



# Parental Behaviour

in

# Burying Beetles

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## **Introduction**

This ASAB resource pack focuses on parental behaviour in burying beetles. The pack consists of a DVD, background information on burying beetles and a series of exercises.

*The DVD is available from the ASAB Education Officer, Michael Dockery (contact details on page 26).*

The first section of the DVD illustrates the life cycle of burying beetles and shows footage and photographs of each stage. This section aims to familiarise students with the organism.

The second section of the DVD describes some key parental behaviours and aims to familiarise students with aspects of the parental care behaviours burying beetles display. It will also introduce some important terms and concepts that underpin the activity and the exercises.

In the final section of video footage the students will record the frequency and duration of the amount of parental behaviour exhibited by a female beetle. The students will then incorporate their findings with results, from earlier research, to complete a data set. The students can carry out graphical representation and statistical analysis before answering some follow-up questions to consolidate the learning experience.



***After watching the footage and completing the exercises the students should:***

- 1) appreciate the importance of rigorously defining the behaviours that are to be recorded;
- 2) have gained experience in observing and recording behaviour – here the frequency and duration of active parental care;
- 3) appreciate that there may be flexibility in the parental care system that has evolved – thus biparental care may be the ‘norm’ in burying beetles but uniparental care still enables offspring to be reared successfully;
- 4) appreciate that conflicts of interest between parents and offspring may exist over parental care;
- 5) gain experience in data analysis and handling large data sets;
- 6) provide exposure to concepts such as experimental design, statistical description and analysis.



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### ***Syllabus Links***

#### **AQA Biology Spec A (A2)**

Module 5

Section 14.2: Investigating variation

Module 6

Section 15.7: Metamorphosis and insect diet

Section 15.10: Simple Behaviour Patterns Module 8b

Internal coursework assessment Skills E and F. Also, this activity could also be used to practice these skills. For the coursework assessment a whole investigation (Skills A-G) must be completed.

#### **AQA Psychology Spec A (A2)**

Module 4

Section 13.5: Determinants of animal behaviour

a) Evolutionary explanations of animal behaviour

Section 13.5: Animal cognition

b) Animal communication

Also relevant for aspects of Module 6 Coursework



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## Background Information

### What are insects?

Insects have been on the planet for about 350 million years. They are the largest group of animals in the animal kingdom, and 80% of all of the living creatures on earth are insects. Insects are ectotherms, like all invertebrates that have six legs, and have a hard outer covering called an exoskeleton. Insects are a very diverse and successful group of animals and include butterflies, bees, beetles and ants.

**INSECT****CLASSIFICATION**

KINGDOM:	Animalia
PHYLUM:	Arthropoda
CLASS:	Insecta
ORDER:	Silphidae
FAMILY:	Nicrophorus
GENUS:	Vespilloides

Some insects are considered as pests. For example, the Colorado beetle damages potato crops, the cotton boll weevil damages cotton crops, grain weevils destroy grain and flour, locust swarms destroy crops, clothes moth caterpillars eat holes in clothes hanging in the wardrobe, and termites and woodworm attack wooden furniture in our homes. A few insects, such as flies and mosquitoes, can carry diseases that are harmful to people, such as sleeping sickness and malaria.

However, there are many insects that are useful to people. For example, without bees, butterflies and moths many plants would not be able to produce fruits and seeds, because plants require these insects as pollinators. Bees also make honey which we eat. Ladybirds are very valuable to horticulturalists because they eat the aphids (and other pest insects) that destroy plants. In fact, ladybirds are so good at protecting crops that some species are artificially reared and released to control some pests (a process known as bio-control). Some insects have been using products for thousands/millions of years and which we 'invented' only relatively recently. Wasps, for example, make paper by chewing wood in their mouths, which they use to build their nests. Some moth caterpillars spin cocoons of silk and this very strong silk can be used to make dress material. Insects are fascinating animals and we can learn a lot by studying their behaviour.



**Beetles**

Beetles are one of the largest groups of insects, and are known collectively as Coleoptera. There are approximately 300,000 species of beetles on the planet. There are many different kinds of beetles, most of which are small, but occasionally some can be found that are as large as your hand. For example, the Hercules beetle *Dynastes hercules* can grow up to 21 cm in length. Some beetles are scavengers that feed on the dead bodies (carrion) of animals and birds.

