HANDBOOK

ANTQUARIUM

GLOBUS EDUCATIONAL

INTRODUCTION

There's nothing more exciting than owning, studying, and taking care of animals. And ANTQUARIUM will let you do just that with one special kind of animal: ants. With ANTQUARIUM you'll discover a lot about nature's secrets. You'll be able to watch ants as they build a complex system of tunnels, creating a beautiful gelscape at the same time, observing how they react to a new environment. You'll enjoy hours and hours of entertaining fun and excitement with ANTQUARIUM. Everything you need to observe ants is included with your ANTQUARIUM:

ANTQUARIUM HABITAT,
ANTQUARIUM GUIDE
WOODSTICK, ANT CATCHER,
MAGNIFYING SHEET.

The ANTQUARIUM guide provides step-by-step instructions for putting together your ANTQUARIUM habitat and taking care of ants. It also includes lots of information about ant research, physiology and lifestyles and how to keep a journal and conduct experiments. Ants are truly fascinating to observe. And you'll soon discover that the ANTQUARIUM is the perfect habitat to do so!

GENERAL INSTRUCTIONS

Provided with the Antquarium are the tools to capture ants for it. Use the stick and collection vial to catch ants from your yard or garden. Find ants and simply place the stick near the ants (or their anthill). The ants will climb on to the stick, then gently tap the stick into the specimen vial. Close the lid and capture more. You can also use the collection vial directly to capture ants. Open and lay it on the ground near the anthill. When ants crawl in, just close the lid!

It is important to capture ants from the same colony. Ants from different colonies will not live together, fighting to death if placed in the Antquarium together. So once you find an anthill, work to collect ants only from that source. It is recommended you place only 12 to 20 ants in your Antquarium. ***(You may also order ants from Globus. Visit www.antquarium.it/usa to do this. A small handling & postage charge applies).***

Once you have collected ants in your vial or received a vial of ants in the mail, open the lid of your Antquarium. Use the stick to make four holes down into the gel, each 1" (2 to 3 cm) deep, evenly space apart. This will help the ants to begin their tunnels.

Use the stick to guide the ants from the vial into the Antquarium. Work quickly, gently tapping the vial against the inside of the Antquarium. **USE CAUTION:** Some ants sting. Be careful not to touch them and as a precaution, it is recommended that you wear gloves.

Once inside your ants are inside your Antquarium, close the lid. Ants will climb up the sides of the Antquarium and out if it is left open for too long.

Ants can take time to adjust to your Antquarium. They may not start tunneling right away. It can take several days for them to become accustom to their new environment and to start burrowing.

Never place your Antquarium in bright sunlight or somewhere

that is too hot or cold. A room temperature of between 65°F and 80°F is best. Sunlight can quickly elevate the internal tempter of the Antquarium. Best to keep it in a shady part of your room.

Your ants will never need food or water as the Antquarium's gel is scientifically designed to be their source of food and water as well as their habitat.

When you're not observing the ants, use black paper to cover the bottom half of the Antquarium habitat. This simulates the darkness of their natural underground environment, making it easier for them to build tunnels.

Open the lid of your Antquarium for a few minutes every 30 days, this will allow fresh air into the Antquarium and make your ants extra active.

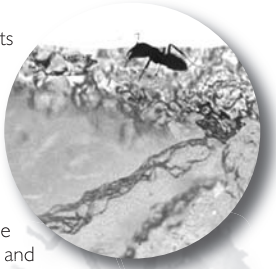
Never place other insects or objects into the Antquarium, this will damage or destroy the delicate habitat and harm your ants.

IMPORTANT: *Your Antquarium is made use a natural gel with an alimentary colouring agent. Occasionally, the gel will begin to grow mould. This mould is often caused by a bacterium that is introduced into your Antquarium from human hands, dirt or debris. It is important to remove the mould to keep your Antquarium and ants healthy. Simply scoop the infected gel out with a stick or knife. Once the mould is removed, your Antquarium will continue to function perfectly.*

Ants normally live up to six months. Some ants may die while in your Antquarium. When an ant dies, the worker ants will clear the tunnels and bring the ant to the top surface. When all the ants dies, use a clean cloth to remove the dead ants and gel they excavated from their tunnels. You may then insert new ants into your Antquarium, but be sure to remove all debris from the surface before inserting new ants.

