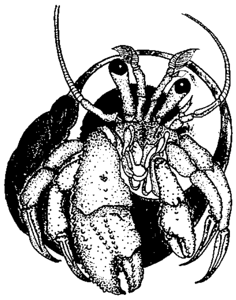
The hermit crab – model study

The following exercises with hermit crabs are given as an example to demonstrate the benefits of intensively studying a single animal in order show what special and interesting creatures they are and introduce some of the main principles of seashore life. This, in turn, will help emphasise the importance of marine reserves in securing parcels of our coastline where studies can be undertaken and the whole rich variety of marine life can be enjoyed.

Exercises with hermit crabs

Hermit crabs hide in their shelters when they see us approaching and only emerge again if they cannot detect threatening movements. To demonstrate this to the students squat motionless beside a pool and have them record the numbers of hermits that they see moving, at 15 second intervals from the time that they first squat down. They will be surprised how many of those empty looking shells lying on the bottom contain a squatter. Looking carefully they will see the value of the crabs having eyes on stalks for peeping out from under the shell to see if 'the coast is clear'.



Pick up one of the hermits.

It withdraws into its shell immediately. Notice how the large pincer claw is shaped and turned on its side to make a lid or manhole cover (or rather snailhole cover!) to close off the entrance to its temporary mobile home.

One exercise you can do away from a marine reserve is to drop a bit of a flea mussel or other animal fragment into a rock pool and watch without moving. Observers will be able to study the feeding behaviour and dreadful table manners of these greedy scavengers.

Hermits are generally regarded solely as scavengers and all will scavenge for scraps of other animals that are dead or injured. However, hermits enjoy a varied diet, also feeding by grazing soft growths of algae, filtering plankton or predating on small animals.

Scavenging for food

To consider their scavenging behaviour, the requirements of a scavenger must first be detailed.

Scavengers are the garbage disposers or undertakers of the seashore and their profession is a highly competitive one. When marine animals die they rot and putrefy very rapidly and the smell can be stomach churning. However, we seldom find smelly bodies littering our beaches because the scavengers always dispose of them before they have time to rot.

Their food is always dead or moribund so scavengers generally only need to locate and devour it. They do not need any special behaviour or equipment to catch and kill the food animal as do predators. The release of body fluids from a dying animal, or the first hint of rotting flesh seeping from it, stimulates the scavengers to activity. They must first speedily establish where the smell of dinner is coming from and then move rapidly to it because many other scavengers will also be aroused and latecomers will miss out on dinner.

The flicking antennae (short feelers) between the eyes are the hermit's smell sensors. Point them out so students don't miss them.

For speedy locomotion long powerful legs are extended from the snail shell home. How many legs protrude from the shell?

Do they use their pincer legs for walking or only for feeding?

Hermit crabs scuttle around very easily under water but make much harder work of dragging their heavy shells around outside its pool. Explain the physics of the shell weight being supported by the water when the animals are submerged (Archimedes' principle).

Archimedes principle – and how it affects hermit crab movement in and out of water

The principle

When any object, living or non-living, is placed in a liquid it displaces some of the liquid and appears to weigh less. The weight loss is equal to the weight (mass) of the liquid displaced.

This phenomenon is easy to demonstrate with a lead fishing sinker suspended on a small spring balance. Applying the principle to marine animals helps to explain how most of them can move with so little effort when they are submerged.

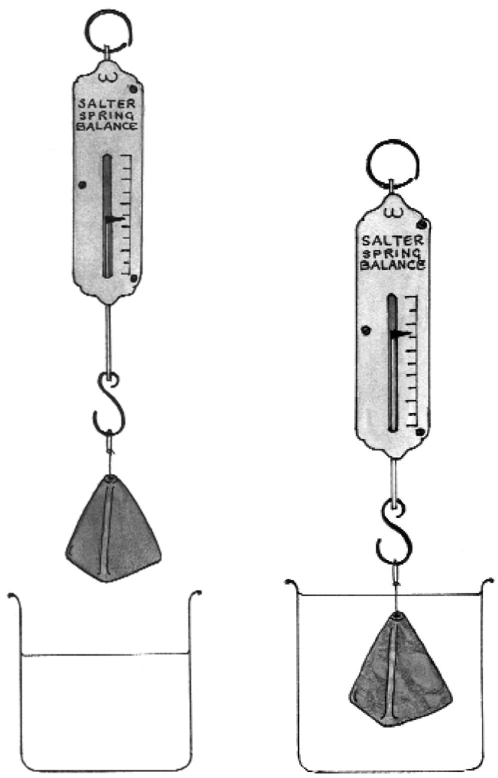
Lead fishing sinkers are manufactured to particular weights, which are often stamped into the soft metal. Class students can verify this weight (mass) when the sinker is suspended on the spring balance hook.

