

It's all in the balance



UNIT 3

This unit deals with the natural balance which occurs in communities of living things and with how it can be disrupted by human activity.

Using this unit

Students should already have an understanding of the topics of producers and consumers, food chains and food webs, and predator-prey relationships.

This unit aims:

- ◆ to help pupils to understand the inter-relationships of a particular food web;
- ◆ to help them to identify some of the characteristics shared by different organisms and those special to particular groups, which enable them to succeed in a particular physical habitat and in the face of competition from other living things (the card game aims to illustrate the variety and uniqueness of living things); and
- ◆ to help pupils to appreciate the effects of both major and minor environmental changes on a habitat, and the possibility of restoration, particularly how humans influence these things.

The card game and discussion points are for classwork. The other activities could be used in class or for homework.

Links with GCSE

Sc2 Life processes and living things

- ◆ Explanation of the distribution and relative abundance of organisms in a habitat in terms of adaptation, competition and predation.
- ◆ The impact of human activity on the environment and how it varies with population-size, economic factors and industrial requirements.

Sc0 The nature of science

- ◆ Scientific knowledge and understanding related to the care of living things and of the environment.
- ◆ Competing priorities and the decisions that have to be made about energy requirements, taking into account relevant social, economic and environmental factors.

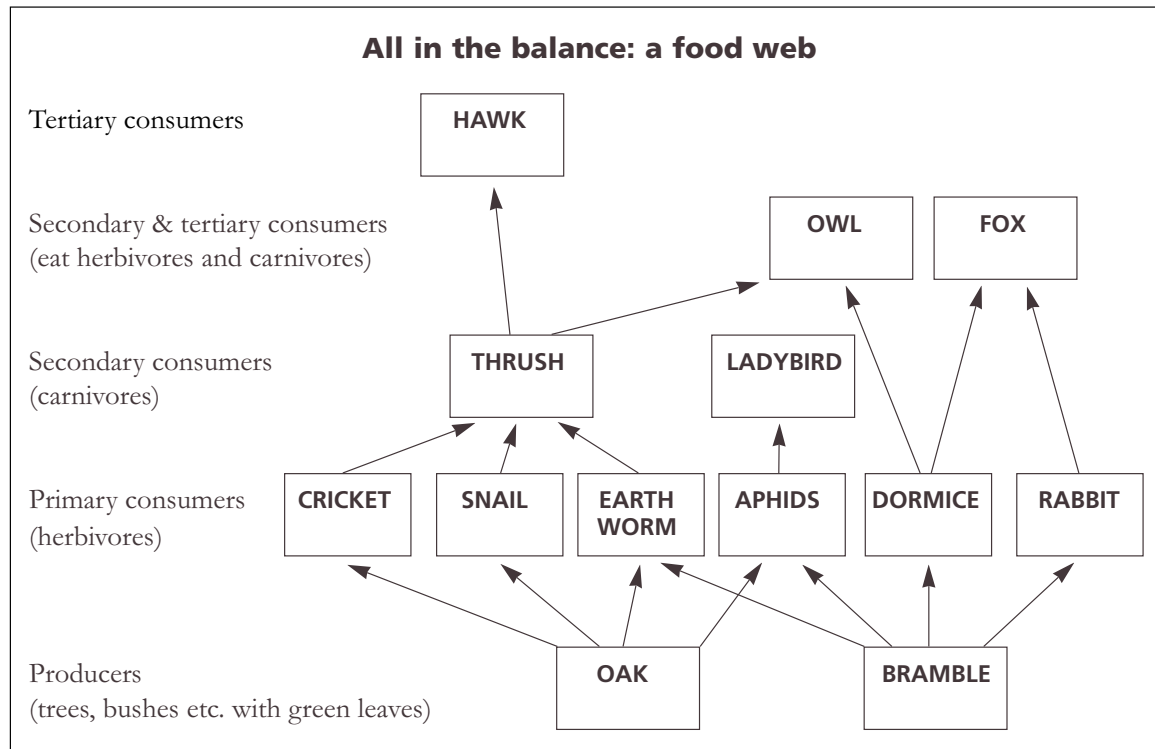
Moral and spiritual aims

- ◆ To increase an awareness and, hopefully, an acknowledgement of God's creativity in the variety and uniqueness of living things, and to show his provision for them.
- ◆ To illustrate that, as we observe and study the natural world, our sense of wonder and pleasure reflect something of the image of God in us.
- ◆ To encourage good stewardship of the natural world by reflecting on the effects of individual actions. This includes an opportunity to look at suffering.