While the gel in your Antquarium is non-toxic, never touch the gel with your hands or place it in your mouth.

IS IT IMPORTANT TO STUDY ANTS?



Entomologists are scientists who study ants and other types of insects. They study them to find out which ones should be controlled since they might be harmful to humans and which ones could be used to make our world a better place to live in. Observing insects and analysing their behaviour might also help us to discover more about ourselves. Watch your ants and become an amateur entomologist. You won't believe what incredible feats of engineering these little creatures are capable of!

The Earth has more than 4,600 kinds of ants. Ants can be found everywhere: from the coast to the tallest peaks, and from decomposing tree trunks to your kitchen.

You'll be truly amazed at what ants can do. They can excavate and create an extensive network of catacombs that are sometimes even up to fifteen feet deep. They can pick up and carry objects weighing several times their own weight. Ants can clamber up trees that are as much as a 100 feet (30.5 metres) tall. If you could move as fast as ants, you'd be able to run 65 miles per hour (104 kph)!

One of the most interesting things about ants is that they work together. Ants cannot survive alone. Like us, they live in communities. They cooperate with each other to build their homes, forage for food, care for the queen and the young ants, and protect their habitat. Others have to be prompted to get things done. Ant colonies wage battles against other ant colonies and, just like in human wars, lots of ants are either killed or injured.

ANTS IN SPACE EXPERIMENT

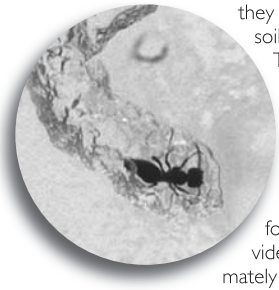
Although the harvester ant, Pogonomyrmex occidentalis has been subjected to the microgravity environment during a series of parabolas on board the Novespace Airbus 300 in December 2000, no experiments have been conducted with these animals on orbit. The objective of this experiment is to observe and characterize the effects of space flight on the tunneling behavior of harvester ants during a 16-day long space shuttle flight. Particular attention will be focused on theactivity level of the ants and their social interactions. Upon their return, the ants and their tunnels will be examined and compared to an equivalent colony kept under similar environmental conditions on the ground. Laboratory experiments using the life support system design and methodology described below have verified that queenless ant colonies can be maintained for extended periods with no addition of food or water, and minimal gaseous exchange. Colonies have been maintained for over eight months in Globus International partner's laboratories and are still living at the time of this article. Upon completion of a successful flight test as provided by the STS-107 shuttle mission, a system will be complete that allows for long-duration maintenance of ants on orbit for months on ISS, with the possibility of use with other insect species. Experimentation with alternate insect species has not yet been done.

Hardware Design

The containment hardware for the ant experiment has external dimensions of approximately 11.113cm wide (4.375 inches), 1.27cm deep (0.5 inch), and 18.415cm in height (7.25 inches). The volume is composed of a larger rectangular area containing the agar/food gel, and a smaller side passageway providing an area for depositing tunnel material. A small space in the wall separating the two sections allows the ants to access the gel for tunneling. The vent slots on the outer sidewalls have a membrane cover, which will keep the ants inside while allowing air to enter the habitat and thus controlling the humidity. A small chamber or nest attached to the outer passageway keeps the ants from tunneling until they are released on-orbit by a crew-activated plunger mechanism.

