Science Show:

* (target audience – 7+ & families)

[Part 1 ~25min; Part 2 ~20 min; 3 ~15min] [60min]

# Bugs on the Brink

**Description**

Journey into the world of insects and arthropods with this interactive show, where students will venture deep into past, during the last Ice Age, compare it to today’s climate changes and investigate how it is affecting insect survival. Through live experiments, dynamic visuals, and storytelling, students will discover how these tiny creatures shape our planet’s future.

**P – Presenter**, next slide, *comments and expected responses*

# Part 1: What are Arthropods and Insects

## Introduction

**P:** Welcome to Bugs on the Brink! Let’s start off with, who here likes bugs?

*Expecting some (hopefully) positive reactions; to the negative reactions presenter should answer that, this, is because we don’t know them yet, and during this show, we’re going to get to know them.*

**P:** And do you know what “on the brink” means?

*Expecting answers on the lines of “in danger/trouble”*

**P:** So today, we’re going to get to know some bugs, what they do, and how they are in trouble. Before we start, who here likes animals?

*Expecting a lot of raised hands/“yes”*

**P:** Can you name some animals? *(we want to deviate from “bugs” at the moment)*

*Expecting dogs, birds, fish etc (even starfish, worms, and jellyfish is good here)*

**P:** These *dogs, birds, and fish* *(whatever they mention)*, make up only a small part of the Animal Kingdom *(refer to animal groups slide).* This circle shows all the animals in the world. This small part here (*points to vertebrates*) is all the *cats, dogs, birds, fish, ….* and all of these (*wide gesture to the arthropods area*) are all the “bugs”… but there is something wrong with this word. Can you tell me what you think of when you hear the word “bugs”?

*Expecting**bugs, ants, bees, crickets, butterflies, flies, mosquitoes, etc… (some may mention spiders, scorpions, millipedes) – someone might mention “creepy crawlies”*

**P:** You see, bugs can be very confusing, because it only refers to a small group of insects. All of these animals we (usually? Incorrectly?) call bugs, actually have another name – they are called **Arthropods**! Say it with me! Arthropods!

## What are Arthropods?

**P:** If we are going to get to know them (and stop calling them creepy), we need to recognise them.

(arthropod characteristics slide)

**P:** All Arthropods have these three common features – and sometimes they are difficult to spot! The first one, is their jointed legs *(use model arthropod leg)* – they are made of multiple hard parts with a joint *(points to joints)* in between each that allows them to move. *This is what the name Arthropod means, jointed foot.*  *[consider bringing up volunteer to hold the leg]*

**P:** The second one is that they all have a tough outer shell *(use the arthropod leg*), but inside they have no hard parts *(show inside of leg, then set it back down)*. We, people, are soft on the outside, but what do we have inside? *(stand next to skeleton to encourage ‘skeleton’ as an answer)* that’s right a skeleton! We have skeleton **inside**. But this hard outer part is the skeleton of an arthropod, and we call it an exoskeleton.

**P**: The last one is that their bodies are split into multiple identical and repeating parts *(refer to segments slides [x3])*. These are called segments. Do you see how the centipede looks like it’s made of repeating blocks? Then when we look at the bee, look at its stripes, they are hiding the segments. Sometimes, like the bee, these are collected into larger groups — like the head, thorax, and abdomen, in insects – these are called **major segments**. And in some animals, like the beetle, we can only see these stripes/segments when they’re upside down.

## Photo Quiz: Arthropod or Not?

**P:** Now that we know what our new friends look like, let’s play a game of who’s who! And for this I am going to need four volunteers. *(explain to volunteers that they will hold up four laminated images and the audience needs to identify which ones are arthropods and which are not, and have the arthropod characteristics slide up as a helpful reference – send arthropods to one side, and the rest to other after guessing – can be increased to 6 if needed)*

## The Four Arthropod Groups

*Added the 4 groups reference slide from the end of the section (this is not in the video)*

**P:** Thereare four types of Arthropods– let’s look at them one at a time.In the beginning of the show, some of you mentioned **insects**. Can anyone tell me how we can recognise an insect from other arthropods? *(show insects slide)*

*expecting (or guide to)* ***3 pairs of legs/ 6 legs****,* ***1 pair/2 antennae****, 3 major body parts [head, thorax, abdomen], and big, bumpy* ***compound eyes – these are made of thousands of tiny eyes shaped like hexagons (ask what shape this is before saying it) – and put on insect eyes mask – they see less detail but are better at detecting movement***

