	Straight arms (Fig 1)	Normal	Middle	Normal	Start in pool	Chin on chest	Togethe-r
Test streamline	Arms apart (Fig 2)	Control	Control	Control	Control	Control	Control
Test kick slow	Control	Slow	Control	Control	Control	Control	Control
Test kick fast	Control	Fast	Control	Control	Control	Control	Control
Test lane position	Control	Control	Next to lane rope (Fig 3)	Control	Control	Control	Control
Test fast arms	Control	Control	Control	Fast	Control	Control	Control
Test slow arms	Control	Control	Control	Slow	Control	Control	Control
Test dive	Control	Control	Control	Control	Dive off the edge	Control	Control
Test push off	Control	Control	Control	Control	Push off	Control	Control
Test head up	Control	Control	Control	Control	Control	Head up	Control
Test fingers	Control	Control	Control	Control	Control	Control	Apart

Figure 1: Streamline position

Figure 2: Arms apart

Figure 3: Next to lane rope

Equipment and Materials

This experiment will require:

- Stopwatch (my swimming watch, and my Mum with a stopwatch)
- A 25m indoor swimming pool (with a free lane with no other people in it)
- Paper and pencil (to record the results, see Table 2)
- Myself (with bathers, goggles, and my swimming cap on)

Risks and Hazards

See Risk Assessment

- Drowning
- Slipping on the edge of the pool
- Hitting your head on the bottom of the pool

Solution

Always have a lifeguard and parent supervision and always make sure you can swim before entering the pool. Also, make sure that there is first aid around, whether it is with the lifeguard or you.

Also, always look for signs on the floor that say 'No Diving'. We could not do the dive test because the pool was too shallow, so if I had dived, I would have injured myself.

Refer to my OSA Risk Assessment Form for more information on risks and hazards.

Table 2: Experiment recording sheet

	Variables							Time		Notes
Test name	**Stream-line**	**Kick**	**Lane**	**Arms**	**Starts**	**Head**	**Fingers**	**Test 1**	**Test 2**	
Control	Straight Arms	Normal	Middle	Normal	Start in pool	Chin on chest	Together			
Test streamline	**Arms bent**	Control	Control	Control	Control	Control	Control			
Test no kick	Control	**Slow**	Control	Control	Control	Control	Control			
Test kick fast	Control	**Fast**	Control	Control	Control	Control	Control			
Test lane position	Control	Control	**Near rope**	Control	Control	Control	Control			
Test fast arms	Control	Control	Control	**Fast**	Control	Control	Control			
Test slow arms	Control	Control	Control	**Slow**	Control	Control	Control			
Test dive	Control	Control	Control	Control	**Dive off the edge**	Control	Control			
Test push off	Control	Control	Control	Control	**Push off**	Control	Control			
Test head up	Control	Control	Control	Control	Control	**Head up**	Control			
Test fingers	Control	Control	Control	Control	Control	Control	**Apart**			

Results and Discussion

Table 3: Results from the experiment

Lap name	Variable	Time (seconds)	Difference from control (seconds)	Notes
Control	-	29.28 29.06 Average: 29.17	-	Swam control lap twice. Used average time of 29.17 sec as the Control lap time.
Test streamline	Streamline	29.03	-0.14	
Test kick slow	Kick	33.42	4.25	Did no kick (instead of slow kick)
Test kick fast	Kick	28.75	-0.42	Hard to keep kick fast and have normal arms
Test lane position	Lane	30.96	1.79	
Test fast arms	Arms	26.37	-2.80	Hard to keep the difference between fast or slow arms and normal kicks
Test slow arms	Arms	31.68	2.51	
Test dive	Starts	-	-	Test not conducted due to pool being too shallow to dive
Test push off	Starts	-	-	Not conducted; same as control lap
Test head up	Head	30.18	1.01	
Test fingers	Fingers	29.91	0.74	
Test breathe every 5 strokes	Breathe	27.21	-1.96	Hard to hold my breathe!
Test breathe ever 2 strokes	Breathe	29.90	0.73	
Test no dolphin kick after push off	Starts	32.55	3.38	

Here are two thoughts I had on the results above.

- I thought about adding some more categories and I did not do the starts test.
- I was incredibly surprised that doing the wrong streamline made you go faster! Perhaps my arms and kick were faster than when I did the control lap or, it did not make much difference.

These are the things that make you faster (at the top) and the things that make you slower (near the bottom.

Results

Faster

- Fast arms
- Breathe every 5-strokes
- Fast kick
- Streamline
- Breathe very 2-strokes
- Fingers
- Head up
- Lane position
- Slow arms
- No dolphin kick after push off
- No kick

Slower

Why – Fast Arms and Fast Kick

I recorded the fastest swimming times with fast arms and kicks. When you kick and pull your arms through the water, these cause propulsion forward. When you move you arms and kick faster, you pull more water back and therefore go forward faster!

Why – Breathe every 2 and 5 strokes

Breathing requires energy and makes you go slower because you have to lift your head up. Breathing less often can make you go faster. This is why breathing every five strokes was faster compared to every two strokes.

Why – Streamline

The streamline one wasn't predicted to be faster than the control lap. I was probably doing the incorrect streamline, as this was difficult to control!