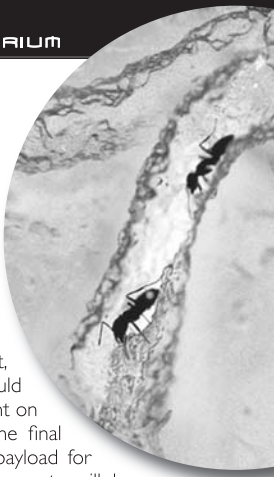
Wetware and gel

Workers of the Harvester ant species Pogonomyrmex occidentalis will be placed into a single experiment enclosure. P. occcidentalis was selected, as it is a very hardy species, thriving in broad temperature and humidity ranges, and typically lives up to one year in the wild and have been maintained for eight months under laboratory conditions in the Globus International partner's facilities. Additionally, these ants are advantageous because they are large, allowing for good visualization of the ants, their behavior, and their large tunnels. The tunneling medium is an agar-based gel. Numerous tests were performed with several types of standard captive ant tunneling media, such as sand, soil, pumice and vermiculite. With all of these media the tunnels risk collapse due to the vibration of landing, and tend to be prone to fungal infection if an ant dies within the habitat, or from food molding. The agar gel was chosen as the tunneling medium as it is firm enough to maintain integrity during launch and landing vibrations, and provides fungus and mold suppression through inhibitors in the gel. The gel is provided by Globus International partner's. The ants tunnel through the gel in a similar manner to the way



they would tunnel through sand, soil or other standard medium. The workers bite off pieces of medium and carry it out of the tunnel, placing it outside the tunneling medium area, as they would with pieces of sand. The gel is colored to provide contrast with the ants for easier visualization with the video. A starter tunnel of approximately 1cm in depth is provided in the gel to stimulate the ants to commence tunneling once inserted into the tunneling area of the habitat. The agar gel contains sucrose to stimulate the ants to eat it. Amino acids, vitamins and minerals are added to the gel to provide an appropriate diet for the ants. As the agar gel is largely made up of water, the ants also receive all their water from the gel as they eat it. Both the metabolizing of the gel by the ants, and the evaporation of water from the gel provides humidity within the tunnels. Adequate ventilation in the habitat ensures that no water collects within the tunnels or habitat area. Unlike the sealed systems based on the ABS design, the ant system depends on limited gas exchange with the cabin atmosphere for removal of CO_2, supply of Oxygen and removal of water vapor. Gas exchange occurs through Millipore brand 0.5-micron filter paper. Six openings of 6mm diameter each with a filter are distributed across the headspace of the system. Distributed openings reduce the chance that gas exchange will be precluded by the ants depositing gel over the openings.

The gel provides disease control by suppressing fungal and mold growth – the primary cause of death in captive colonies after desiccation. As the animals tunnel through the medium and eat it, the mold inhibitor contained in the gel eradicates mold and fungal spore, which also prevents the ants from being a source of infection in the case of the death of one of the workers.



Experiment Samples and Materials

Ten days prior to integration of the experiment into the GBA-ICM, the ants are placed onto a diet of agar gel, similar to the gel used for the flight medium. This ensures that the exterior of the animals' exoskeletons and their digestive tract, are free of fungal spore that could later contaminate the experiment on orbit. Several hours prior to the final integration of the experiment payload for the shuttle launch, the harvester ants will be placed into an activation chamber, located within the experiment habitat, to maintain them separated from their tunneling material. A small amount of the agar gel is placed in the activation chamber to provide food and water for the time the ants remain within the activation chamber, which is expected to be approximately 43 hours under a nominal launch scenario. Once on orbit the activation chamber will be opened by a crewmember, thus activating the experiment and allowing the ants to have access to the experiment volume. Video and still images are recorded daily of the ant habitat. Students at the participating schools maintain ground control habitats in their classrooms, and compare the ant tunneling and activity to that of images of the on orbit ant habitat. High fidelity ground control habitat is maintained within a GBA-ICM at the SPACEHAB Astrotech Facility at Cape Canaveral for the duration of the nominally 16-day Shuttle flight. Three to four months prior to the launch date, a full ground-based experiment will be performed under flight like conditions within the GBA-ICM at BioServe to verify proper functioning of the hardware, wetware and protocols.

ANT DISCOVERIES

People have been wondering about how ants communicate with each other for a long time. Benjamin Franklin conducted experiments with ants to find out how they let each other know where to find food. Since then, many more interesting things have been discovered. Did you know that ants have special glands that make chemicals? These chemicals, called pheromones, make other ants change they way they act. Everyone has seen a large column of ants walking along the same path. Well, they're probably following the pheromones that were put there by an ant from their colony!