This information pack will describe the life-cycle of one of these scavenger beetles, the burying beetle, *Nicrophorus vespilloides*. *N. vespilloides* is a woodland species that is found in Britain, most of Europe, North America, Middle East, China, Japan and some other parts of Asia. Like many insects (such as butterflies) burying beetles undergo metamorphosis, i.e. are holometabolous. The change through the four different life-history stages (egg, larva, pupa and adult) is described below, and is illustrated in Figure 1 and in the first section of the video footage.

**Egg**

The burying beetle egg is small (approximately 2 mg in mass and 2 mm in length), oval and whitish-cream in colour. They are very delicate and can be easily squashed if handled. Females lay their eggs in the soil and leave them to hatch. After one mating, a female will lay between 20 and 40 eggs, depending on the size of the food resource she has to offer the offspring.

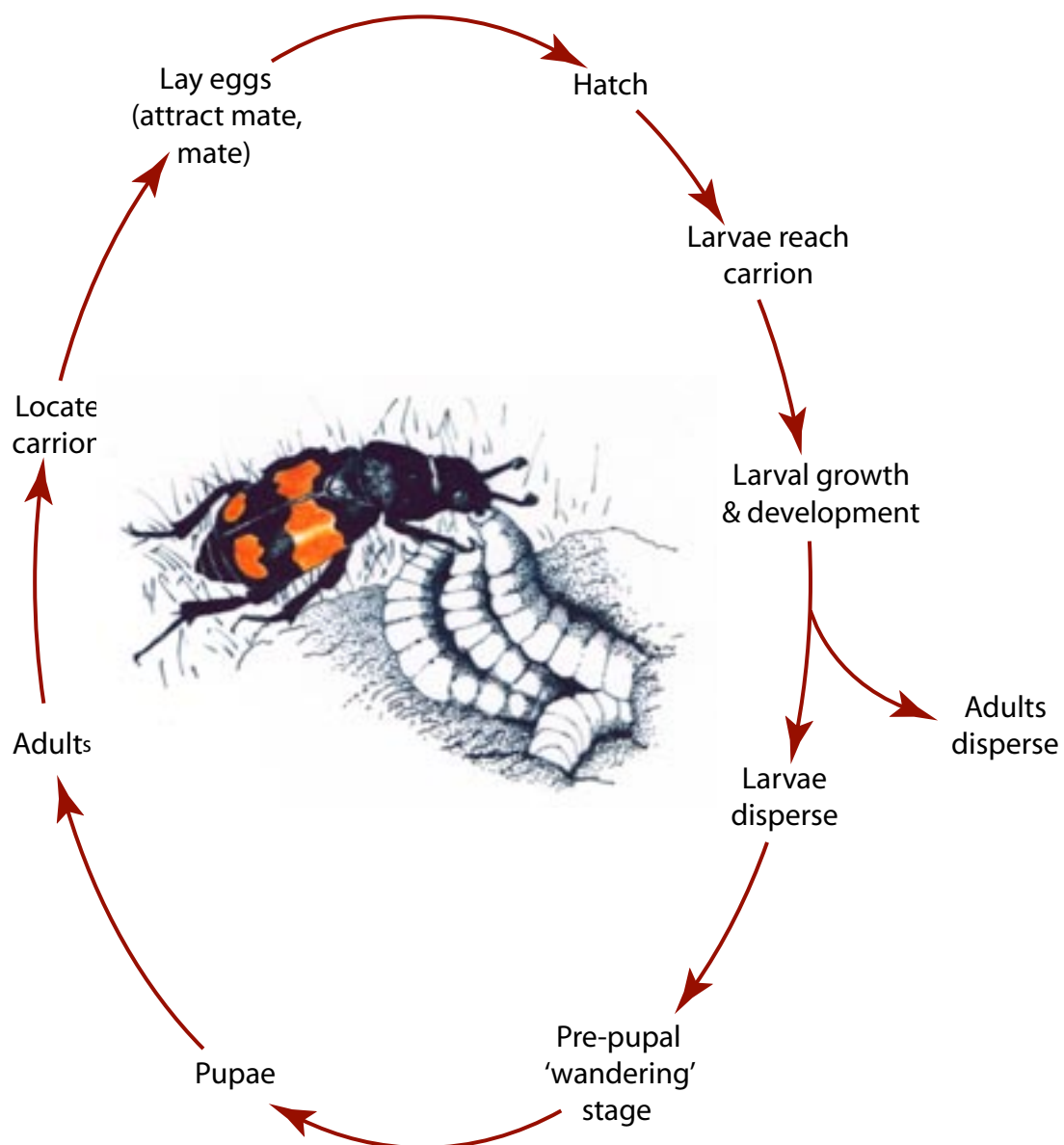
**Larva**

When a larva first hatches from its egg it is white in colour and quite soft. After about half an hour the larva's outer skin becomes a little harder and the larva gains its colour (cream) and has a striped appearance. This stage of development is the growth stage, and the larva spends all of its time eating and growing. As the larva grows, its skin splits and falls off. Underneath a new bigger skin (without stripes) has already grown so that the larva can carry on eating and growing. Burying beetle larvae go through four 'moult' like this, and they increase in size from about 0.2 mg at hatching (4 mm in length)

to about 0.2 g when they are fully grown (15 mm in length). This means that in just one week the larva's size increases 1000 fold!

