

## Activity Plan & Guidance (KS3 & KS4)

### Learning Objectives

- Learn how levels of dissolved oxygen (DO) can be a sign of water pollution.
- Understand that the types of macroinvertebrates found in a sample of water can be a good indication of DO and water quality.

### Resources

- Water Pollution PowerPoint Presentation
- [Dissolved Oxygen Micro-lesson](#)
- Macroinvertebrate Survey

### Activity

**Starter**

- Use the 'Water Pollution PowerPoint Presentation' to introduce types of water pollution and how this affects dissolved oxygen in our canals and rivers.
- Watch the '[Dissolved Oxygen Micro-lesson](#)' to reinforce the key points.

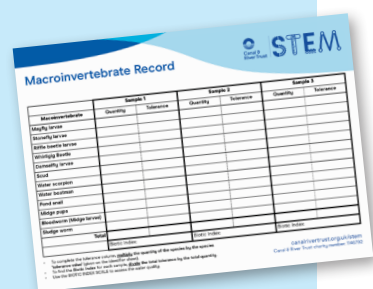
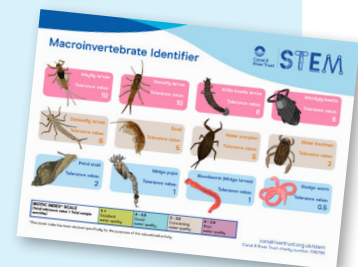
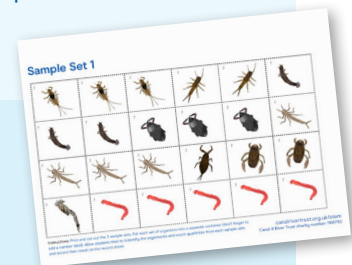
**Task prep**

1. Print and cut out the 3 sample sets from the 'Macroinvertebrate Survey' document. Put each set of organisms into a separate container (add a label) and space them around the room. (For a large class, create duplicate sample sets, for example: 2 of each set, suitable for 6 teams).
2. Display the 'Macroinvertebrate Identifier' for the whole class to see (or print one out for each team).
3. Explain that "A macroinvertebrate sample collection has been conducted at 3 different canal locations. A hand-net was swept through the water for one minute and the contents of the net were emptied into a container. We've managed to bring back the samples to the lab for investigation. We are going to see what macroinvertebrates we can identify and how they can give us an indication of water quality and DO at each location."

**Run the task**

4. Separate the class into teams and give each team a macroinvertebrate record sheet to fill in. Each team should sort through the sample container of 'collected' macroinvertebrates and record their findings in the quantities column.
5. To complete the tolerance column, **multiply** the **quantity** of each species found by their **tolerance value** (as shown on the identifier sheet). Record the answer and add up the totals.
6. To find the **biotic index\*** for each sample **divide** the **total tolerance** by the **total quality**.
7. Compare the biotic index number for each sample to the scale shown on the identifier sheet.

*\*This biotic index has been devised specifically for the purposes of this educational activity.*



## Activity Plan & Guidance (KS3)

### Activity continued

- Conclusion**
1. Ask groups to reveal their conclusions about the biotic index levels of each sample.
  2. Discuss why the results may be questionable and how the experiment could be made more accurate (discuss elements like the time of day the samples were taken also the time or year).
  3. Question: Which is a better indication of the water quality, the number of organisms or the type of organisms? Why?  
*It's not the number of organisms that is important, but the number of different species. The number of organisms found might just be a factor of collection time, whereas the number of different species able to live in the area gives a clearer picture of water quality.*