**P: This one may be familiar as well… how many of you have heard of arachnids? *(show arachnids slide)***

***expecting yes from some, and others may shout out spiders and scorpions***

**P: And who can tell me how to recognise an arachnid?**

***expecting*** *(or guide to)* ***4-pairs of legs /8 legs****,* ***no antennae****, and many* ***simple eyes – not like those of insects – put on spider eyes mask – these can be very different in their quality of vision, depending on the arachnid (e.g. many jumping spiders have excellent sight)***

**P: This next group has a very strange name, but I am sure you’ve seen some of them. Who here has seen a centipede or a millipede? *(show myriapod slide)***

***expecting yes from some (the name is given away on the slide, but this is not an issue, showing the photos is more important)***

**P: This group is called myriapods, which means many legs, and** they all have **many, many legs, a long body**. And do you know which one is a centipede, and which one is a millipede?

*expecting uncertain response – here’s some information that can be given depending on how engaged the audience is – centi means hundred, and milli means thousands, so millipedes have a lot more legs. Also, if we look closely, we can notice that* ***centipedes have one pair of legs on each segment, while millipedes have two.***

***if audience asks about the eyes, some individual species of this group have*** *simple eyes and others have compound eyes*

**P:** The last group are called crustaceans. Can you name the ones here, or any others that you know? *(show crustacean slide)*

*expecting lobster and crab from picture, some may mention shrimp/prawns*

**P:** The crustaceans come in lots of shapes and sizes, they have many legs, some have many antennae, but they are mostly aquatic. Because of these different features, it’s sometimes difficult to tell if an arthropod is a crustacean without ruling out the other 3 first. *(fun fact – pill bugs/woodlice are an example of land-based crustaceans)*

## Photo Quiz: Arthropod Groups

**P:** So, let’s see if you can tell arthropods apart. I need eight volunteers. We’re going to have another quiz game, but this one will be a speed round. *(as before, the volunteer show the images to the audience, the presenter guides, and the audience guesses. Line up the volunteers in a single file, and go through the images – keep reference slide up for help)*

*Insect (mosquito), crustacean (crab), arachnid (spider), insect (shield bug), myriapod (millipede), crustacean (mantis shrimp), insect (beetle), myriapod (centipede)*

# Part 2: The importance of Arthropods

## Roles of Arthropods

**P:** Now that we got to know the Arthropods, we need to know what they do. Do you know that arthropods have jobs?

(have a little fun with jobs, by telling the audience, not accountants or teachers)

**P:** Let’s try and figure out what these jobs are! I need 4 volunteers *(picks 4 audience members to come on stage; they are given a coloured bucket each [green-herbivore, red-predator, yellow-pollinator, brown-decomposer])*. Each one of you must look for cards like these around the room with the same colour as your bib and put them in these paper bags. Ready? Go!

*volunteers hunt for their items [maybe 3-4 each] and come back to the centre of the stage*

**P:** Let’s see what you have found.

## Herbivores

**P:** First up, green. What did you have to collect?

*volunteer shows bag with cards showing pictures of leaves*

**P:** This was the job of a **herbivore**! Like these. (*shows herbivores slide*). Herbivores eat plants, and they can be useful get rid of weeds.

## Decomposers

**P:** What about brown, what have you collected?

*volunteer shows cards with brown leaves, dead insects, and poop emoji (possibly yuk reaction from audience/volunteer)*

**P:** We call animals with this job, **decomposers**! (*shows decomposers slide*) They eat dead plants, animals, and even poop! – they are the cleaners of the animal kingdom! Decomposers are very important because they break down dead and waste material into small parts – so that the nutrients can be more easily recycled back into the soil, helping new plants grow.

## Predators

**P:** What about red? (*checks bag, with other insect pictures; shows predators slide*) This was the job of a **predator**! Now, predators may seem a scary because they eat other animals, but they are very important too. They control the population of the herbivores, otherwise they will eat all the plants!

(Presenter refers to photo of the ladybeetles)

**P:** Here’s a fun fact: what some people call a ‘ladybug’ or ‘ladybird’ is actually a **beetle**! So it’s better to call it a ‘ladybeetle’ instead.

## Pollinators

**P:** Finally, let’s look at yellow (*collected flowers; shows pollinators slide*), these animals are a **pollinator**. Pollinators visit flowers to drink their nectar *(which is a sugary liquid that provides them with energy)*. While doing so, pollen gets stuck to their bodies, helping plants make fruit, seeds, and nuts! Can you name the pollinators on the screen?