When the sinker (still suspended on the balance) is lowered into water the weight shown on the balance will be substantially less. The decrease in weight is equal to the weight of the water displaced.

If the demonstration is repeated with a tomato or small cucumber, the weight of water displaced is almost the same as the weight of the fruit in air because both of these fruit consist of little else but water. This means that when they are submerged in water they register almost no weight on the spring balance.

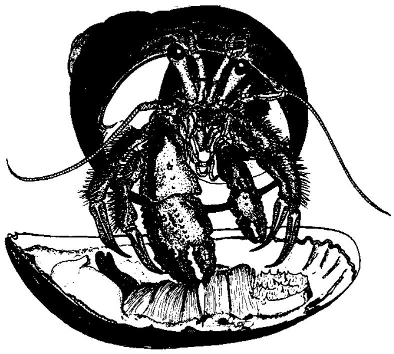
Many invertebrate animals are also mainly water (with small amounts of protein in muscles and bodily organs that are slightly heavier, balanced by stored fat and oils that make them lighter). Therefore each animal's weight in air is very close to the weight of water displaced when it is submerged – because most of its own body consists of little but water.

Consequently most free living invertebrate animals are almost weightless when they are submerged and therefore have to expend very little physical effort to move around underwater. The surrounding water supports most of their weight. However, if they are taken out of water they have to support all of their own weight and, like the hermit crab, struggle to do so on dry land.



Adaptions for feeding

The scavenger's dinner often retains some of the natural, passive defences that were so effective when it was alive, such as scales (fish), an external skeleton (shrimp or crab) or chalky shell (snail or clam). Scavengers must therefore possess a means of dislodging or penetrating this armour and they also need equipment for tearing apart the flesh inside into small enough pieces to fit into the mouth.



The hermit crab has one large and one small pincer claw. The large claw is a powerful and versatile tool. As well as acting as the shell lid when the animal withdraws into its home, the large pincer can wrench food free, lever aside scales, crush through exoskeletons of other crustaceans and hold the food securely as it feeds. The walking legs are also used to hold down the food or brace the hermit against it so the pincer can gain purchase to tear off chunks of flesh.

Generally the large pincer is too big to pass food easily to the mandibles and it is the smaller pincer that takes the food from the larger one and passes it back to the mouth. There, other mouthparts help to stuff it into the opening. Hermits tend to have rather messy table manners as they attempt to consume as much of the food as possible before other larger or more powerful scavengers push them to one side.

Hermits are sufficiently common that you can take half a dozen for a class to study back to the classroom from shores outside of marine reserves.

A twisted body

It is good to show the students how well a hermit is adapted to live inside a chalky spiral tube and how difficult it is to get one out of its shell. By selecting one living in a fairly thin shell like that of a cats eye snail, the hermit can be extracted without harm by cutting around the shell spiral with a pair of side cutters or strong scissors to remove the shell. Have a spare empty shell of about the same size handy so the hermit can be slipped into a new home after being examined by the class.

Note how the hermit's long abdomen is soft, flexible and twisted to fit the inner spiral of a coiled shell. The tail appendages are also modified, forming a hook so that the hermit can anchor itself to the central column of the shell's spiral. It can then instantly draw itself back into the safety of the shell if danger threatens.

Have the students gently feel the hard head and thorax and the soft abdomen of the crab. Only the portions of the animal that are regularly protruded from the shell have a hard outer skeleton as protective armour. The abdomen is not stiffened with a hard outer crust, like the tail of a crayfish, because it needs to slip and bend easily up inside the ever-decreasing spiral of the protective shell. To aid this ease of movement the hermit crab has completely lost its bilateral symmetry with the appendages on the right side being larger than those on the left.

Low tolerance to drying out

Hermits have a low tolerance to drying out and on the seashore during low tide they are always restricted to pools. If while studying them in the classroom they are left out of water for more than about half an hour they may not recover when placed back in seawater.

The right sized shell

A final point to consider with the students is that when a hermit crab grows, like all crustaceans, it must moult its old outer protective skeleton because the hard parts will not stretch. A new soft skeleton is already secreted underneath and is expanded to the new larger size by the hermit absorbing water and remaining almost motionless until the new skin hardens. While the hermit can secrete a new outer skin it cannot enlarge its snail shell home which may be too small to be comfortable and safe.

From time to time therefore hermits have to seek new homes and occasionally you can see one swapping shells in a pool at the beach. If you keep them in a classroom aquarium for a few weeks with some empty shells marked with nail varnish, it is easy to demonstrate that hermit crabs regularly change their shells.