Amazingly, ants can find their way home even when they're far, far away. Entomologists have determined that some ants can use the sun to find their way home - even on a cloudy day. Experiments have been conducted to discover if ants can see colour. The results of those experiments aren't conclusive. One entomologist discovered that ants can discern the differences in certain shapes. In fact, ants seem to like vertical stripes more than horizontal ones.
Can ants learn? You've probably heard that scientists put rats in a maze to see if they can learn how to find their way out. But did you know that scientists have also tried to find out if ants can learn to complete a maze? Some ants are very good at finding their way out. The ants that have to look for food and then find their way back to their anthill can also find their way through a maze. Could pheromones be the reason why they did so well?

An entomologist conducted a remarkable experiment to determine if ants could solve a problem. He made a small island of dirt, surrounded it with water, and then put some ant pupae (young ants) on it. To save the pupae, the adult ants threw dirt on the water until they had built a bridge and were able to bring them home. That same entomolo-

gist then tried another experiment. This time he made an island without any pupae on it. But even without any pupae, the ants still threw dirt on the water! The scientist discovered that ants have a tendency to fill in water with dirt. Experiments and data sheets are included in this guide so that you can conduct some experiments with your ants just like an amateur entomologist. Don't forget to take good care of your ants because they're truly amazing animals!

ANT JOURNAL

Scientists jot down all their observations, experimental results and discoveries in notebooks that are called journals. It's a very good way for them to remember what they saw and when they saw it. It's fun to keep records in a journal! To make your own journal, just use a regular notebook or bind paper in a homemade cover to make your own.
To keep your journal, do the following:
1- make up a title for your journal and write it on the cover together with the date and time that you put the ants into the ANTQUARIUM habitat.
2- record the date and time each time you begin observing your ants.
3- list the equipment that you use, such as a magnifying glass, paper, stones, or other items.
4- make observations about ant activities and write them in your journal. Try to answer questions like: do ants sleep and if so, where? How many are working? How do ants react when they are in groups? How many ants die? Take notes and/or draw pictures. If you conduct an experiment, describe it in detail in your journal.
5- use a piece of string to measure the length of the ant tunnels from outside your ANTQUARIUM. How many inches or centimetres of tunnels do you think they can dig in one week?

Draw an ant here

ANT ACTIVITES

ANT ACTIVITY # 1
Observing the body of an ant
You can learn a lot about an ant's body by looking at it very closely. Take one of the pages of your journal and do the following:
• Draw a picture of an ant's head and show all the parts. Don't worry if it's not very artistic. See what different things are on its head. Try using the magnifier.
• Draw a picture of its middle part. What's connected to the middle part?
• Draw a picture of the back end of the ant's body. Does it have any markings?

ANT ACTIVITY # 2
Pheromones
As we already mentioned, pheromones are chemicals that one ant gives off to make other ants act in a certain way. Did you notice that your ants move their dead companions to a garbage pile away from their tunnels. There is a specific pheromone that tells them when ants are dead. Ants will move a live ant to the garbage pile if you put a chemical called oleic acid on it. They will continue to carry that poor ant to the garbage pile until the smell of the oleic acid has completely worn off. There's a simple way to find out how pheromones work. Tap on the habitat glass using your fingernail. One ant will notice it first and give off an "alarm" pheromone that the other ants will detect. Then other ants will get very excited and come running to find out what's happening! Use a small stick to tap lightly on the frame. Observe how many ants come running.

ANT ACTIVITY # 3
Ant's vision
As we already mentioned, entomologists have determined that ants seem to like vertical (up and down) stripes better

than horizontal (side to side) ones. Try this experiment and see if you agree with their conclusions:
copy the squares shown below and tape them against the outside of the ANTQUARIUM frame. Observe the ants for five or ten minutes and then fill in the chart below. Put a check in the right box for each ant that's attracted to the vertical or horizontal lines. Jot down your observations in the space on the right. Leave the papers against the ANTQUARIUM habitat for one or two days. Describe what the ants did when they noticed the paper. Based on your results, do you think that your ants showed a preference?