When a larva is fully grown it enters a pre-pupal wandering stage and searches for a suitable place to form a pupa in the soil. During this stage a larva is quite vulnerable to predators. When disturbed a larva tries to frighten off its attacker by rolling over and over in the soil, and squirting a smelly liquid from its anus.

### **Figure 1: The burying beetle life-cycle**

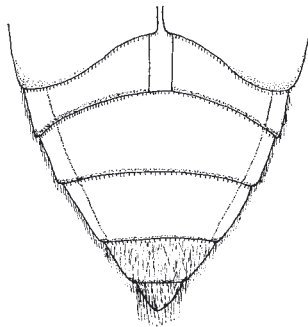
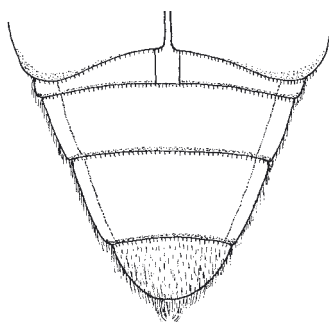


**Pupa**

The pupal case forms around the larva, and is a semi-hard protective covering. From the outside it appears that the pupa is in a resting stage. This is not quite true, however, and on the inside lots of changes are occurring so that the larva can change into an adult beetle. Again, during this phase, the beetle is quite vulnerable to predators. If the pupa is disturbed it moves jerkily, flipping its tail end in the air.

**Adult**

When the adult beetle first emerges from its pupa it is white in colour and soft. After about 12 hours the outer skin or cuticle of the beetle has fully hardened and the beetle's full colour can be observed. Adult burying beetles have black bodies with yellow/orange spots on their outer wing coverings or elytra. The black coloration helps the beetle's camouflage in the soil, and the yellow/orange spots may act as warning coloration to potential predators (aposematic coloration). Burying beetles also stridulate (rub their wings on the underside of their bodies) making a loud squeaking noise to frighten off predators. When handled, these beetles produce a smelly fluid from their mouth and anus in an attempt to prevent predators from eating them. When threatened the beetles run away and bury themselves in the soil, if cornered though, the beetles roll over onto their backs and play dead.

**Figure 2****Male****Female**

Approximately seven days after emergence from the pupa the adult beetle is sexually mature, and it searches for a mate. Male and female beetles look identical to the human eye, and the only way to tell males and females apart is to turn them over onto their backs and have a look at the final section of their abdomen (see Figure 2). When a male burying beetle tries to find a female to mate with he produces a pheromone to attract her. To make himself even more attractive he finds a carcass that can be used as a food resource for the larvae and defends it from other males.



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## Burying beetle reproduction

The male or female, or both, adult beetles first locate a carrion. This is usually a small vertebrate carcass such as a mouse (or bird). They remove all of the fur (or feathers) and roll the carcass into a ball. Mouth and anal liquid secretions are deposited over the carcass to slow down the rate of decay and to prevent the carcass from rotting for as long as possible. Preparing the carcass in this way stimulates the mated female to lay her eggs in the soil around the carcass. About 24 hours after the eggs have been laid, they hatch and the new larvae make their own way through the soil, and find the carcass. At the carcass, the larvae sit in a hole in the top (called the brood chamber) that has been made by their parents. The larvae stay in the brood chamber for the whole of their larval stage, which lasts for four to five days. During this time the larvae beg for food and are fed by their parents. After the larvae have gone through their first moult they are able to feed themselves, but their parents also continue to feed them until they have fully grown. When the larvae have fully grown, and the entire carcass has been eaten, both the larvae and the parents leave the carcass. The parents leave to find new mates and new carcasses, and the larvae leave to find a place to pupate. Larvae search for a pupation site, which might take up to ten days. During this wandering (dispersal) stage of their life-cycle the larvae do not feed or grow anymore.