Notes on the activities

Activity 1: Food webs

The completed food web is as follows:



Activity 2: Distinguishing features

This activity is simply to draw pupils' attention to distinguishing features. It requires no additional knowledge, only a closer look at the information on the game cards. This could then lead into the discussion of the unique and special place human beings occupy ('made in the image of God', spiritual beings, etc.).

Mammals Rabbit - eats vegetation, mainly leaves and grass.

Dormouse - eats vegetation, mainly seeds and berries.

Birds Hawk - hunts by day.

Tawny owl - hunts mainly at night.

Insects Cricket - eats vegetation e.g. oak leaves, by cutting pieces of leaf with biting mouthparts.

Aphids - feed on sap using piercing and sucking mouthparts.

Plants Bramble - the stem is protected by spines.
Oak-tree - no stem spines.

Activity 3: Tipping the balance

- This activity encourages good stewardship, but also gives an opportunity to question our motives for such. Is it solely for our pleasure now and that of future generations, or to serve God by caring for it wisely but unselfishly? The former view, being primarily centred on humanity, will tend to preserve that which we like or find useful, and to use that which we need, whilst discarding or ignoring the alternatives. The view that 'the earth is the Lord's and all that is in it' sees it as entrusted to us to be enjoyed but 'handled with care'. Many believe that we will be accountable to our Maker for our actions.

The 'Tip the balance' items 2, 3 and 4 could be discussed as a whole class exercise or in small groups or, alternatively, done as a written exercise for homework.

- shared lifts; use of public transport where possible (services need to be available, reliable and economical); walk or cycle (safe footpaths and

- cycle tracks need to be provided); limit the number of journeys made (probably requires sacrifice in terms of choice of school/work-place/leisure activities).
3. Whilst all these activities are acceptable when done in a controlled and balanced way, when we do them in excess we tip the balance.
- (a) Insecticide sprays - reduce the whole insect population, harmful or not. A reduction in the number of pollinating bees and butterflies will reduce some fruit and seed production. Food chains will be affected as insectivores have less food. Pollution by spray drifting to neighbouring habitats or leaching into local waterways will affect further insect populations and food chains.
- (b) Rabbit shooting - increased growth of local crops and natural vegetation. Coarse grasses grow altering the habitat and resulting animals found there. Reduced food supply for foxes may result in them raiding local domestic sources, e.g. hens, or in decline in the fox population.
- (c) Damaging the bark of a tree - may result in death of the tree brought about by invasion of pathogens and a disruption of food supply from leaves to roots in the phloem vessels. This would lead to a loss of all of the food chains dependent on it.
- (d) Horse riding or motor cycle scrambling - destruction of the woodland floor habitat and its associated flora and fauna; destruction of the soil structure making possible recovery much slower; and muddy tracks which are unpleasant for walkers and wild mammals.
- (e) Personal response answer.

Activity 4: Why is there suffering?

The discussion may include illness, war, famine, animal cruelty, blood sports, etc., and the response support of welfare charities (e.g. Oxfam), action groups (e.g. Greenpeace); hospital visiting; letter writing (e.g. to an MP, newspaper, Amnesty International, etc.); and prayer.



It's all in the balance



UNIT 3

This unit will tell you about the natural balance that is found in communities of living things and how this can be affected by human activity.

1 Food webs



1. Use the Plant and Animal cards to construct a food web.
2. Fill in the blank food web sheet below:

All in the balance: a food web

Tertiary consumers

Secondary & tertiary consumers
(eat herbivores and carnivores)

Secondary consumers
(carnivores)

Primary consumers
(herbivores)

Producers
(trees, bushes etc. with green leaves)

Did you know that millions of species have been identified? All these fit into their own food webs.

