Stickleback Fish Lab: Which allele is dominant, spine or no spine?

Mrs. Kellymaharaj

Richview Collegiate Institute

The purpose of this investigation is to determine which allele, whether producing a pelvic spine or not producing a pelvic spine, is dominant in a stickleback fish.

The dominant allele of the stickleback fish is producing a pelvic spine because when there is a change in the environment, stickleback fish with pelvic spines accumulate in higher frequencies This information was gathered from the video, "Making of the Fittest: Evolution of the Stickleback Fish - HHMI Biointeractive Video." This means the dominant allele, having pelvic spines, is faster and the recessive allele, having no pelvic spines, is slower because the dominant allele has two possible genotypes to create the pelvic spine making it faster compared to the recessive allele which only has one possible genotype.

If the pelvic spine allele is dominant to the no pelvic spine allele than the offspring of a pure-breeding pelvic spine stickleback fish (FF) with a pure-breeding no pelvic spine stickleback fish (ff) will have pelvic spines.

Let F represent SPINE and let f represent NO SPINE

Diagram 1: Punnett Square between a pure-breeding pelvic spine fish (FF) with a pure-breeding no pelvic spine fish (ff)

F_1	F	F
f	Ff	Ff
f	Ff	Ff

Table 1: The genotypic ratio and phenotypic ratio of the F_1 generation

GENOTYPIC RATIO					PHENOTYPIC RATIO		
Heterozygous (Ff)	:	Homozygous Dominant (FF)	:	Homozygous Recessive (ff)	Spine	:	No Spine
4	:	0	:	0	4	:	0
100%	:	0%	:	0%	100%	:	0%

Table 1: Shows the predicted genotypic ratio and phenotypic ratio of the F_1 generation. These predicted ratios were calculated from the Punnett Square shown in *Diagram 1.*

As shown in *Table 1*, the predicted results for the F_1 generation is that the offspring will have a phenotype of 100% chance of having pelvic spines and their genotype will be 100% heterozygous.

The offspring of the previous generation are all heterozygous (Ff) and have pelvic spines. If they are to interbreed with each other, it is predicted that most their offspring will have pelvic spines.

Let F represent SPINE and let f represent NO SPINE

Diagram 2: Punnett Square between two heterozygous stickleback fish (Ff)

F_2	F	f
F	FF	Ff
f	Ff	ff

Table 2: The genotypic ratio and phenotypic ratio of the F_2 generation

GENOTYPIC RATIO					PHENOTYPIC RATIO
Heterozygous (Ff) : Homozygous Dominant (FF) : Homozygous Recessive (ff)					Spine : No spine
2	:	1	:	1	3 : 1
50%	:	25%	:	25%	75% : 25%

Table 2: Shows the predicted genotypic ratio and phenotypic ratio of the F_2 generation. These predicted ratios were calculated from the Punnett Square shown in *Diagram 2*.

As shown as *Table 2*, the predicted results for the F_2 generation will have a phenotype of 75% having pelvic spines while 25% do not. Their genotype varies, where it is predicted that 50% are heterozygous (Ff), 25% are homozygous dominant (FF), and 25% are homozygous recessive (ff).

RESULTS

Table 3: The First Generation of Stickleback Fish, Whether They Had a Pelvic Spine or Not

GENERATION	FISH NUMBER	SPINE	NO SPINE
F_1	01	✓	
F_1	02	✓	
F_1	03	✓	
F_1	04	✓	
F_1	05	✓	
F_1	06	✓	
F_1	07	✓	
F_1	08	✓	
F_1	09	✓	
F_1	10	✓	
F_1	11	✓	
F_1	12	✓	
F_1	13	✓	
F_1	14	✓	
F_1	15	✓	
F_1	16	✓	

Table 3: This table shows the first generation of offspring of a pure-breeding spine stickleback fish and pure-breeding non-spine stickleback fish. The results were generated by breeding the two fish then, documenting the offspring in pictures to see whether they had grown a pelvic spine or not to determine which allele is dominant.

LEGEND: ✓ - Denotes that the fish has the trait of the column's title (SPINE or NO SPINE)

Table 4: The Second Generation of Stickleback Fish Whether They Had a Pelvic Spine or Not

GENERATION	FISH NUMBER	SPINE	NO SPINE
F_2	01		✓

F_2	**02**		✓
F_2	**03**		✓
F_2	**04**	✓	
F_2	**05**		✓
F_2	**06**	✓	
F_2	**07**		✓
F_2	**08**	✓	
F_2	**09**	✓	
F_2	**10**	✓	
F_2	**11**	✓	
F_2	**12**	✓	
F_2	**13**	✓	
F_2	**14**	✓	
F_2	**15**	✓	
F_2	**16**	✓	
F_2	**17**	✓	
F_2	**18**	✓	
F_2	**19**	✓	
F_2	**20**	✓	
F_2	**21**	✓	
F_2	**22**	✓	
F_2	**23**	✓	
F_2	**24**	✓	
F_2	**25**	✓	
F_2	**26**	✓	
F_2	**27**	✓	
F_2	**28**	✓	
F_2	**29**	✓	
F_2	**30**	✓	
F_2	**31**	✓	
F_2	**32**	✓	
F_2	**33**		✓
F_2	**34**	✓	
F_2	**35**		✓
F_2	**36**	✓	
F_2	**37**		✓
F_2	**38**	✓	
F_2	**39**		✓
F_2	**40**	✓	

Table 4: This table is the second generation of stickleback fish. These fish were obtained by breeding the fish from the previous generation then, documenting the offspring in pictures to see whether they had grown a pelvic spine or not to determine which allele is dominant.

LEGEND: ✓ - Denotes that the fish has the trait of the column's title (SPINE or NO SPINE)

The F_1 generation of stickleback fish were created by breeding a pure-breeding pelvic spine stickleback fish and a pure-breeding no pelvic spine stickleback fish together. The results were that all 16 of their offspring (100%) have grown pelvic spines. The F_2 generation of stickleback fish were created by breeding the F_1 generation of stickleback fish together. The results were that 31 out of 40 (77.5%) of the F_2 generation have grown pelvic spines while 9 out of 40 (22.5%) have not grown pelvic spines.

Conclusion

The allele that produces a spine is dominant. The predicted results for growing a pelvic spine closely matched the actual results of the stickleback fish. Since the first generation of stickleback fish must have a heterozygous genotype (Ff) [bred between pure-breeding pelvic spine fish and pure-breeding no pelvic spine fish], this indicates that the "grow-a-pelvic-spine-allele" is dominant. This means stickleback fish with spines can appear in higher and faster frequencies because they have two possible genotypes of heterozygous (Ff) and homozygous dominant (FF), while stickleback fish with no spines appear slower because they only have one possible genotype (ff).