Burying beetles are quite unusual because their growth stage (the larval stage) is much shorter than the other stages of their life-cycle. This is probably because the larvae need to eat as much as they can, and grow as quickly as possible before the carcass rots, and the food is spoilt. Studies have found that there is a relationship between the size of larvae at dispersal and the size of the adult they become. Large larvae develop into large adults. Large adults have been found to have an increased fecundity and an increased success rate during competition for mates and carcasses. Large size therefore confers a fitness advantage to offspring, and this large size is probably related to the amount of care they received. When a larva finds a suitable place,



it pupates and remains as a pupa for about ten days. After this time the adult emerges from the pupa, and the life-cycle begins again.

## **Parental care**

Parents of many species of animals provide some sort of care to aid their offspring's growth and development, and to increase the survival chances of their offspring. There is a lot of variation in the amount of care that parents of different species provide to their offspring, and quite often males and females differ in the amount of parental care that they provide. In mammals, females provide milk to their offspring, and they feed and protect their offspring until the offspring are able to look after themselves. In birds, both the male and the female generally participate in care and build a nest for their offspring, forage for food and protect their offspring from predators. The parental care provided by mammals and birds is considered to be quite elaborate and sophisticated, and such extensive care is rarely seen in insect species. Burying beetles, however, do provide elaborate parental care during their offspring's larval stage, in a manner comparable to that observed in birds.

There are four main behaviours performed by burying beetle parents that are considered as parental care: these are, carcass maintenance, carcass defence, processing carrion and feeding larvae. These parental behaviours can be observed in the second section of the video footage, and are described below.

## **Carcass maintenance**

The act of carcass preparation (fur removal, secretion deposition, etc.) described in the previous section, forms part of the behaviour considered as carcass maintenance. Carcass care is a very important behaviour that is performed throughout the whole of the larval stage. Burying beetles frequently tend to their carcass removing mould and fungus, and spreading new liquid secretions over the surface of the carcass to slow down its decay.



## Carcass defence

The carcass is a very valuable resource that is of use to other organisms such as flies, micro-organisms (fungi and mould), some vertebrates (foxes and crows) and of course other burying beetles, both of this species and other species too. To prevent the carcass from being discovered, the parents bury it in the soil as quickly as possible. To do this, the parents dig underneath the carcass so that it falls into the hole below, the parents then cover the top of the carcass with more soil. Not only does this hide the carcass, it also prevents competitors from discovering the carcass using their sense of smell. The adult beetles eat any fly eggs and larvae that they find on the carcass, and they continuously inspect the carcass for intruders. When other burying beetles try to steal the carcass from a resident pair, a fierce battle takes place, with biting, chasing and very loud stridulations. In extreme circumstances, the beetles die, or are killed, defending, or attacking, a carcass. Usually larger individuals win these battles.

## Processing carrion

The parents treat the inside of the carcass with regurgitated oral fluids via the brood chamber. To help the larvae feed for themselves, the parents chew the meat into small, bite-sized pieces. This behaviour is very important for the survival of newly hatched and first instar



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larvae. Small larvae have difficulty tearing off chunks of meat because their small mouthparts are not strong enough to do it efficiently for themselves.

### **Feeding larvae**

The parents feed their larvae (in a way similar to that seen in some birds) by regurgitating small chewed pieces of the carcass from their mouths directly into the mouths of their larvae. When the parents are close to the larvae, the larvae beg for food. When begging, a larva pushes its mouthparts towards the parents mouth and 'tickles' its parents mouthparts with its legs. Often, several larvae beg at once and there is competition between larvae for access to the food, with much pushing and jostling for position. Whilst feeding, the adults often make soft, gentle stridulations to attract their larvae. These stridulations sound very different to the anti-predator/competitor stridulations described previously. Both of the parents perform all of these parental care behaviours, and offspring can be reared successfully by either a single parent (uniparental care), or by both parents (biparental care). Biparental care is very unusual in insects. In most insect species male parents never help rear their young. Burying beetle males, however, quite often help.



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## **Exercises: Instructions for students**

Burying beetle parents have been shown to vary greatly in the amount of care that they provide to their offspring. Some parents provide lots of care whereas others provide very little care at all. Both male and female burying beetles provide care to their offspring. It has been suggested that a female parent might spend more time caring for the offspring than a male because a male, due to extra-pair copulations (i.e. the female may mate with other males even though she is rearing offspring with this male), cannot be sure that all of the offspring are his.

In the exercises that follow, you will analyse the findings from a laboratory study that was performed to determine whether:

- 1) Parental care influences offspring development and growth.
- 2) Males and females vary in the amount of care they provide.
- 3) Offspring size is affected by whether it was a male or female parent that provided the care.