### Completed Macroinvertebrate Record

Macroinvertebrate	Sample 1		Sample 2		Sample 3	
	Quantity	Tolerance	Quantity	Tolerance	Quantity	Tolerance
Mayfly larvae	3	30	2	20	0	0
Stonefly larvae	2	20	1	10	0	0
Riffle beetle larvae	3	24	2	16	0	0
Whirligig beetle	3	18	1	6	2	12
Damselfly larvae	4	24	3	18	3	18
Scud	0	0	1	5	2	10
Water scorpion	1	5	3	15	1	5
Water boatman	2	4	1	2	2	4
Pond snail	0	0	4	8	4	8
Midge pupa	1	1	3	3	1	1
Bloodworm	5	5	3	3	2	2
Sludge worm	0	0	0	0	1	0.5
<b>Total</b>	24	131	24	106	18	60.5
	Biotic Index: = 5.46		Biotic Index: = 4.41		Biotic Index: = 3.36	

## Activity Plan & Guidance (KS3)

### Suggestions

- Try to make this survey as realistic as possible, bring in elements of scientific role-play and equipment (e.g. forceps, magnifying glass) to make the experience more realistic and memorable.
- Students could research into each of the macroinvertebrates to find out what makes them more or less tolerant to harsh water conditions.
- Ask students to research food chains and food webs containing these macro-organisms.

### Plenary

- Students could create a scatter graph to display the macroinvertebrate results of two opposing sample sites (best and worst).
- Students research or plan quick rescue solutions to the problem of low oxygen levels in canals and rivers (dredging, aeration, filtering etc).

### KS3/4 Curriculum Links

#### KS3 Science

- Analysis and evaluation (present observations and data using appropriate methods, including tables and graphs. Interpret observations and data, including identifying patterns and using observations, measurements and data to draw conclusions).
- Relationships in an ecosystem (the interdependence of organisms in an ecosystem and how organisms affect, and are affected by, their environment, including the accumulation of toxic materials).

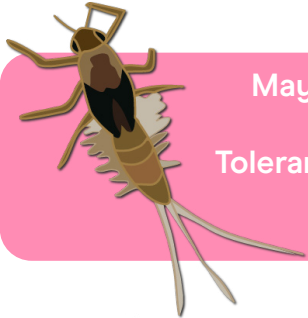



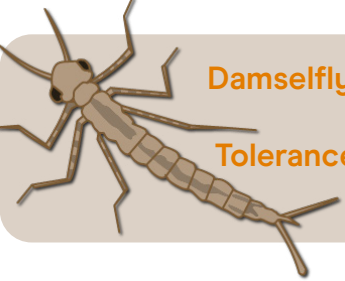







#### KS4 Science (Biology)

- Ecosystems (the importance of biodiversity and methods of identifying species and measuring distribution, frequency and abundance of species within a habitat)

### Useful links/extra resources

- [Canal & River Trust STEM learning resources](#)
- [Waterways and Wildlife: Managing our natural environment](#)
- [A Scientific Survey of the aquatic macroinvertebrates of the Montgomery Canal](#)

# Macroinvertebrate Identifier

 <p>Mayfly larvae Tolerance value: 10</p>	 <p>Stonefly larvae Tolerance value: 10</p>	 <p>Riffle beetle larvae Tolerance value: 8</p>	 <p>Whirligig beetle Tolerance value: 6</p>
 <p>Damselfly larvae Tolerance value: 6</p>	 <p>Scud Tolerance value: 5</p>	 <p>Water scorpion Tolerance value: 5</p>	 <p>Water boatman Tolerance value: 2</p>
 <p>Pond snail Tolerance value: 2</p>	 <p>Midge pupa Tolerance value: 1</p>	 <p>Bloodworm (Midge larvae) Tolerance value: 1</p>	 <p>Sludge worm Tolerance value: 0.5</p>