2 Distinguishing features

The plant and animal types shown on the cards have some features in common, but each has at least one specific feature which distinguishes it from all the others and enables it to succeed in its particular niche.

- Using the information given on the cards, choose two different mammals, then write down the differences between them. Repeat for birds, insects and plants. For example, a pair not included in any of these groups are the snail and the earthworm. The snail has a hard shell (for protection from predators and drying). The earthworm is protected from these by living in burrows under ground.
- Do you consider humans to be distinct from animals? In what ways are they special and unique? Write down your ideas for use in a short discussion.



3 Tipping the balance

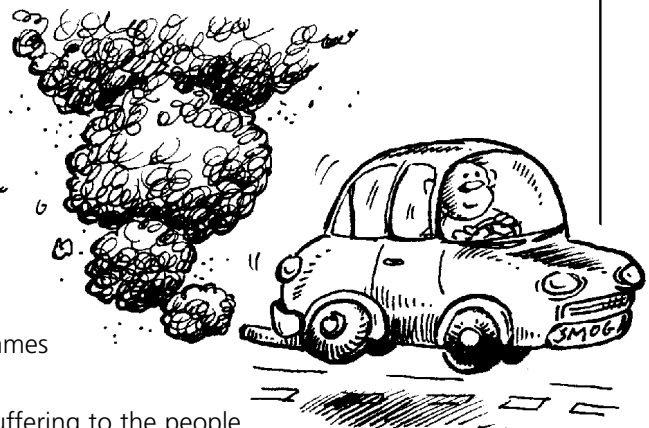
Most caring people would say that we should care for the environment and its creatures, but what is their motive? This will affect how they act. Some of their actions may tip the balance.

- Consider the following statements :
 - ◆ The earth is a source of raw materials.
 - ◆ The earth is a living organism.
 - ◆ The earth is a gift entrusted to us by a creator.

How might people who see the earth in each of these different ways treat their environment? Write down your ideas for a discussion.

- The consequences of car driving include the following:

- ◆ use of fossil fuel (a non-renewable resource);
- ◆ pollution of the air (poisonous carbon monoxide, 'greenhouse gas'- carbon dioxide, lead - if leaded petrol used - and 'acid rain' gases - sulphur dioxide and nitrogen oxides);
- ◆ it requires new road building programmes and road maintenance; and
- ◆ accidental injury may occur causing suffering to the people or wild animals involved.



Suggest how these problems could be reduced or avoided.

3. What are the consequences of each of the following activities?
- using an insecticide spray to kill the insect pests in the garden;
 - rabbit shooting;
 - damaging the bark of an oak tree; and
 - horse riding or motor cycle scrambling in a small local woodland.
 - Do you think any of these activities is worse than the others? If so, why?
4. Consider the situation where a large green area in the centre of your town or village is being considered for development to provide much needed carparking and housing. The green has been used for children's games and by walkers and the local football and cricket clubs. Write a letter to your local newspaper expressing your views on these plans.



4 Why is there suffering?

The food web shows that the secondary and tertiary consumers are carnivores feeding on other animals in the food chain. Animal populations tend to remain fairly constant as a result of the adaptations for survival described, in spite of some of their number being eaten by predators. The question of suffering, therefore, is accepted, yet many feel uneasy about it.

- What kinds of suffering could be avoided? For example, hunger in some parts of the world may be the result of unfair distribution of food. Include in your answer examples of animal and human suffering.
- The Bible says that one day things will be different.

"There will be no more death or mourning or crying or pain."
(*Revelation 21 v 4*)

"The creation itself will be liberated."
(*Romans 8 v 21*)

What kind of suffering distresses you particularly in the world today? What can you do to relieve it in some way?



5 A card game

Play the game using the card sets, following the instructions carefully.
The information given below may be useful revision before you play.