### **Experimental design**

20 burying beetle parents (10 male and 10 female) were observed for 4 days during the larval stage, and the amount of time that they spent caring for their offspring was recorded. As a measure of care, the time that the parent spent in the brood chamber (the hole in the top of the carcass where the larvae feed) with their offspring was recorded. For each parent three 10-minute observations were made each day, at 9.00 am, 12.00 pm and 3.00 pm. The time that the parent spent caring was calculated and recorded in minutes. The following measurements were then taken, for each parent:

- 1) mean development time (days) of the offspring (the time taken for the offspring to grow from hatching to adulthood);
- 2) mean mass of the larvae at dispersal (mg).

These results are shown in Table I.



**Table 1: The care provided by 20 (10 female and 10 male) parents and the effect on offspring development and mass.**

Parent number	Sex of parents	Time spent caring (minutes)	Mean development time for offspring (days)	Mean offspring mass at dispersal (mg)
1	male	20	34	115
2	female	55	30.5	160
3	female	85	26	200
4	male	0	36	80
5	female		33.5	120
6	male	65	30	180
7	female	10	35	90
8	male	95	25	210
9	male	70	28.5	175
10	female	15	35.5	110
11	male	50	31	145
12	female	100	25.5	230
13	male	30	33	120
14	female	45	32	155
15	male	90	27	220
16	female	75	27.5	185
17	male	35	32	130
18	female	60	29	170
19	male	80	27	195

# ***Parental Behaviour in Burying Beetles***

## **Exercise 1: Continuous sampling**

Equipment: Stop clock/watch

Record sheet 1

Video footage sections 1 and 2

1. Watch the second section of the video footage to familiarise yourself with burying beetles and their behaviour. See also the 'Definition of behaviour' sheets for guidance. (Appendix 3).
2. Use the footage in section 3 of the video to watch the parent for 10 minutes and record the time in minutes that the parent spends inside the brood chamber with her offspring.
3. You have recorded 10 minutes worth of data. This parent (number 5) was observed for an additional 110 minutes by another researcher. It was found that the parent spent 18 minutes inside the brood chamber. Add your data to this data to obtain a value for the total time this parent spent caring. Insert this value into Table 1.
4. Using the data in Table 1, complete the analyses outlined below.

# ***Parental Behaviour in Burying Beetles***

## **Data analysis**

### **Analysis A**

Is the amount of parental care correlated with

- a) how quickly the larvae grow?
- b) how large the larvae are at dispersal?

1. Draw a scatter graph to show how the time a parent spends caring relates to how quickly the offspring grow (development time). You will need to give careful consideration to which variable goes on the x axis and the y axis.
2. What trend is evident from the scatter of points?
3. Draw another scatter graph to show how the time a parent spends caring relates to how large the offspring are at dispersal.
4. What trend is evident from the scatter of points?

### **Analysis B**

Is there a difference between male and female parents and

- a) the amount of care given?
- b) the mass of the offspring?

Using the appropriate statistical test, determine whether:

- 1) males and females vary in the mean amount of care they provide.
- 2) mean offspring mass is affected by the gender of the parent that provided the care.



## ***Parental Behaviour in Burying Beetles***

### **Exercise 2: Instantaneous sampling (optional)**

Equipment: Stop clock/watch

Record sheet 2

Video footage sections 1 and 2

1. Watch section 2 of the video footage to familiarise yourself with burying beetles and their behaviour. Use the 'Description of behaviour' sheets for guidance. (Appendix 3.)
2. Using the footage in section 3 of the DVD, observe which behaviour the parent is performing.
3. Start the stop watch/clock.
4. At time zero, circle the behaviour that is being performed by the parent.
5. Repeat at 15 second intervals for up to 10 minutes.
6. Count the number of times each behaviour was observed.
7. Represent these data graphically.

# ***Parental Behaviour in Burying Beetles***

## **Questions**

In light of these data, the graphs and the statistical analysis:

1. Explain why care is advantageous to burying beetle offspring.
2. Why is it advantageous for larvae to beg from their parents?
3. Why might it be important for both male and female burying beetles to provide care?
4. What factors might affect the time a parent can spend caring for its offspring?
5. Why might it be advantageous to study burying beetle behaviour in the laboratory rather than in the field?
6. In this study, behavioural observations were made three times per day, and on four consecutive days of larval development. Why might it be important to record parental care behaviours at different times of the day and on different days of larval growth?
7. Identify **one** problem that the researchers may have had in this study and discuss how this may affect their findings.
8. What other measurement of parental care might the researchers be able to record during their observations?