BIOTIC INDEX* SCALE (Total tolerance value ÷ Total sample quantity)	5 + Excellent water quality	4 - 4.9 Good water quality	3 - 3.9 Concerning water quality	0 - 2.9 Poor water quality
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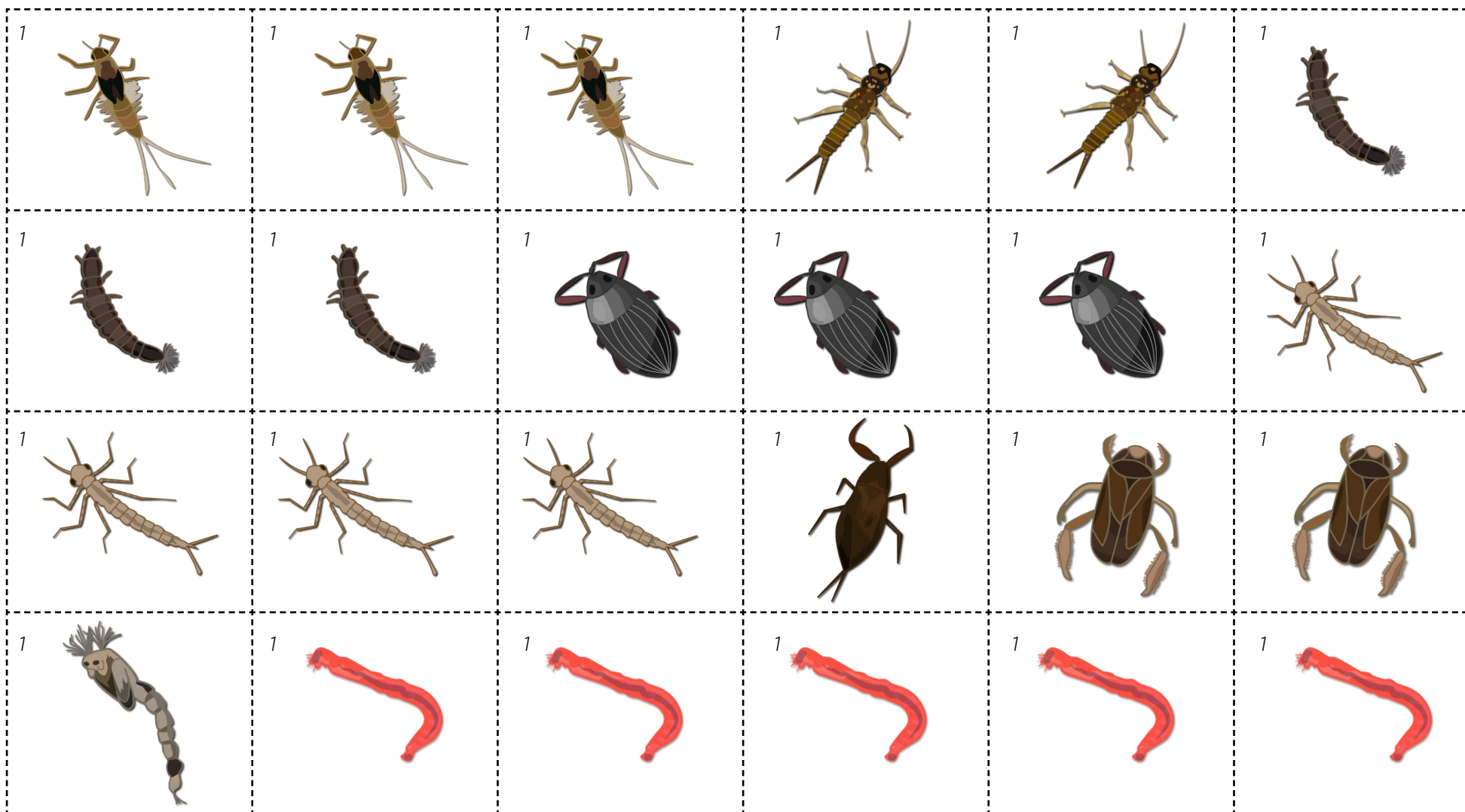
# Macroinvertebrate Record



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Stonefly larvae						
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Whirligig beetle						
Damselfly larvae						
Scud						
Water scorpion						
Water boatman						
Pond snail						
Midge pupa						
Bloodworm (Midge larvae)						
Sludge worm						
<b>Total</b>						
	Biotic Index:		Biotic Index:		Biotic Index:	

