

ANATOMY OF AN ARTISTIC SWIMMING ROUTINE

1. Apnea time

- In **solo** and **duet** routines, the swimmers spend **more than half the routine in apnea**.
- The percentage of time spent in apnea is higher in solo technical routines than it is in solo free routines ($p < 0.05$).



	Solo technical	Solo free
Routine (s)	124.6 ± 8.4	178.0 ± 6.5
Apnea phase (%)	72.9 ± 4.3	67.5 ± 4.8
	Duet technical	Duet free
Routine (s)	148.6 ± 6.2	207.7 ± 9.6
Underwater phase (%)	63.0 ± 4.9	63.6 ± 5.3

*Significant differences ($p < 0.01$) between solo and duet technical routines compared to free. Values obtained during the 2011 Spanish Artistic Swimming Championship.

The **maximum duration** of the apneas correlates positively with the scores for the routines ($p < 0.05$).



KEY IDEA 1

- Artistic swimming requires an exceptional capacity to perform intense exertion while in apnea.

2. Duration and number of apneas

The routines of the world's best swimmers are characterised by **frequent** and **prolonged** periods of seconds (s).



*Values obtained during the 2011 World Artistic Swimming Championship.

Total immersion time (TIT)

ST	SF	DT	DF
82.7 s	105.3 s	85.0 s	125.1 s

Nº of immersions (NIM)

ST	SL	DT	DF
17.1	26.4	21.0	33.3

Prolonged immersions longer than 10 s (> 10 s)

Time	ST	SF	DT	DF
	45.2	63.7	53.5	76.6
Nº	ST	SF	DT	DF
	2.9	4.0	3.9	5.2

ST: Solo technical SF: Solo free DT: Duet technical DF: Duet free

*Values obtained during the 2011 Spanish Artistic Swimming Championship.

		Solo Technical		Solo Free	
		Spanish Champ.	World Champ.	Spanish Champ.	World Champ.
Total duration of apnea	(%)	72.9	72.4	67.5	65.7
Maximum apnea (s)		20.7	19.0	23.4	22.3
Apneas longer than 10 s	(n) (s)	2.9 47.5	3.6 54.2	3.9 62.3	4.1 65.2

*Values obtained during the 2011 Spanish Artistic Swimming Championship.



KEY IDEA 2

- Prolonged apneas impose significant physiological stress on the swimmers.
- The capacity to perform multiple prolonged apneas is critical to artistic swimming performance.

Rodriguez-Zamora, L., et al. (2012, 2014a, 2014b); <https://doi.org/10.1371/journal.pone.0049098> - <https://doi.org/10.1519/JSC.0b013e3182a20ee7> - <https://doi.org/10.1055/s-0033-1353177>

Iglesias, X., et al. (2014, 2015); <https://archives.rpd-online.com/article/download/v23-n1-iglesias-rodriguez-zamora-et-al/1430-4908-1-PB.pdf> - <https://dx.doi.org/10.4321/S1578-84232015000100009>

Castiella, S. (2024); <http://inefc-grceib.cat/wp-content/uploads/2025/01/Castiella-2024-Synchro-Project-Barcelona.pdf>

RED SynchroProject II: High performance and health in female artistic swimmers (reference: SYNCHROJECT - 99784) - Funded by the Senior Council for Sports (Ministry of Education, Vocational Training and Sports) - 2024 REDES sports science research programme. SynchroProject, funded by the Senior Council for Sports (201/UPB10/11) and the Women's Institute of Catalonia (U-34/10)

Iglesias, X. (2025). Anatomy of an artistic swimming routine [Infographic]. SynchroProject. Grup de Recerca en Ciències de l'Esport INEFC Barcelona (GRCEIB); <https://inefc-grceib.cat/synchroproject/>

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3. Body position

Inverted vertical positions predominate.