Distinguishing features

- ◆ **Birds** have waterproof feathers which can be raised or lowered for temperature control. They lay shelled eggs.
- ◆ **Mammals** have waterproof hair which can be raised or lowered for temperature control. They give birth to live young.
- ◆ **Insects** and their larvae have a waterproof exoskeleton (a cuticle).
- ◆ **Worms** and **snails** have no waterproof outer layer. When active, they move and feed in a damp habitat. They have both male and female reproductive organs, i.e. they are hermaphrodite.
- ◆ **Invertebrates** e.g. insects, worms and snails, are ectothermic, i.e. their body temperature depends on that of the environment. They become more active as it gets warmer (to about 30°C).
- ◆ **Predatory birds and mammals**, e.g. hawks, owls, foxes, have front-facing eyes for good 3D vision. This is needed for judging distance accurately.
- ◆ **Preyed-upon animals**, e.g. rabbits, dormice, have eyes at the side of the head for all round vision. They also depend on excellent hearing and good camouflage for their protection.

Feeding particulars used in this game

Birds

- ◆ **Hawk** - small mammals and birds, hunted by day.
- ◆ **Tawny owl** - small mammals and birds hunted mainly at night.
- ◆ **Thrush** - invertebrates e.g. snails & insects.

Mammals

- ◆ **Fox** - small mammals and birds hunted mainly at night.
- ◆ **Rabbit** - vegetation e.g. grass
- ◆ **Dormouse** - vegetation e.g. seeds and berries.

Insects

- ◆ **Ladybird** - very small insects.
- ◆ **Cricket** - vegetation e.g. oak leaves
- ◆ **Aphids** (greenfly and blackfly) - plant sap.
- ◆ **Earthworm** and **snail** - humus and decaying leaves.







Plants

- ◆ **Bramble and oak tree** - photosynthesise.

Instructions for playing the game

This is a game for 6 or more players - based on a woodland food web.

Contents

The pack of cards contains 13 sets of 7 cards. Each set contains a plant or animal card; adaptations for feeding , reproduction  and water conservation  cards; response to temperature  and light  cards; and protection from predators card ; plus 4 **TIP-THE-BALANCE** cards.

Object of game

The object is to collect a complete set of 7 correct cards (i.e. belonging to the same set - the plant or animal card plus 6 characteristics for survival), before the **WOODLAND CLEARANCE CARD** is called.

Method of play

1. Each player is dealt a card from the **Plant** or **Animal** set.
2. The rest of the pack is well shuffled and then 6 cards are dealt to each player.
3. The remainder of the pack is then placed face down on the table.
4. Play then proceeds in a clockwise direction. The first player takes a card from the centre pack, looks at it and then either discards it to a central discard pile or keeps it but discards one from his hand.
5. The second player follows suit and so on.
6. At predetermined intervals (e.g. 10 minutes), a **TIP-THE-BALANCE** card is turned up and read out. The instructions given should be followed!

TIP-THE-BALANCE Cards

Drought card

Collectors of **oak tree, bramble, snail** and **earthworm** miss one turn, as photosynthesis slows, snails and earthworms become dormant. (Other organisms play on although drought would affect their food supply and numbers if prolonged.)

Heatwave

Collectors of **oak tree, bramble, aphids, crickets** and **ladybirds** have an extra turn as photosynthesis speeds up, and the exothermic insects become more active. (This would affect food supplies to the whole food chain in the long term.)

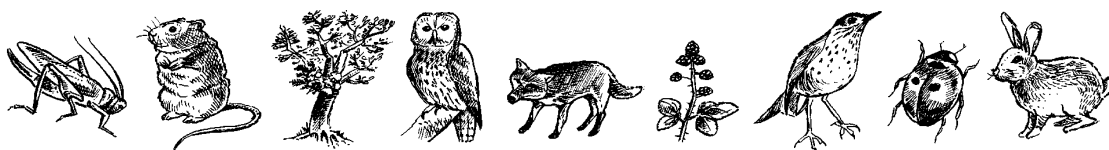
Foxhunt

Collectors of **fox** sets miss 2 turns as their numbers are depleted.

Woodland clearance

End of game because of the destruction of the habitat to which these organisms are adapted, as this causes their death.