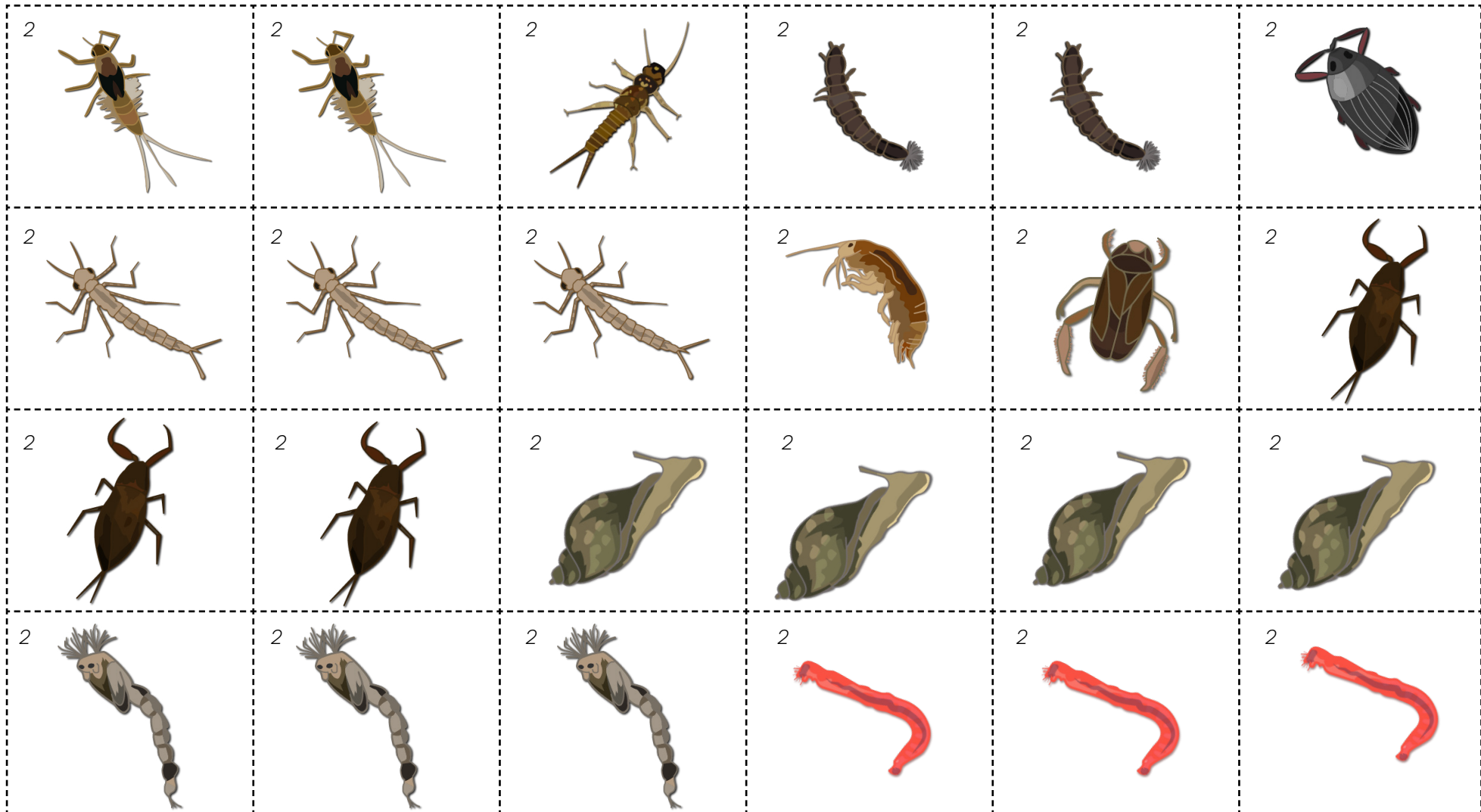
- To complete the tolerance column, **multiply** the quantity of the species by the species 'tolerance value' (given on the identifier sheet).
- To find the **Biotic Index** for each sample, **divide** the total tolerance by the total quantity.
- Use the BIOTIC INDEX SCALE to assess the water quality.