# Parental Behaviour in Burying Beetles

## Worksheet: Defining behaviours

- 1) Some of the behaviours that can be seen whilst observing burying beetles are listed below;
- carcass maintenance, grooming, begging, feeding, defence.

Which of these behaviours can be considered

- a) a parental care behaviour;
  - b) an offspring behaviour;
  - c) neither a) nor b)
- 2) How would you define the following behaviours? Your definitions should describe the behaviour such that another person who had never observed burying beetles before could identify the behaviour.
- a) carcass maintenance
  - b) grooming
  - c) begging
  - d) feeding
  - e) defence.
- 3) Identify **one** other behaviour you observed in the footage and provide a definition for it. It could be behaviour shown by an adult beetle or larva.

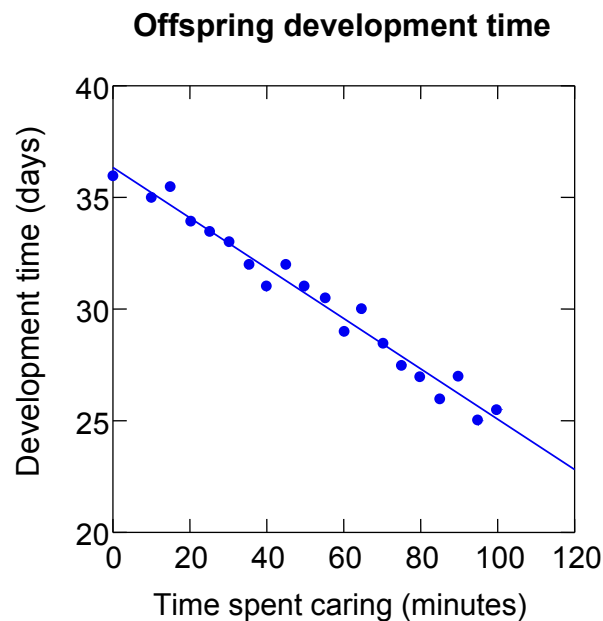
**Exercises: Guidance for teachers****Exercise 1:  
Continuous  
sampling**

The students should record the time, to the nearest minute, that the parent spends inside the brood chamber (the hole in the top of the carcass where the larvae feed) over a 10 minute period. These data should be added to the data below to give a score of the total time parent number 5 spent caring for her larvae, over the whole of the development period, and inserted into Table 1 for the analyses.

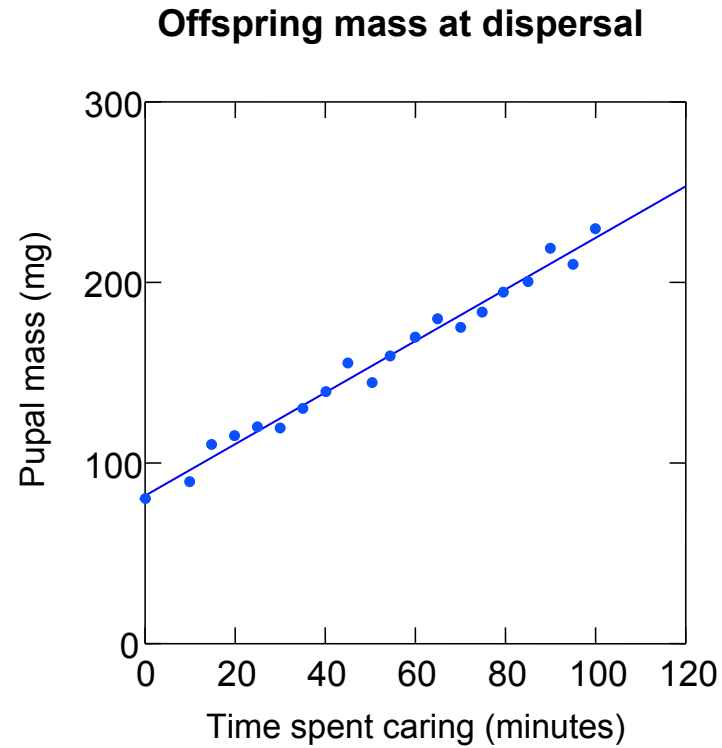
In 110 minutes the time spent caring by parent number 5 = 25 minutes in total. The student will record 7 minutes of behaviour and add this to the 18 minutes already provided.