If no player has a complete set, the winner is the one with the most cards for the allocated set.





Fox

THE CARDS

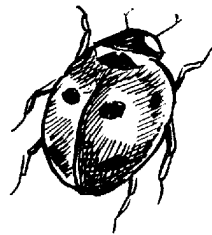
(13 sets of 7 cards and
4 TIP-THE-BALANCE cards)



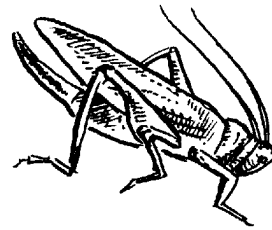
Dormouse



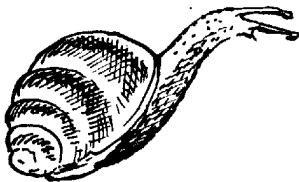
Thrush



Ladybird



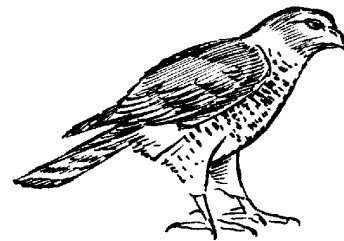
Cricket



Snail



Oak tree



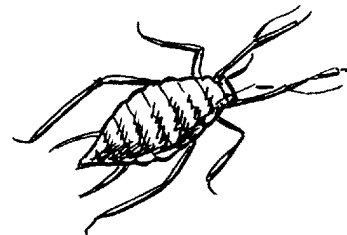
Hawk



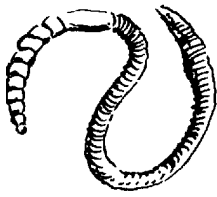
Tawny owl



Bramble



Aphids



Earthworm

TIP-THE-BALANCE CARD

HEATWAVE

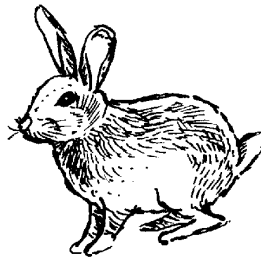
Collectors of **oak tree**, **bramble**, **aphids**, **crickets** and **ladybirds** have an extra turn as photosynthesis speeds up and the exothermic insects become more active. (This would affect food supplies to the whole food chain in the long term.)



waterproof hair



eats vegetation e.g. grass

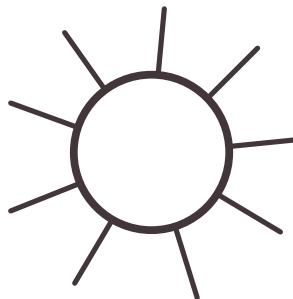


Rabbit

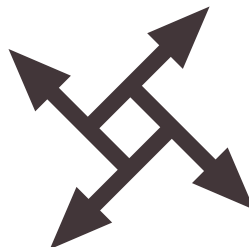
TIP-THE-BALANCE CARD

FOXHUNT

Collectors of **fox** sets miss 2 turns as their numbers are depleted.



lateral vision: wide view



excellent hearing
good camouflage

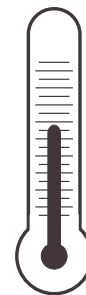
TIP-THE-BALANCE CARD

DROUGHT

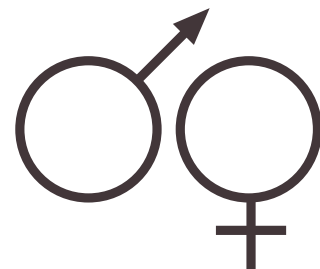
Collectors of **oak tree**, **bramble**, **snail** and **earthworm** miss one turn as photosynthesis slows, snails and earthworms become dormant. (Other organisms play on although drought would affect their food supply and numbers if prolonged.)

WOODLAND CLEARANCE

End of game because of the destruction of the habitat to which these organisms are adapted, as this causes their death.



