

1. Are there particular differences in the way vertebrates and invertebrates visually process orientation and shape? And how would you design an experiment to test this?
2. What evidence is there that insects use cognitive maps?
3. Which of the following is not used by insects as a method of navigation?
 - a. dead-reckoning
 - b. vestibular system
 - c. landmarks, objects
 - d. entire scene

Can insects use the sun to navigate? Is navigation restricted to visual and spatial aspects?
Could the insect use smell?

Open Research/ Project idea

A computational model of how octopi recognize shapes.

Short Answer Question

What is a cognitive map? Do insects have the ability to organize landmarks into cognitive maps?

Multiple Choice Answer question

A water strider in a current needs to jump to stay in the same place. There is a single light that the water strider can see. Which of the following scenarios would NOT occur.

- a. If the lamp goes out, the water strider will continue to make precise jumps.
- b. If the lamp goes out, the water strider will begin making random jumping movements.
- c. If the lamp moves, the water strider will also move.
- d. With the light on and stationary, the water strider's jumps are precise.

Research Question

Given that animals in general have great difficulty differentiating between left and right when they lack external cues, how is dead reckoning used for navigation if the animals do not use visual cues to figure out their left from their right?

Short answer question

What is a cognitive map?

Multiple choice question

What is one popular hypothesis for a mechanism for octopus shape recognition as put forth by Sutherland in the reading?

- a. Template matching -- low-resolution pixel-by-pixel comparison of shapes stored in memory
- b. Geons -- image is converted to a representation made up of simple abstract 3D shapes, and these abstract shapes are compared to stored representations of objects
- c. 2D image is converted to a horizontal and a vertical projection, which are compared to such stored projections in memory
- d. the octopus simply classifies objects as "food" or "non-food" through a simple neural network

1. How does an animal handle changes in the scenery with which it is familiar?
2. What are some arguments for dead reckoning vs. scene-based navigation in animals?
3. If you were lost in the woods, the best animal to ask for directions would be
 - a. Bee
 - b. Ant
 - c. Octopus
 - d. Fruit fly

Open research question/project idea:

Sutherland investigated the octopus' ability to discriminate between geometric forms, but further work could be done to investigate its ability to recognize natural images.

Short answer question

What evidence is there that the water strider uses visual cues for orientation?

Multiple choice question

Honey bees primarily navigate using

- a. dead reckoning
- b. map-based landmark navigation
- c. route specific landmark navigation
- d. road signs

1. Open research question/project idea:

Determine whether the dead reckoning ability of desert ants based on their magnetic sense or on visual cues, such as the location of the sun.

2. Short answer:

What evidence is there for use of dead reckoning as a navigation strategy in insects?

3. Multiple choice:

In pattern recognition, do insects use:

- a. polymorphic concepts
- b. 3D object representations
- c. local retinotopic features
- d. local and global retinotopic features

1. Create a model that takes a snapshot of landmarks in a starting position and uses the landmarks to navigate to an end position identified only by its vector offset. (Mountaineers do this all the time.) The landmark "homing" model didn't explicitly code range information about landmarks. It may be necessary to do so for this problem.
2. The insect navigation model did not explicitly code range and size information of landmarks. How did it sidestep this issue.
3. Which one of the following was not one of the assumptions about the insect brain used in making the navigation model:

- a. A model must use a relatively small number of neurons.
- b. A plausible model must be confined to local interconnections
- c. Recurrent connections are necessary to maintain state.
- d. The neurons put out a "graded response"

1. How can we make the model more neurobiologically accurate? Could neuroimaging techniques be used to discover the functional properties of the neurons that are involved in landmark navigation?

2. Describe the snapshot model: what type of information is stored and considered in the matching of the snapshot and the current view?

3. Foraging insects use landmark-based information for navigation.

According to recent studies, how do insects accomplish this task?

- a. By storing a relatively unprocessed retinal image
- b. By use of a cognitive map
- c. By calculating their position relative to the sun

1. **Open research question:** Present an octopus with a square peg square hole task, the same kind you give to small children. With their dexterity of tentacles, grasping and moving the pegs would not be a problem but would they be able to discriminate different shapes and match them with the holes? When the activity is completed, positive reinforcement (i.e. food) would be offered. You would probably have to train them to realize the necessary task, perhaps repeat the basic action and reinforce it. I'm not certain of the specifics.

2. **Short answer question:** How does a water strider maintain its position in a stream? What cues does it use to accomplish this?

3. **Multiple choice:** Which of the following is not a mechanism for navigation in insects?

- a. retinotopic matching
- b. peer pressure
- c. dead reckoning
- d. snapshot based cognitive maps

1. **Open research question**

Are there arguments against aiming for a unified model of pattern recognition across species?

2. **A short answer question**

What type of experiments test whether an animal is able to organize landmarks into cognitive maps?

3. **A multiple choice question**

In an experiment on honey bee pattern recognition by Tinbergen (1932), honeybees used

- a. local cues over global cues.
- b. global cues over local cues.
- c. both local and global cues randomly.

Research Question:

Are cognitive maps common to all insects?

Short Answer Question:

Name and define two strategies of visual recognition that insects use for navigation.

Multiple Choice Question:

Insects represent and match patterns utilizing

- a. an exact copy of the image
- b. the local features of the image
- c. retinotopic matching
- d. all of the above
- e. none of the above