*expecting butterfly and bee*

**P:** Exactly! Bees and butterflies are great examples of pollinators. But did you know they aren’t the only ones? (*shows more pollinators slide*) Other insects like **moths**, **wasps**, **flies**, **mosquitos**, and even **beetles** are important pollinators too!

(thanks volunteers and sends them back to their seats)

## The Scales of Life: Food Chains and Ecosystem

**P:** Let’s take a look at how all these jobs fit together. (***shows first food chain slide***) Here’s a simple food chain. The plants are eaten by herbivores, and those herbivores are eaten by predators. But does that mean, that all the herbivores are eaten by the predators?

*(guide the audience to a “no” and move to the scales)*

*(use ratio of 1 cuboid blocks to roughly 6 small marbles – sometimes its 5 – don’t ask why)*

*(suggested: use of 3 cuboid blocks; blocks for flowers and ladybeetle,*

*marbles for aphids and bees)*

**P:** Now, nature isn’t just made up of one chain—there are lots of different chains working together. (*shows second food chain slide*)

**P:** Let’s look at this relation more closely. Do you know what these are? (expecting scale balance) We’re going to call these, **the scales of life**.Let’s say I’m a farmer, growing a lot of plants. Plants attract herbivores *(point at food chain)*, like a type of true bug called aphids *(attaches aphid card)* – these are herbivores that steal nutrients and hurt the plants. If we have a lot of plants, we’re going to attract a lot of these pests. *(adds marbles to represent aphids.)*

**P:** Now that we have so many pests, look at the tree of life in the middle, its going to fall! How can we fix this? Is there any arthropod friends that can help us?

(expecting predators, or more specifically ladybeetle.)

**P:** That’s right—predators! In this case, ladybeetles, can help us control these pests! So let’s add predators to the other side of the scale *(add ladybeetle card, and blocks)* – like this we balance things out again, the tree of life is straight, and our plants remain healthy.

**P:** So now that thefarmer no longer needs to worry about pests, he starts growing loads of plants. But before they make fruit, they make (*pause to encourage audience to say flowers*) flowers *(adds card and blocks)*. But the flowers alone won’t make the fruit. What else do we need? *(expecting pollinators)*

**P:** Exactly, we need pollinators! So, let’s label the other side of the scale with pollinators.

(Label scale, and presenter adds marbles to balance the scale)

**P:** If we don’t have enough pollinators for all our plants, the scale is not balanced—and that means less fruit! But if we add enough pollinators, the scales are balanced, the tree of life won’t fall, and the farmer is happy! This is why it’s important to have lots of bees, butterflies, and other pollinators working together. *(just in case – too many pollinators means that there isn’t enough food, and pollinators will starve)*

# Part 3: Habitat Changes

## Photo Difference Exercise: Exploring Ice Age Malta

**P:** Now that we got to know the arthropods and learned about their jobs, where do they go at the end of the day? (*expecting “home”)* And where is home? Where do they live?

*expecting in the soil, trees, plants, in the air – basically everywhere*

**P:** This is where we can find them (*shows slide with panorama of Xrobb l-Għaġin & Ġebel Ciantar*), in the soil, trees, plants, in the air – basically everywhere. The photos you are seeing are of two places in Malta: the first one is called Xrobb l-Għaġin in Marsaxlokk, and Ġebel Ciantar in Siġġiewi. Do you see any arthropds here?

*Allow time for audience to familiarize itself with the images and expecting a no – because they’re too small*

**P:** Although we can’t see them, they’re in the bushes, the soil, even cracks in the walls. These are their homes! But did you know that their home didn’t always look like this?

**P:** Let’s see a show of hands, how many of you have been to Għar Dalam?

*Interact with audience to establish a familiar point – follow up by asking who has seen the elephants – and does that mean that there were once elephants in Malta? – yes*

**P:** A very very long time ago, even before people lived in Għar Dalam, there world was very very different! *(show ice age art slide [x2])* This is what these same places could have looked like back then.