ANT ACTIVITY # 4
Ants never see red
Did you know that ants can't see red? Use red cellophane to make a light shield. The shield will only allow red light to pass through. Because ants can't see red light, they'll think they're always the dark. Watch them as they go about their everyday business.

AN ANT FROM THE OUTSIDE IN

There are three parts to an ant: a head, a thorax, and an abdomen. The more interesting body parts of ants, from head to abdomen, are listed below. Some ants have eyes that are very well developed while others are blind. Ant eyes are different from ours. In fact, they consist of a lot of tiny eyes (called ommatidia). Ant antennae (feelers) are very important because they use them to smell, taste and touch. How do your ants find the food that you leave for them? Ants have strong mandibles that they use to move soil, cut up food, fight, bite, carry other ants and move eggs and larvae. The tongue and other mouth parts are located under the mandibles. An ant's legs and wings are attached to

the thorax (only the queen and male ants have wings and only for a very short time in their lives). The little brushes on an ant's two front legs are used to clean its antennae and back legs. The abdomen of an ant consists of two different parts. The rear end of the abdomen is called the gaster. In order to lift a large object an ant will often move its gaster forward. Not all ants sting. However, stinging ants have a stinger at the end of their gaster. When it stings, an ant injects formic acid into its enemy. This can paralyze or kill other ants.

AN ANT FROM THE INSIDE OUT

Just like us, an ant has a brain, a heart, a nerve cord, and a stomach. However, an ant's organs are nothing like ours.

Does it look like a human heart?
Even though there aren't any veins or arteries to hold the "blood", the ant's heart still pumps a colourless liquid freely through the ant's body. The blood is used to eliminate any waste products.

Did you know that an ant has two stomachs?
The little one is the ant's own stomach that it uses to digest food. The other stomach is a "public stomach" called the crop. The crop acts like a large storage tank since it holds food that can be shared by all the other ants in the colony. An ant can bring up some of the food stored in its crop and feed it, mouth to mouth, to another ant. (some entomologists believe that this is the way that ants share chemicals and tell each other what needs to be done for the community.)

THE LIFE OF AN ANT

An ant colony begins when a young queen and male ants leave the nest where they were born, flying high into the sky. The males soon die after they mate. Then, the queens lose their wings. The queens of some species of ants dig into the ground. All alone, each queen clears a small chamber, seals the tunnel, and starts laying eggs. The queens will never leave their chambers. The eggs hatch and become larvae which are little, legless, worm-like creatures that must be fed by the queen. When the larvae are fully grown, they become "pupae". Ant pupae have either a barrel or an ant shape. Over time, new adult ants emerge from the pupae. They busily start working to prepare the new nest but also have to go out and find food. The job of these new worker ants is to take care of the queen along with the new eggs and larvae. The queen will spend the rest of her life laying eggs. Most of those eggs will become workers, while only a few will become either males or queens. The workers are all females, even though they can't lay eggs. They are assigned to do the many different jobs that are necessary to guarantee that the ant colony will survive. The jobs depend on the life style of that particular type of ant. Of all the different types of social insects, ants have the most interesting variations in community life. Harvester ants dig deep underground "cities" that often extend as much as fifteen feet below the surface. They gather seeds for future dinners, storing them in underground bins. If a seed sprouts, an ant will grab it and dump it outside many feet away from the entrance to the "city." After a rain, ants immediately start removing seeds from the nest laying them on the ground and waiting until they have dried. Then they grab their seeds and scamper back into the nest where they are again neatly piled in their bins. The harvester ants like to keep their nest spick and span and usually are as neat above ground as they are below. They make a pile of garbage, including dead ants, away from the entrance to the nest.