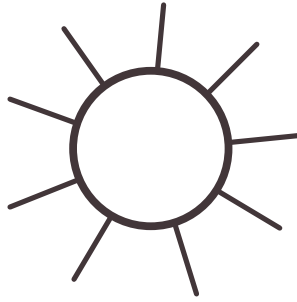
warm: hair lies flat
cold: hair raised



large number of young
fed and reared in nest



waterproof hair



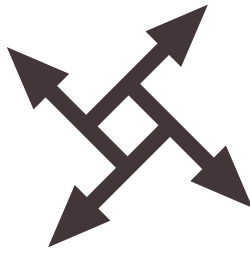
lateral vision: wide view



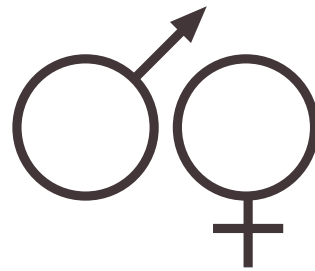
warm: hair lies flat
cold: hair raised



eats vegetation e.g. seeds
and berries



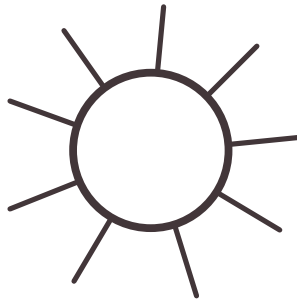
excellent hearing
good camouflage



large number of live young
fed and reared in nest



waterproof feathers



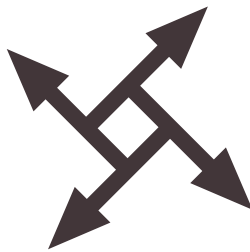
lateral vision: wide view



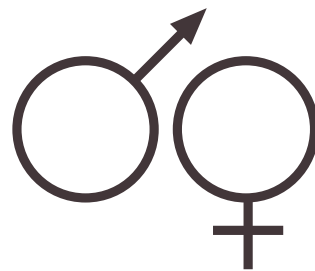
warm: feather lie flat
cold: feathers fluffed out



eats invertebrates e.g. snails
and insects



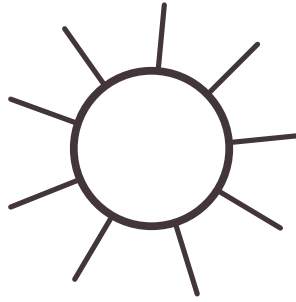
good camouflage



shelled eggs
young fed and reared



waterproof exoskeleton



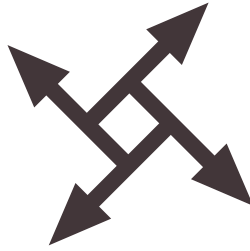
moves towards light



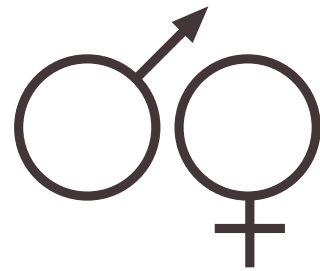
more active as temperature increases



eats very small insects



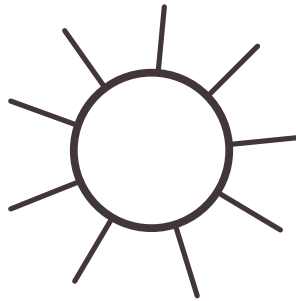
bright warning colours (unpleasant taste)



