



## The NightWatch Insect Biodiversity Kit

### Biodiversity

Taking a step back, what is *biodiversity*? A reasonable working definition is:

***Biodiversity is the sum of all biological diversity,  
including diversity among ecosystems, communities, species, and genes.***

Biodiversity exists throughout multiple layers of organization. At the broadest level, there is diversity among ecosystems: California's Mediterranean ecosystem differs from the Pacific Northwest's forest ecosystem. At the next level down, communities within ecosystems are diverse: the several suites of plants and animals living within an L.A. arroyo differs from the groupings found in a lakeside park. Diversity of species, the next level down, is probably the most common way we think of biodiversity: different numbers of species of any (or all) animal and plant groups may be found in superficially similar habitats. A patch of mowed lawn in L.A.'s Downtown may host a different number of species of insects than a similar patch of mowed lawn in Griffith Park. At the finest level, biodiversity includes differences *within* species. Natural evolutionary and genetic processes lead to genetic differences (differences in allele frequencies) within a single species between different locations.

Biodiversity encompasses all those levels of diversity.

### Why we care about biodiversity

Why look at biodiversity at all? The diversity of life on the planet is what keeps us healthy and keeps us alive. Without the network of organisms around us, we'd have no oxygen to breathe, nothing to eat, and no way to get rid of waste. There's just no way for us to survive on this planet without the diverse biota that supports us.

Do humans absolutely need every species on Earth to survive? Certainly not. So which ones *do* we need? Well, that's the problem: we don't know. To answer that question, we first need to know who the players are. What species exist? Where are they? What is their genetic composition? Unless we know what exists, we can't manage the environmental change through which we are going to be living.

We do know one thing for sure. Every species of animal and plant on the planet today descended from a chain of ancestors that successfully reproduced in *every generation* since the beginning of life. Not mostly successfully, not just many times, but *without a single failure to reproduce* since the beginning of biological time. Most species (about 99.9%) didn't make it — they are extinct. Around us today are the very few lineages that succeeded. They survived through all five mass extinctions that Earth has already seen.

We're facing the sixth great extinction right now. Today's biological diversity is the sole reference we have on surviving a mass extinction. Understanding biodiversity is essential to our survival. We'd best get working.

### Why insects?

Insects are, by far, the most diverse group of organisms on the planet. There are over a million species described, and an estimated 1–10 million undiscovered species. Because there are so many species of insects in small areas, they provide an excellent tool for looking at biodiversity. You get a whole lot more data from surveying a square meter for insects than surveying it for mammals.

## The *NightWatch* approach

The *NightWatch* kit was originally designed as a part of the Natural History Museum's *BioSCAN* insect survey project. Because of its simple design, though, it also makes a great tool for you and your students to explore the biodiversity of your schoolyard or neighborhood.

The trap attracts insects at night by using a light lure and captures them in a dish of soapy water. The trap primarily targets flying insects (though walking insects, spiders, isopods, and even terrestrial amphipods may enter the trap). The light is in the ultraviolet range (around 400 nm wavelength), a wavelength visible to most insects (Briscoe, Adriana D., and Lars Chittka. 2001. The evolution of color vision in insects. *Annual Review of Entomology* 46(1): 471–510. doi:10.1146/annurev.ento.46.1.471).

Flying insects are attracted to the light, fly around it, and become trapped by a dish of soapy water. In the morning, the catch can be filtered out of the water and examined.

## Assembling and deploying the trap

1. For distribution to students, you may want to assemble the battery and LED lamp onto the plastic cup cover as shown at right. That ensures that there is one battery and one LED lamp per kit.

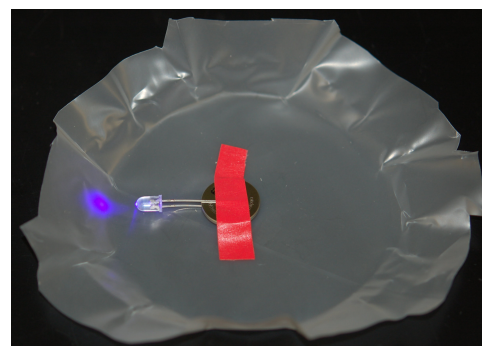
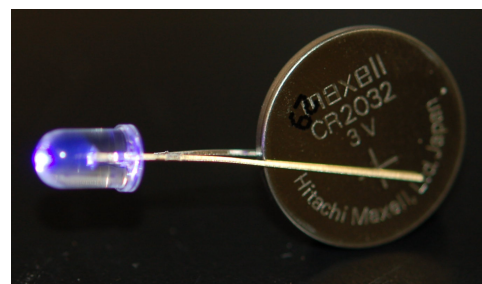
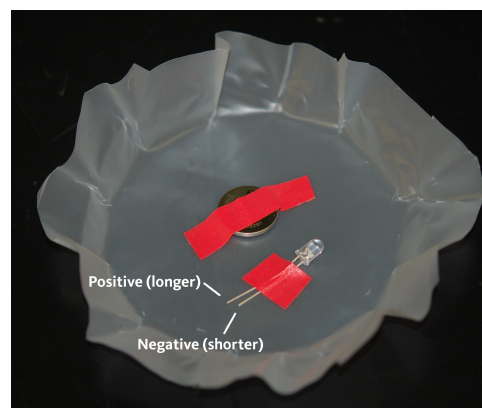
**NOTE:** we use one LED lamp in this example. That may not be bright enough for artificially lit urban areas. You may want to try using several LED-and-battery assemblies in each cup, particularly if your deployment site is not completely dark.