**P:** But it looks so different! Shall we find what was different together?

*Audience points out the main differences and we comment briefly on these differences*

*From Xrobb l-Għaġin point out:*

* ***more land*** *during the Ice Age – there was so much frozen water in the world that the sea level was much lower than today. Malta was connected to Filfla, Gozo and even Sicily!*
* *more* ***vegetation*** *- Because it rained so much more*

*From Ġebel Ciantar point out:*

* *some* ***snow*** *on plants - Malta had a much colder climate -* and we call this time The Ice Age! *(consider asking audience who has watched the Ice Age movies)*
* ***storm*** *on the horizon—more rain back then*
* ***no people****! Humans hadn’t arrived in Malta yet, so no roads, no buildings, no walls.*

**P:** So if Arthropods live in these places now, do you think they also lived there back then?

*Expecting a big yes – ask if there are more or less bushes and soil – yes there is*

**P:** so this was a better home for them. What happened? How did it change?

*Allow a moment to attempt to get the word ‘climate change’ or even ‘the weather changed’, or maybe ‘the world became warmer’*

## Weather vs. Climate

**P:** Before we said that the world used to be colder – so now it’s warmer! The weather and climate have changed! – *if no one mentioned weather/climate – we ask if anyone has heard of these terms*

**P:** We need to make sure not to confuse the two. Weather and climate are not the same—weather is what’s happening right here, right now! But climate is what we expect to happen over a long period of time.

(Shows climate gif of a dog on a leash – presenter explains during)

**P:** If we picture a dog on a leash, the dog is changing its direction quickly, just like the weather, sometimes is hot, sometimes its cold, then warm again. But the dog cannot go too far from the person holding the leash—that’s the climate. So, while weather changes day-to-day, the climate tells us what to expect over the years, and changes very slowly!

## Demo: Carbon Dioxide

**P:** So, if the climate can change slowly, what makes it change?

(expect comments on climate change sources – volcanoes, people, cars, gasses, etc, but the answer we’re looking for is anything that leads to greenhouse gasses or carbon dioxide)

**P:** Has anyone heard of carbon dioxide and greenhouse gasses?

(expecting a yes by some)

**P:** Greenhouse gasses are special kind of gasses that trap heat and warm the air. Carbon dioxide is one of the most common of these gasses - and it’s all around us. Can you see it? (*allow for audience to look around*) Maybe someone can smell it? (*allow for answers)* So how do we know it’s there? I think, maybe there is a way we can prove it’s there - Let’s do a little experiment to find out more.

(moves tables 1&2 out of the way, moves to experimental setup)

**P:** Alright, I’ve got this conical flask, and we’re going to add some baking powder—this is the same stuff we use to bake cakes! Now, I’m going to add some vinegar. What do you think is going to happen?

(Wait for audience responses)

(presenter/volunteer adds vinegar to the baking powder, and the mixture bubbles vigorously)

**P:** Look at all those bubbles! Do you know why this is happening? A gas is being produced and it’s trapped in the bubbles. Even when the bubbles burst, the gas should still be there, in the flask. If we test it with a lightened split, the fire goes out. I’m also going to try to tilt this flask over the candle… Let’s check… Watch closely!

(presenter tilts the flask and pours the invisible gas over the candle, which goes out)

**P:** Look at that! The candle went out! That means that invisible gas is carbon dioxide. Even though we can’t see it, it’s there, and it just put out the flame! So what does it do to the Earth (*moves to inflated globe*)? If there’s too much carbon dioxide, it acts like a blanket (*puts blanket on globe*) and it gets hotter. Imagine putting a blanket on in the middle of summer!

## Map Exercise: Where does Carbon Dioxide Come From?

**P:** So, if carbon dioxide warms the air, where do you think it’s coming from?

*Allow time for audience to give some answers, such as volcanoes, cars, planes, etc.*

**P:** Wow, there’s so many! Let’s try and picture them on this map of the world. I am going to need some help…

(presenter moves toward a board with a world map, and picture cards piled on the side)

(one at a time, the presenter attaches picture cards on map and tell the audience what they are – sources: **cars**, **planes**, **fossil fuel power station**, **volcanoes**, **cows** – each card has a red border)

## Putting everything together

**P:** Oh my! That’s going to release so much carbon dioxide! No wonder it feels like the Earth is under a blanket.

**P:** Do you remember the pictures from the Ice Age? This is what Malta would look like in the future with all this warming.

(presenter shows global warming landscape [x2] slide)

**P:** Is it still green? (*expect no*)— there’s less plants, it’s hotter, and drier! So what’s going to happen to the arthropods? Do you think they’ll be ok?

Expecting no

**P:** That’s right, the warming earth, changing climate, and even human activity, will destroy the homes of the arthropods. And when their homes are gone, they will start to die (they already started to die). And what will happen then? Who can tell us?

(expecting answers related to less pollinators, less plants/fruit/food)

**P:** If the climate keeps changing, the pollinators won’t have a home, the herbivores won’t have plants to eat, the arthropods could even disappear. And if butterflies disappear, what happens to the scales of life?