large number of eggs laid near food source



waterproof exoskeleton



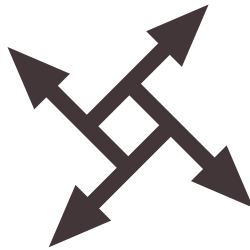
lateral vision: wide view



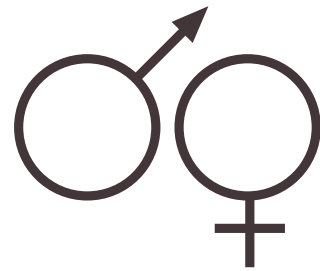
more active as temperature increases



eats vegetation e.g. oak leaves



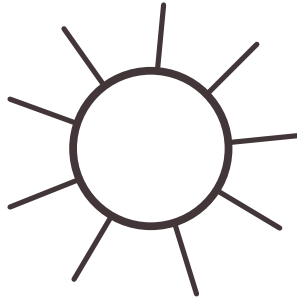
good camouflage



large numbers of eggs laid near food source



waterproof exoskeleton



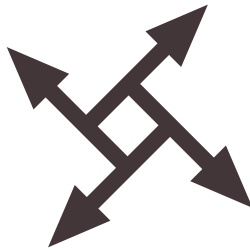
moves towards light



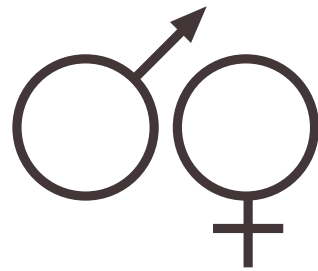
more active as temperature increases



feeds on sap – using piercing and sucking mouth parts



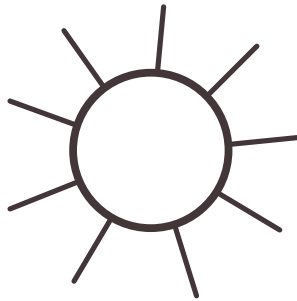
good camouflage



produced in large numbers near food source



stays in damp habitats



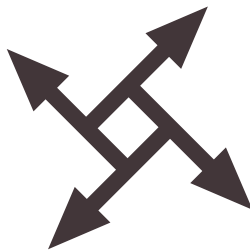
moves away from light



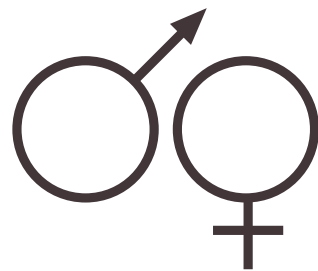
moves to a cooler place



humus and decaying leaves



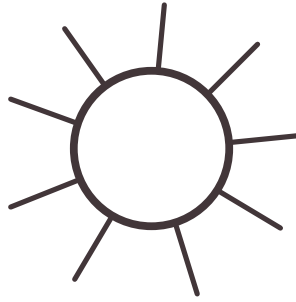
lives in tiny burrows in the soil



hermaphrodite (male & female)
large number of eggs laid



stays in damp habitats



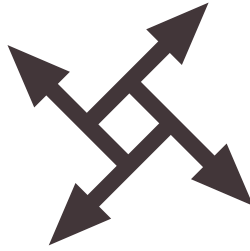
moves away from bright light



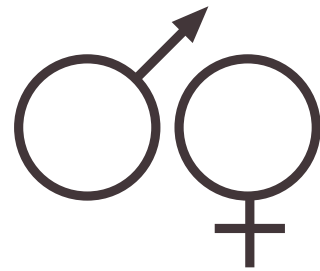
moves to a cooler place



humus and decaying leaves



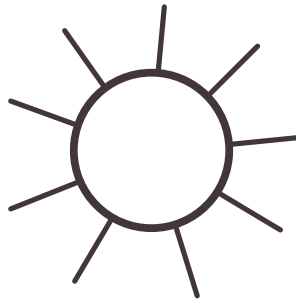
camouflage and hard shell



hermaphrodite (male & female)
large number of eggs laid



leaves covered with waxy cuticle



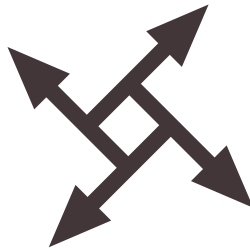
photosynthesises and grows
towards light



