

Painted Turtle Hatchling Sex Determination

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Grades: 10-12

Subject: science, biology, environmental science

Skills: graphing, data analysis, theorizing

Duration: 60 minutes

Vocabulary: temperature dependant sex determination, TDSD, genetic sex determination, chromosome, threshold temperature.

Objectives:

- Students will be able to:
- 1) estimate the sex of hatchling Painted Turtles by mean nest temperatures.
 - 2) draw conclusions on sex determination based on nest temperatures from laboratory and field data.

Method:

Students graph and compare incubation temperature data from laboratory and natural conditions.

Background:

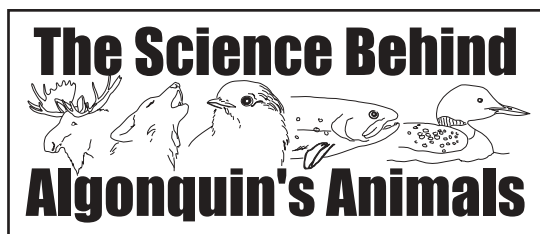
One aspect of Painted Turtle research in Algonquin Park looks specifically at how sex of hatchling turtles is determined. For most vertebrates sex of the offspring is determined by one sex chromosome provided by each parent. In humans, a male has XY chromosomes and females have XX. In some species of turtles, such as the Painted Turtle, there are no sex chromosomes present at the time of fertilization. This means that a turtle embryo has no sex. What has been discovered in other turtle research is that the sex of the embryo is determined by temperature. The temperature determines which sex hormones will be produced. This occurs during the middle third of incubation. For Painted Turtles this falls during weeks seven to ten of incubation. In laboratory conditions it has been demonstrated that Painted Turtle eggs incubated at differing constant temperatures will produce a constant sex. Painted Turtles have two threshold temperatures, a point where above a certain temperature one sex will be produced and below the other sex will be produced. For Painted Turtles



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these are above 27°C and below 23°C. Above and below these temperatures females will be produced, in between, 23-27°C, males will be produced. In nature, turtle nests are exposed to continually fluctuating temperatures during this critical period of sex determination. What wildlife researchers wanted to determine was if a mean temperature of nests in the wild could be used to determine the sex of Painted Turtles, and how fluctuating temperatures in natural conditions influence sex ratios. This was done by comparing Painted Turtle eggs incubated in a laboratory with eggs incubated under natural conditions.

With incubation temperatures set at 2°C intervals between 20°C and 32°C only males were produced at 22, 24 and 26°C. Only females were produced at 30 and 32°C and both sexes were produced at 20 and 28°C. The highest percentage of males occurred at 26°C (100%).

In comparison, results from naturally incubated nest in the field showed that, as in incubators, the highest percent of males occurred at intermediate temperatures. At lower temperatures though, percentage of males was higher than in laboratory conditions.

Materials:

✓	Items Required	Quantity
	Painted Turtle Temperature Data Sheet *	one per student
	graph paper	one per student
	Painted Turtle Incubation Temperatures Inquiry Sheet	one per student

* The data for this exercise is representative of actual findings but is not the actual data from the research.

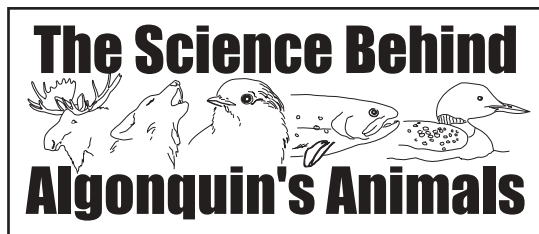
Procedure:

- 1) Ask students how the sex of most animals is determined (sex chromosomes). Ask if they know of any animal which does not rely on sex chromosomes from the parents to determine sex. Make a list on the board of the answers. If the list is small you may want to assign this



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as a task for homework, having each student provide two animals. Below is a list of animals found in Ontario which have Temperature Dependant Sex Determination (TSD).

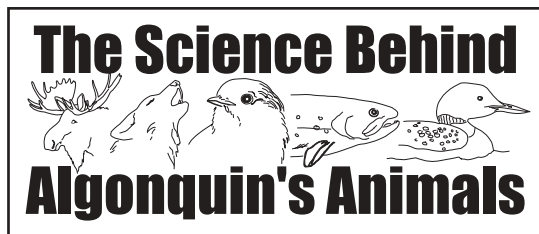
- Snapping Turtle
 - Musk Turtle
 - Painted Turtle
 - Map Turtle
 - Blanding's Turtle
 - Spotted Turtle
 - Box Turtle
- 2) When a list has been generated ask the students how the sex of these animals is determined (temperature). During a certain period of incubation nest temperatures will produce the sex hormones that will determine the sex of the offspring. This is known as Temperature Dependant Sex Determination (TSD).
 - 3) Explain to the students that scientist are unsure exactly how temperature determines the sex of some animals as temperatures in nature are always fluctuating and nests and eggs are exposed to a variety of environmental factors.
 - 4) Tell the students that in Algonquin Provincial Park wildlife researchers did a study to determine if mean nest temperatures could be used to determine the sex ratios in Painted Turtle nests. Explain how this was done as described above in Background.
 - 5) Explain to the students that they will be given two sets of data, the laboratory results and the field results. For each set of data they will be graphing and comparing the data and answering a series of questions.
 - 6) Give the students the data from the laboratory incubated eggs first and have them work through the inquiry sheet.
 - 7) When they have finished the first two points on the inquiry sheet, give them the data from the naturally incubated nests, and have them complete the remaining questions.



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Extensions:

Have students research why some species of turtle have temperature dependent sex determination and others have genetic sex determination.

Evaluation:

Ask students to:

- 1) Research and write a paper on either the pros or cons for temperature dependent sex determination in some reptiles.
- 2) Research and write a paper on what effects global warming might have on species that have temperature dependent sex determination.



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