**Data analysis****Analysis A**

- I. Graph of development time against care.



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- The scatter graph indicates that the more care an offspring receives the faster it completes its development.
  - Graph of dispersal mass against care.



- The scatter graph shows that the more care an offspring receives the larger it grows. Note that even when the offspring receives zero care they can still survive, however, both development and growth are enhanced by care.



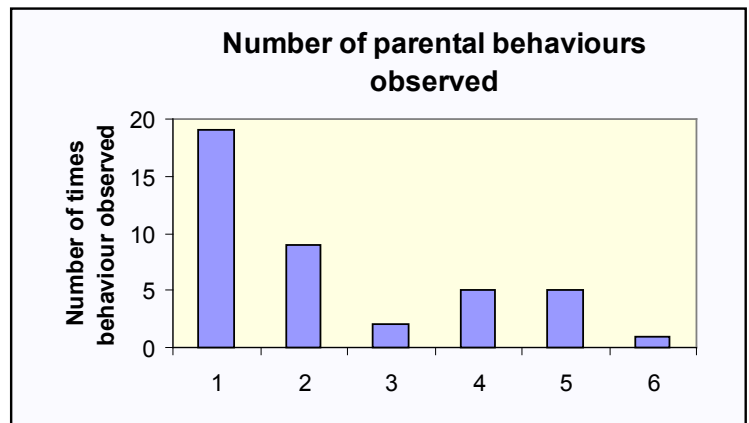
**Analysis B**

- 1) Males and females do not significantly differ in the amount of care that they provide (see table below). Males and females are equally likely to be either good, or bad, parents.
- 2) Males and females do not significantly differ in the effect of their care on offspring growth (see table below). The sex of the parents cannot be used to predict how much care the offspring will receive.

The statistics in the table were obtained using a t-test.

	Male parent	Female parent	P- value
Mean time spent caring (mins)	53.5	57.0	0.86
Mean larval dispersal mass (mg)	157	156	0.96

**Exercise 2:  
Instantaneous  
sampling (optional)**



Where behaviour

- 1 = carcass maintenance
- 2 = processing carrion
- 3 = feeding larvae
- 4 = grooming
- 5 = absent
- 6 = other

See Appendix 2 for a copy of a completed record sheet for this exercise.

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## Answers to Questions

1. Care is beneficial to offspring because it allows them to grow quickly and attain a larger size. Often, during development, offspring have to make a trade-off between either fast development or large size. For burying beetles, however, parental care would appear to allow the offspring to maximise both. Fast development is advantageous because it decreases the risk of predation, enables the offspring to eat all of the food before the carcass rots and it decreases the risk of carcass loss to competitors. Greater mass is important because heavier individuals at dispersal have a greater chance of surviving to adulthood, heavier adults have an advantage during competitive interactions for mates and carcasses and heavier females tend to produce more eggs.
2. Begging is advantageous to offspring because it signals to the parent how hungry the offspring are. Offspring that are good at begging will obtain more food from their parents.
3. Caring for the offspring, maintaining the carcass and defending the carcass are costly in terms of time and energy. Whilst one parent is engaged in one of these behaviours, the other parent needs to be able to competently perform the other behaviours. Also, there is competition amongst burying beetle adults for carcasses and fighting often occurs. It is possible that it is necessary for both parents to be able to provide care in case one is killed whilst defending the carcass.
4. Factors that could influence how much time a parent can spend providing care include:
  - the number of offspring;
  - the size of the carcass;
  - the number of competitors and predators;
  - the parent's condition.



5. Advantages of a laboratory based study include:
  - able to control environmental conditions and keep them constant;
  - able to standardise carcass size and brood size, both of which can affect care levels;
  - attain larger sample sizes, no losses from predation etc.;
  - easier to manipulate conditions. For example, it is difficult to find carcasses, in the field as they would be buried under the soil;
  - able to observe the whole life-cycle.
  
6. Several observations are made because the level of care that a parent provides can fluctuate according to the time of day and as larval development progresses. For example:
  - burying beetle adults are at their most active before dusk;
  - larvae are capable of self-feeding 24 hours after hatching and are no longer completely dependent on their parents for food.

Therefore, recording behaviour at different phases of development is vital to get a representative picture.
  
7. Problems that may be encountered by the researchers and that may affect their results include:
  - sometimes it is difficult to clearly see what the parent is doing and some behaviour may go unrecorded;
  - external noise or disturbance can stop the parent from behaving normally;
  - imprecise recording – measurement error.
  