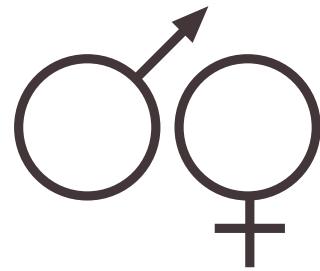
grows more quickly in warmth



photosynthesis



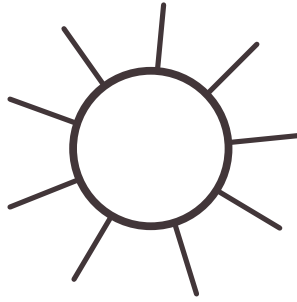
waxy leaf cuticle
no stem spines



huge number of seeds (acorns)



waterproof feathers



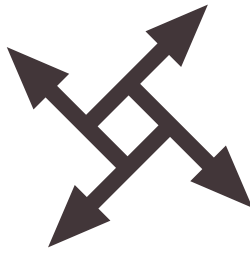
excellent 3D vision
hunts by day



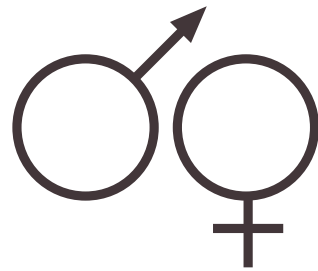
warm: feathers lie flat
cold: feathers fluffed out



shelled eggs
young fed and reared



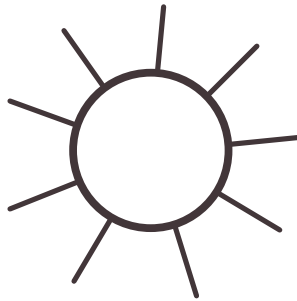
large size
good camouflage



catches small birds and
mammals in clawed talons



waterproof feathers



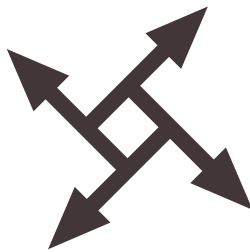
excellent 3D vision
mainly nocturnal



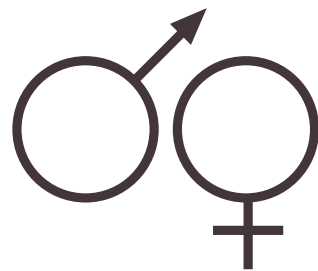
warm: feathers lie flat
cold: feathers fluffed out



catches small birds and
mammals in clawed talons



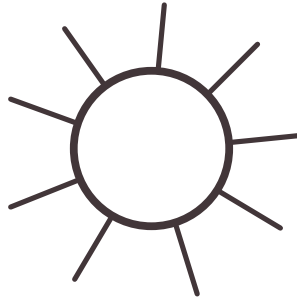
large size, good camouflage
roosts in holes



shelled eggs
young fed and reared



leaves covered with waxy cuticle



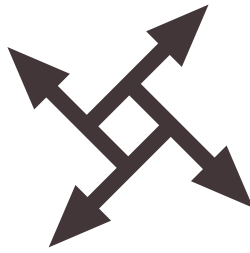
photosynthesises and grows towards the light



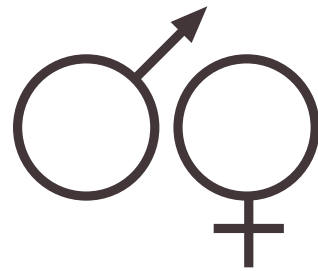
grows more quickly in warmth



photosynthesis



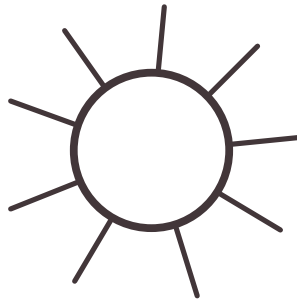
waxy leaf cuticle
stem spines



huge number of seeds –
blackberries



waterproof hair



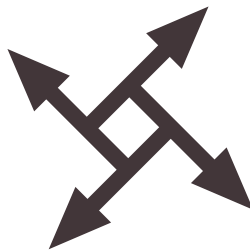
excellent 3D vision
mainly nocturnal



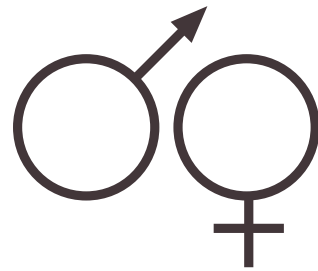
warm: hair lies flat
cold: hair raised



catches small mammals etc
sharp teeth and cunning



large size
good camouflage



few young born alive
young fed and reared