Why – Fingers

When you do your freestyle arms, you push the water away with your hands. When you separate your fingers, you have less surface to propel yourself forwards so, you go less far with each pull of your arms.

Why – Head up

When you have your head up, you are using energy to get it up and keep it up. All your valuable energy is wasted by you putting your head up and therefore, you go slower. Also, your head up causes your body to create more drag through the water, and therefore swim slower.

Why – Lane position

When you are swimming close to or near the lane rope, your body is touching the lane rope so, your body is dragging on the lane rope and creates drag which makes you go slower.

Why – No dolphin kick after push off

When we do dolphin kicks underwater, we go faster and stay underwater for longer. When you don't do dolphin kicks, you go slower because we don't have all that extra speed that comes from when you do dolphin kicks.

Conclusion

From my results, swimming with fast arms and kick were the elements of swimming technique that I should focus on to do the fastest freestyle. In fact, I tested this by swimming 25 metres with both fast arms and kicking, in the same pool as the experiment. My time was 24.2 seconds, which is five seconds faster than my control lap, and proves my conclusion.

References

- DK 2019, *Children's Encyclopedia*, *Australian Edition*, DK Australia, Melbourne
- Britannica Books 2020, *Britannica All New Children's Encyclopedia*, Britannica, UK
- Farndon, J. et al, 2017, *Wild About Science*, Miles Kelly Publishing, UK
- DK 2019, *Scientists Who Changed History*, DK Publishing, London

Log Book

Date	Remarks
5/4/2023	Wrote notes on the iPad about what I wanted to investigate and how.
30/4/2023	Research by reading science books. (See the references page for the books I researched from). Also started drafting report on the computer (Question, Hypothesis and Background). My Mum typed in the references because I didn't know how to put them in.
6/5/2023	Continued report on the computer (Method, Equipment and Materials, Variables Tables).
7/5/2023	Did my swimming and did my spreadsheet. Here are a few thoughts about what I found out. ▪ I thought about adding some more categories and I did not do the starts test. ▪ I was incredibly surprised that doing the wrong streamline made you go faster! Perhaps my arms and kick were faster than when I did the control lap or, it did not make much difference. ▪ Other than that, I was not that surprised about anything else. We will do more swimming so I can get more results to put in my spreadsheet and get the most exact answers.
8/5/2023	I did the risk assessment form, and my Mum helped me add in three pictures and I wrote in my report (Risks and Hazards, Solution).
20/5/2023	I continued my report on the computer (Risks and Hazards).
21/5/2023	I continued my report on the computer (Results and Discussion).
3/5/2023	I edited on the comments that my Mum and Dad had put in and made my report better. I also wrote in my report (Conclusion, Planning and Conducting).
7/5/2023	I tested my conclusion by swimming a lap of 25m with fast arms and kicks, and updated by report

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: Patrik Porter ID: _____

SCHOOL: Scotch College

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

I will be swimming laps of a 25m pool using different techniques.

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
Drowning slipping off the edge of the pool ✓	Make sure I have a lifeguard at the pool and make sure I can swim before going in. And get parent supervision. I will not run on the edge of the pool ✓✓

(Attach another sheet if needed.)

Risk Assessment indicates that this activity can be safely carried out

RISK ASSESSMENT COMPLETED BY (student name(s)): Patrik Porter

SIGNATURE(S): Patrik Porter

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

TEACHER'S NAME: Mr Dana Pace

SIGNATURE: _____ DATE: 23/5/23

7-5-23

By Patrik Porter

	Variables							Time		Notes
Test name	**Stream-line**	**Kick**	**Lane**	**Arms**	**Starts**	**Head**	**Fingers**	~~Test 1~~ Watch	~~Test 2~~ Phone	
Control 1 → Control 2 → control	Straight Arms	Normal	Middle	Normal	Start in pool	Chin on chest	Together	–	29.28 / 29.06	
Test streamline	**Arms bent**	Control	Control	Control	Control	Control	Control		29.03	
~~Test kick slow~~ No kick	Control	**Slow**	Control	Control	Control	Control	Control		33.42	
Test kick fast	Control	**Fast**	Control	Control	Control	Control	Control		28.75	Hard to keep kick ~~slow~~ fast and have normal arms
Test lane position	Control	Control	**Near rope**	Control	Control	Control	Control		30.96	
Test fast arms	Control	Control	Control	**Fast**	Control	Control	Control		26.37	Hard to maintain the diffences in speed in the kick & arms
Test slow arms	Control	Control	Control	**Slow**	Control	Control	Control		31.69	Hard to maintain the diffences in speed in the kick & arms
Test dive	Control	Control	Control	Control	**Dive off the edge**	Control	Control			Too shallow to dive.
~~Test push off~~	Control	Control	Control	Control	**Push off**	Control	Control			
Test head up	Control	Control	Control	Control	Control	**Head up**	Control		30.18	
Test fingers	Control	Control	Control	Control	Control	Control	**Apart**		29.91	
5-strokes	–	–	–	–	–	–	–	–	27.21	Had to hold my breath!
2-strokes	–	–	–	–	–	–	–	–	29.9	
No dolphin kick	–	–	–	–	–	–	–	–	32.55	Similar to "Test no