8. Another behaviour that could be used as a measure of care is the number of times that the parent is observed feeding the larvae i.e. the number of mouth to mouth regurgitations.



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## Worksheet: Answers for teachers

- 1) Some of the behaviours that can be seen whilst observing burying beetles are listed below;
- carcass maintenance
  - grooming
  - begging
  - feeding
  - defence.

Which of these behaviours can be considered?

- a) a parental care behaviour: **carcass maintenance, feeding, defence**
  - b) an offspring behaviour: **begging**
  - c) neither a) nor b): **grooming.**
- 2) For guidance, please see the 'definition of behaviours' in Appendix 3.
- 3) Examples might include;
- Adult behaviour: locomotion, burrowing into the soil
  - Larval behaviour: self feeding, locomotion.



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# Parental Behaviour in Burying Beetles

## Appendix 1: Record sheets for Exercises 1 and 2

### Exercise 1

	Time parent spends in brood chamber (mins)		
	Enters chamber	Leaves chamber	Difference
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
			Total

# Parental Behaviour in Burying Beetles

## Exercise 2: Behaviours Observed

Time (mins)	Carcass maintenance	Processing carrion	Feeding larvae	Grooming	Absent	Other
0.00						
0.15						
0.30						
0.45						
1.00						
1.15						
1.30						
1.45						
2.00						
2.15						
2.30						
2.45						
3.00						
3.15						
3.30						
3.45						
4.00						
4.15						
4.30						
4.45						
5.00						
5.15						
5.30						
5.45						
6.00						
6.15						
6.30						
6.45						
7.00						
7.15						
7.30						
7.45						
8.00						
8.15						
8.30						
8.45						
9.00						
9.15						
9.30						
9.45						
10.00						
Total						

## *Appendix 2: Record sheets with answers for teachers*

### Exercise 1

	Time parent spends in brood chamber (mins)		
	Enters chamber	Leaves chamber	Difference
1	0	6.15	6.15
2	8.15	8.30	0.15
3	9.25	9.50	0.25
4			
5			
6			
7			
8			
9			
10			
			Total = 6.55

## Exercise 2: Behaviours Observed

Time (mins)	Carcass maintenance	Processing carrion	Feeding larvae	Grooming	Absent	Other
0.00	x					
0.15	x					
0.30	x					
0.45	x					
1.00	x					
1.15	x					
1.30	x					
1.45			x			
2.00			x			
2.15	x					
2.30	x					
2.45	x					
3.00	x					
3.15	x					
3.30		x				
3.45		x				
4.00		x				
4.15		x				
4.30		x				
4.45		x				
5.00		x				
5.15		x				
5.30		x				
5.45	x					
6.00	x					
6.15					x	
6.30				x		
6.45				x		
7.00				x		
7.15					x	
7.30				x		
7.45				x		
8.00					x	
8.15	x					
8.30	x					
8.45	x					
9.00	x					
9.15					x	
9.30						x
9.45					x	
10.00	x					
<b>Total</b>	<b>19</b>	<b>9</b>	<b>2</b>	<b>5</b>	<b>5</b>	<b>1</b>



## **Appendix 3: Definition of behaviours**

Use section 2 of the video footage to familiarise yourself with these parental behaviours.

### **Exercise 1**

#### **INSIDE BROOD CHAMBER**

This should be recorded when the parent is inside the hole in the carcass where the larvae are present (called the brood chamber). If the parent is standing over the hole and performing behaviours not associated with care (e.g. grooming) then this should be recorded as 'outside the brood chamber'.

Note: Remember that parental care behaviours are; carcass maintenance, processing carrion and feeding larvae.

### **Exercise 2**

#### **CARCASS MAINTENANCE**

The parent walks over the carcass, moving the carcass and removing pieces of unwanted mould and fungi.

#### **PROCESSING CARRION**

A parent's head is buried deep inside the brood chamber with only its abdomen visible. During this time the parent chews the carcass into small bite-sized pieces for the larvae to eat.



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## FEEDING LARVAE

Mouth to mouth contact between a larva and a parent. During this contact the larva will rise up and use its legs to tickle the parent's mouthparts.

## GROOMING

The parent moves its front legs over its mouthparts and then across its head, antennae and body. They do this to clean themselves, just in the same way as cats, who lick their paws and then rub their paws over their face.

## ABSENT

The parents are recorded as absent when they are not inside the brood chamber or close enough to the chamber to provide care.

## OTHER

Sometimes the parent just stands still and does not appear to be doing any of the behaviours mentioned previously. Such behaviours should be recorded as 'other'.