2. To begin assembly, remove the battery and LED lamp from the tape.
3. Place the legs of the LED on either side of the battery. The longer (positive) leg should go on the positive (+) side of the battery, and the shorter (negative) leg should go on the negative (-) side of the battery.

**The LED should light up** (most of its emission is ultraviolet, but it does glow with some visible light). If it is not lit, you may have the wrong orientation, so try flipping the LED over.

4. Use the tape to attach the LED-battery assembly to the plastic cover. Make sure that the tape secures the prongs of the LED lamp as well as the battery.

*If the tape isn't sticky enough, use any other tape you have.*



# NightWatch

- Next, put a weight into the plastic cup. This will keep it from tipping over when the dish is filled with soapy water. We've used a small rock, but anything heavy will do.



- Finally, put the plastic cover back onto the cup (with the LED and battery inside the cup). Secure the plastic cover with the rubber band.

*For those of you paying close attention: yes, there should be a rock in the cup in the photo at right. This picture comes from an earlier design where we used hot-melt glue to attach the cup to the dish. Sorry!*



- When you are ready to deploy the trap, fill the bowl about 2/3 full with a 1% solution of liquid dish soap (that's about 1 tsp of liquid soap in 2 cups of water). The soap breaks the surface film of the water so that insects don't "bounce" off it when they touch the surface. Don't use too much soap or you'll be fighting suds when you filter out the catch.

***The trap is now ready to go out for the night.***

## Retrieving the trap

First, inspect the trap. It may be that a raccoon used your trap to wash its hands, so the water appears dirty. That's OK, as long as all or most of the soapy water is still in the dish.

In the worst case, your trap may have been badly disturbed by a visiting animal (kicked over or emptied). In that case, try again the next night. Experiments and observations don't always work the first time (and, bonus: you have field evidence of larger wildlife at your site).

Check the LED lamp: it should still be glowing. The lamp may be faint, and daylight is bright, so look carefully. If the LED went out, try touching the tape and battery, to see if the legs of the lamp simply lost contact with the battery. If that's the case, try again next night, making sure the LED lamp and battery are secure. If the LED lamp won't glow, you may have a bad battery or a bad LED lamp. Try others until you get a pair that works.

Now check the water in the trap for insects (even if your light went out, you may have caught some). It may look as though there are no insects in the trap. Look carefully at the water — some insects are very tiny. If the trap really is completely empty, that's fine! Learning that your trap, in your location, caught nothing is just as important as if you did get insects. You have evidence of absence, which is often more difficult data to get than evidence of occurrence.

If you do have insects in the trap:

1. Carry the trap to a sink (without spilling!).
2. Have one person hold the paper coffee filter open over the sink.

***Make sure to support the filter well with your fingers, or the bottom may break open when you pour in the water.***



3. Have a second person slowly pour the soapy water with insects through the coffee filter, trapping the insects in the filter.
4. Run a little tapwater into the bowl to rinse it out, and filter that through the coffee filter as well. Rinsing the bowl and filtering that rinse water will help catch any remaining insects that stuck to the bowl, and will also help rinse soap out of the sample in the filter.
5. Now you have all the insects that were caught in the trap transferred to (and concentrated in) the paper filter





If you are partnering with a university or museum doing molecular genetic work with the specimens, use a 95% ethanol solution to preserve the insects (pure, not denatured ethanol). Other alcohols, like rubbing alcohol or isopropyl alcohol, are not nearly as good at preserving DNA. However, if you cannot get 95% lab-grade undenatured ethanol, you can use pure drinking spirits such as (in order of preference): 190-proof Everclear (which is 95% ethanol), 151-proof Everclear (75.5% ethanol), or a high-proof rum such as Bacardi 151.

If you will be examining the insects for morphology (with no genetic analysis), then you can preserve them in rubbing alcohol (denatured ethanol or isopropyl alcohol, usually at 75%). That will ensure the insects are dead and prevents them from decomposing.

## Resources

**Most parts** of the NightWatch kit can be purchased at grocery stores or stores like Target:

- Disposable plastic bowl

- Disposable clear plastic cup (clear so that the light shines out)

- Heavy weight plastic wrap for cup lid

- Rubber bands to hold plastic wrap onto cup

- Tape to hold LED and battery on the plastic wrap

- Liquid dish soap (best is unscented plain dish soap like Ivory)

- Paper coffee filters (preferrably size #6, but size #4 will work with care)

**The batteries** are type “CR2032” button batteries. If you need a few, you can get them at drugstores. If you will need more than 5–10, however, it is cheaper to buy them in bulk. One good source is Digi-Key:

- Digi-Key Corporation

- <http://www.digikey.com>

- Part Number: CR2032

- Description: “Battery lithium coin 3V 20mm”

- Price: (varies based on quantity ordered, but is about \$0.20/each)

- NOTE:* because these contain lithium, you must have them shipped by ground, not air.

**The ultraviolet LEDs** can also be ordered online. The vendor we have used is Tayda:

- Tayda Electronics

- <http://www.taydaelectronics.com>

- Part Number: A-1155

- Description: “LED UV 5mm Ultraviolet”

- Price: \$0.10/each