# Sample Set 1



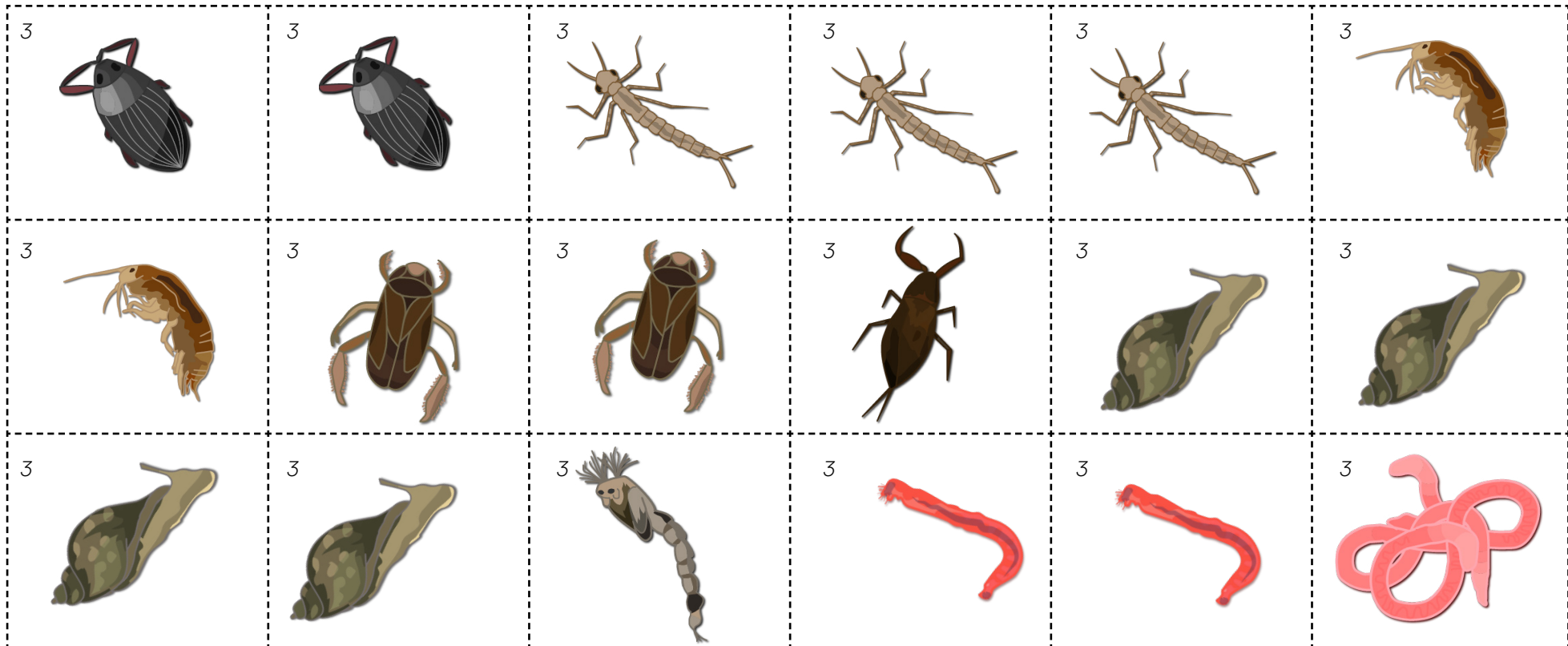
Instructions: Print and cut out the 3 sample sets. Put each set of organisms into a separate container (don't forget to add a number label). Allow students time to identify the organisms and count quantities from each sample set and record their results on the record sheet.

# Sample Set 2



Instructions: Print and cut out the 3 sample sets. Put each set of organisms into a separate container (don't forget to add a number label). Allow students time to identify the organisms and count quantities from each sample set and record their results on the record sheet.

# Sample Set 3



Instructions: Print and cut out the 3 sample sets. Put each set of organisms into a separate container (don't forget to add a number label). Allow students time to identify the organisms and count quantities from each sample set and record their results on the record sheet.