In Africa, the fierce ant "hunters" (called army ants) are always on the go and don't have a permanent home. Army ants eat insects, dead animals, or any living creature that they can catch. They have been known to reduce a tethered horse to a skeleton in a matter of hours. Can you imagine how strong their mandibles are! They do most of their hunting when they have larvae to feed. (their queen lays 25,000 eggs at a time.) When these ants go through villages, the people often leave until the ants have gone away. You shouldn't be surprised if you see row after row of ants carrying little leafy "sails"! Called "leaf cutters" or "fungus growers", these special "farmer" ants chew up leaves to make a special kind of spongy mulch. They spread this mulch over the floors of large underground chambers and use it to grow a special kind of fungus. Small bulbs grow on the fungus that is eaten by the ants. These ants have to be very good farmers in order to grow enough food for the entire colony, which may consist of several million ants. Some ants have to take care of special "cows". These "cows" are insects called aphids. The ants stroke the aphids to make them give off little drops of liquid, called honeydew. One group of these "dairyman" ants uses living "storage tanks". Certain members of this group are loaded up with honeydew until they can't even move. They spend their lives hanging from the ceiling of their chamber, feeding hungry ants that pass by, taking all the extra honeydew from the ants that collect it. Now you know why they're known as "honey pot ants". Some ants make slaves out of other ants. They raid other colonies and steal the pupae. When those pupae become adults, they are used as slaves. There is something common to all these different ant communities. They consist of female workers that take care of the queen and the young ants. They work together to make sure that their colony survives, and that's just what they do. Ants are some of the longest-living insects. In fact, some ant queens have been known to live up to fifteen years, while workers may live up to seven years. A you can tell, ants are a very successful group of animals!

There are some very interesting books about ants. Take the time to visit our public library and discover a lot more interesting facts about this special type of animal.

ANT ANSWERS

I can't find any ants. What can I do?
Visit www.antquarium.it/usa to order a supply of Turbo Ants for your Antquarium. These will be either phonomyrmex californicus (California harvester) or pogonomyrmex occidentallis (Western harvester) ants mailed from a Globus approved supplier in the USA. A small handling & postage charge will apply. BE CAREFUL: don't mix different species of ants or allow different colonies to mingle. If you have found ants in your yard, do not mix them with the ones your receive in the mail. Open and release your ants back to where you found them then insert new ants.

How long will it take to receive the ants once I've placed an order?
In general, your ants should arrive within two to three weeks after mailing your ant certificate. We will send your ants by mail as soon as we receive your order. If the weather is extremely cold, your order may be delayed by one week in order to protect the ants.

Will a lot of ants die when shipped by mail?
Because some of the ants will die during shipment, we send many more ants than are needed for your ANTQUARIUM habitat. If you live in a cold area, keep an eye out for the mail delivery. You don't want the ants to freeze outside in a cold mailbox.

Will I also receive a queen ant?
The handling of ant queens is controlled by federal regulations. You will receive only worker ants, which are

non-reproducing female ants. Even without a queen, these ants are exciting creatures to watch. If you decide to find your own ants, look for the queen, eggs, and larvae.

Can ants escape from the ANTQUARIUM habitat?
No. The ANTQUARIUM habitat is escape-proof. However, always handle your ANTQUARIUM habitat with care. Don't drop it.

Does the ANTQUARIUM habitat have enough air?
Yes. Small vents built into the ANTQUARIUM frame supply enough air for the ants to breathe but are too small for them to escape.

How long will my ants live?
With proper care ants will even live up to six months.

DON'TS:

- Don't touch the ants: they may bite and sting you to protect themselves!
- Don't shake the ANTQUARIUM habitat. Jiggling it my harm your ants and damage their tunnels. Being careful will also make it easier for your ants to adjust.
- Don't put your ANTQUARIUM habitat in direct sunlight or outside when it is cold. Doing either may mean that your ants will get too hot or cold, and die.
- Don't let different types of ants live in the same ANTQUARIUM habitat. Ants use a specific chemical scent to identify each other. In fact, ants from one colony will fight other ants if they don't have the same scent.
- Don't release the ants your receive in the mail into your local environment. They might damage some plants. They should always remain in the ANTQUARIUM habitat.

NOT SUITABLE FOR CHILDREN UNDER THREE YEARS OF AGE.

GLOBUS INTERNATIONAL

WWW.BEACHWORLD.IT