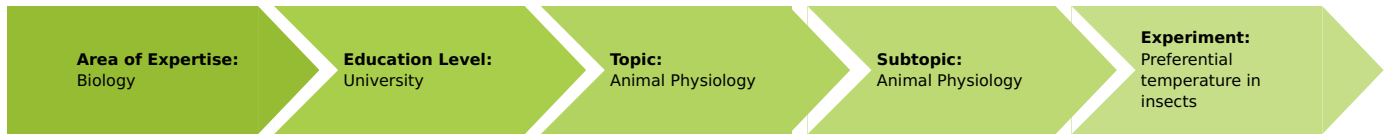


Preferential temperature in insects (Item No.: P4060200)

Curricular Relevance



Difficulty



Intermediate

Preparation Time



30 Minutes

Execution Time



2 Hours

Recommended Group Size



2 Students

Additional Requirements:

- At least 20 insects of different species

Experiment Variations:

Keywords:

Temperature optimum, Poikilothermic animals, Thermotaxis, Phototaxis, Thigmotaxis, Torpor, Environmental requirements, Geographical separation

Overview

Short description

Principle

To test the temperature demands of poikilothermic animals. Using their thermoreceptors the animals recognize the temperature which suits them, gather in an area at the corresponding temperature (thermotaxis) and thus show their preferred temperature. To produce a temperature gradient between approximately 45 °C and 10 °C using a ring shaped temperature organ. To record the positions of the individual animals.



Fig. 1: Temperature organ

Equipment

Position No.	Material	Order No.	Quantity
1	Temperature organ	65983-93	1
2	Lab thermometer, -10..+50C	38055-00	6
3	Rubber tubing, i.d. 8 mm	39283-00	2
4	Sea sand, purified 1000 g	30220-67	1
5	Immersion thermostat Alpha A, 230 V	08493-93	1
6	External circulation set for thermostat Alpha A	08493-02	1
7	Bath for thermostat, makrolon	08487-02	1
8	Hose clamp for 5-12 mm diameter	40997-00	8
9	Rubber tubing, i.d. 10 mm	39290-00	1
10	Tubing connector, ID 6-10mm	47516-01	2

Tasks

1. Test the temperature demands of poikilothermic animals. Using their thermoreceptors the animals recognize the temperature which suits them, gather in an area at the corresponding temperature (thermotaxis) and thus show their preferred temperature.
2. Produce a temperature gradient between approximately 45 °C and 10 °C using a ring shaped temperature organ and record the positions of the individual animals.

Set-up and procedure

Set-up

- The temperature organ is set up so that the incidence of light is uniform, e.g. near a window. The equipment is connected to power and water supplies approximately half an hour to one hour before the experiment begins. The cooling water discharged is drained away. The floor of the temperature organ is spread thinly with sand and slightly moistened.
- On one side of the organ six thermometers are inserted fully in the holes. To protect the thermometers from breakage, a transparent sleeve is slipped over them. The temperatures of the six segments of the organ are read off at short intervals, until constant values are obtained. These six temperatures are recorded.

Procedure

- Approximately 20 insects of different species (at least three individuals of each species) are marked with coloured dots and placed in the temperature organ. The plexiglass cover is positioned on the organ so that the heating is located between segments 6 and 7.
- After half an hour's acclimatization time the positions of each individual insect are recorded at five minute intervals for one hour. Animals in the cold area which show signs of torpor are moved by careful prodding.

Result and evaluation

Results and evaluation

- The temperature requirements of animals with regard to their environment differ widely: they vary from temperatures just below 0 °C for arctic and antarctic animals to temperatures of around 50 °C for desert animals, and animals from hot springs. Within these limits many species prefer one range: the preferential temperature. Temperature requirements have a strong influence on the distribution of a species. Different preferential temperatures lead to the geographical separation of closely related species.
- In order to determine the preferential temperature, the mean value is obtained from the 12 values recorded for each animal investigated. The mean value of all investigated individuals of a species gives the preferential temperature for this species.
- Although the preferential temperature for most animals is determined by heredity, it can be influenced by many factors: the direction of incidence of light, humidity, physical contact with the wall, the time of day, fasting state etc. Orientation of the animals towards the light (phototaxis) can be prevented by providing uniform illumination of the temperature organ (e.g. by setting it up near the window). Orientation in humidity gradients can be excluded by using a moistened temperature organ. In a "damp" organ the relative humidity varies only between 90% and 60%, but in a dry organ between 80% and 30%. In a ring shaped temperature organ the animals can pass freely through the cold area and therefore rarely become torpid. However, if a linear temperature organ is used, congregation of the animals due to thigmotaxis in the corners of the cold end is often observed, which falsifies the results.