43.3% ± 5.3%

of time in an inverted vertical position

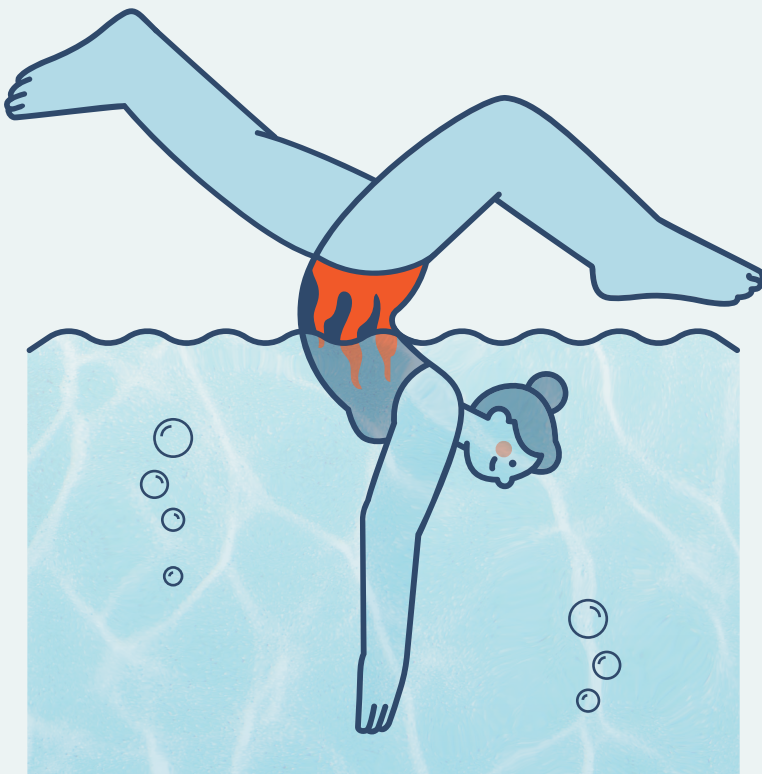
31.3% ± 5.5%

of time in a vertical position

25.4% ± 4.1%

of time in a horizontal position

*Values obtained during the 2011 Spanish Artistic Swimming Championship.



KEY IDEA 3

- Inverted positions generate unique cardiovascular responses, such as reflex bradycardia.
- Adaptation to these positions plays a vital role in the swimmers' performance and safety.

4. Performance predictions and correlations

The key factors for predicting **performance** (competition score) in artistic swimming are:

- Peak lactate

- Positive correlation with performance ($R = 0.55$, $P < 0.05$).

+ Concentration of lactate = better performance

- Immersion parameters

- No. of immersions: positive correlation with performance ($R = 0.39$, $P < 0.05$).
 - Maximum immersion time: positive correlation with performance ($R = 0.48$, $P < 0.05$).
- More immersions and a higher maximum immersion time are associated with better performance.

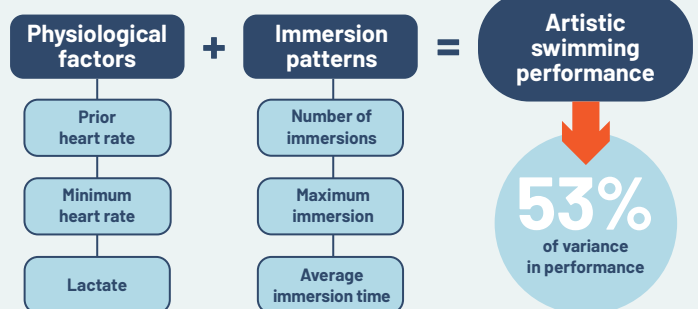
- Heart rate (HR)

- Heart rate = better performance

- Pre-exertion HR: negative correlation with performance ($R = -0.41$, $P < 0.001$).
 - Minimum HR during the routine: negative correlation with performance ($R = -0.24$, $P < 0.05$).
- Lower heart rates pre-exertion and during the routines are associated with better performance.

- Performance prediction model

- Pre-exertion HR and minimum HR during exertion account for 26% of variance in performance.
- Lactate + immersion parameters = 53% of variance in performance.



KEY IDEA 4

- Artistic swimming performance depends on a complex interaction of physiological and technical factors.
- A decrease in heart rate during the routines and prior to exertion are indicators of performance.

Rodriguez-Zamora, L., et al. (2012, 2014a, 2014b). <https://doi.org/10.1371/journal.pone.0049098> - <https://doi.org/10.1519/JSC.0b013e3182a20ee7> - <https://doi.org/10.1055/s-0033-1353177>

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5. Rule changes

Evolution towards more precise and competitive scoring.

Simplified scoring system

Scoring by a panel of 15 judges has been replaced by a panel of **10 judges** who score both artistic impression and execution.

Unification of routines

Technical and free routines are scored the same way, thereby **making the scoring process more consistent**.

Technical controllers

Specialist roles designed to ensure **precision in scoring** the difficulty and synchronisation of routines. The difficulty of each routine is calculated mathematically beforehand.

Strategic Coach Card

Creation of varied Coach Cards that are adapted in line with each team/athlete and their **capacities**. **Strategic changes** can be made between the preliminary and final rounds.

World records and increased competitiveness

Scores are not limited to a maximum (**100 points**); this means that world records can be set and introduces an element of **uncertainty** to the final ranking.

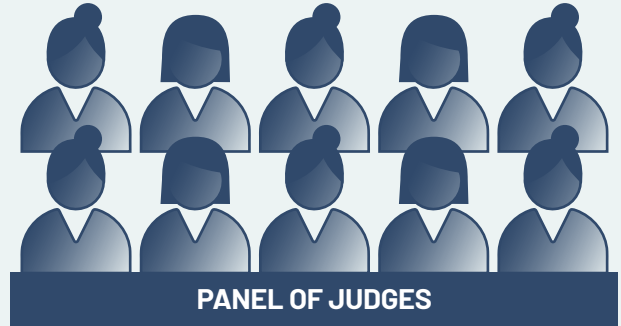
Greater speeds and heights

The sport becomes much faster, with an increased need for **strength, speed** of movement and demonstration of **height**.



KEY IDEA 5

- The changes seek to increase competitiveness and make the scoring process more precise.
- The element of uncertainty is introduced to the final ranking, making it less predictable and more interesting for spectators.



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