(presenter moves back to scale, and removes marbles from the pollinator side of the scale)

**P:** We won’t have enough pollinators for our plants, the tree of life starts falling, and we won’t have food for everyone.

## What Can We Do?

**P:** Is there anything we can do to stop this?

(possible good answers – stop climate change, stop releasing carbon dioxide – but we may also no get any answers)

**P:** Let’s go back to the map… don’t you think we have too much red here? What if we change some of these red cards with something that doesn’t make carbon dioxide? Could this work?

*Expecting yes*

**P:** I have here some green cards instead, who’s going to come help me put them on the map?

(one at a time, volunteers take some red cards away and replace them with green cards. The presenter explains what each card is – e.g. power plant pictures with solar panels/wind turbines/etc.; cars with buses; planes with trains – all the new cards have a green border)

**P:** Thank you for helping me! Do you think we will be able to help our new arthropod friends this way? (*hopefully audience says* yes – *fix the scale balance – and remove the blanket from the earth*). But until this happens, we’re going to need all of you to help protect them. Although they are very small, they are still very important. And even if some of us might find them a little scary, they are still doing their best to help us.

**P:** What have we learnt today?(**Summary Questions**)

* Arthropods are animals with jointed legs, hard exoskeleton, and segmented body
* The 4 groups of arthropods are insects, arachnids, myriapods, and crustaceans
* They have very important jobs which include:
  + herbivores, decomposers, predators, pollinators
* If one of these jobs isn’t done, we get an imbalance in the scales of life/nature,
  + which effects our food production
* Arthropods live in the soil, bushes, trees, near water
* Their homes have been changing due to climate change
* Climate change is caused by release of greenhouse gasses like carbon dioxide
* We can stop/slow these changes by changing the systems that release these gasses:
  + E.g. cars, planes, power plants, teaching,…

**P:** And lastly, let’s check again, who likes bugs after this show?

*A simple evaluation exercise to see if you get more raised hands*

**Cheat Sheet**

**Part 1 – What are Arthropods?**

* Bugs/creepy crawlies
* Animal groups
  + 5% vertebrates
* Arthropod characteristics
  + Game
* Arthropod types
  + Game

**Part 2 – What do Arthropods do?**

* Arthropod Jobs
  + Bucket game
  + Herbivore
  + Decomposer
  + Predator
  + Pollinator
* Food Chain
  + Scales of life
    - Aphids/predator
    - Flower/pollinator

**Part 3 – Arthropod Home & Climate Change**

* Where do they live?
  + Ghar Dalam
  + Home Changed
    - How?
    - Why?
* Greenhouse Gasses
  + CO2
  + Experiment
  + Blanket
* Where is CO2 coming from?
  + Map & red cards
  + Scales of life + blanket
* What can we do?
  + Volunteers & green cards
  + Remove blanket
  + Fix scales of life
  + *we’re going to need all of you to help protect them. Although they are very small, they are still very important. And even if some of us might find them a little scary, they are still doing their best to help us*

**Resources List** (*in order of use*)

* Part 1:
  + Arthropod Leg [***FRAGILE***]
  + Skeleton
  + Game: Non/Arthropod laminates [*Labelled #1*]
  + Arthropod masks (*Insect & Spider*)
  + Game: Arthropod groups laminates [*Labelled #2*]
* Part 2:
  + Treasure hunt game:
    - 4 coloured buckets (*green, blue, red, orange*)
    - upvc cards (*9 [3 unique images] for each colour, use 6*)
  + Scales of life:
    - Scale balance
    - Laminated tree image
    - 4 laminated cards (*aphid & ladybeetle, bee & flowers*) w/Velcro
    - 3 blocks
    - 18-19 marbles (*not all marbles weigh the same*)
* Part 3:
  + CO2 experiment:
    - Conical flask (*5L*)
    - Baking soda (*5-6 heaped teaspoons*)
    - Vinegar (*eyeball 100-200 ml*)
    - Splint/s
    - Candles (*multiple*)
    - Matches/lighter
  + Inflatable globe
  + Sheet/blanket
  + Map of Greenhouse gas sources:
    - Large whiteboard
    - Large world map
    - 4 strong magnet bars (*caution: edges can scratch map,* *repurposed from used lift, may be hard to replace*)
    - Magnetized cards (*18 red, 18 green [9 unique images per colour], no need to use all – extra magnets in box*)