Logistics document for Drosophila stands at science fairs

This document supports presentations for extracurricular school visits and science fair presentations of the Manchester Fly Facility. For all resources mentioned in this document, we either provide links, or they can be downloaded from our fighshare repository: https://dx.doi.org/10.6084/m9.figshare.4262921. The '*Experimental-Instructions*' document in that repository explains experimental procedures needed for the listed activities here. Further resources for *Drosophila*-related science communication can be found here: www.flyfacility.ls.manchester.ac.uk/forthepublic/outreachresources

A) CONTENTS

B) Example schedule for an extracurricular school visit

C) General information

D) General equipment list

C) Activities

1. Introductory presentation
2. Explain the roots/ Understanding behaviour (fly cinema)
3. Classical marker mutations (fly surgery)
4. Modern genetic markers (the green lantern)
5. How to study nerve cells in our brain (fly laser quest)
6. Action Potentials and Seizures
7. Synapses
8. How our brain is wired
9. Testing motor skills (fly climbing wall)

B) Example schedule for an extracurricular school visit

Schedule: We prefer to organise larger extracurricular school visits with up to 200 pupils where classes of up to 25 rotate through up to four parallel sessions about topics that were agreed with teachers beforehand. See below an example schedule of a visit with three rotations through three parallel sessions, respectively.

Introduction: Ideally, all students attend one introductory presentation at the start of the day (or repeated for each rotation) so that they are prepared for the conceptual idea and rationale behind work with *Drosophila*. Another way to introduce to *Drosophila* beforehand, is to agree with teachers that all students will have visited the "Why fly?" web page (droso4schools.wordpress.com/why-fly) or at least have seen the two educational movies

(bottom of that web page). These larger events reach more teachers and pupils at a time and also provide more meaningful evaluation data (see an example here).

Enhancing activities: Ideally, pupils re-live the event through homework tasks, such as essay writing (see examples here) or concrete biology topic-related tasks. For any of these, our droso4schools resources are available online to enable students to revisit the materials we presented.

25 students/ group	Group A	Group B	Group C
10.35-11:05	Introductory Presentation (20 min) allow 10 min for pupils to split off into their groups and get to the labs		
11:05-11:25	Genetic Markers (Instructor 1)	Climbing (Instructor 2)	Neuro (Instructor 3)
5 mins	move rooms		
11:30-11:50	Neuro (Instructor 3)	Genetic Markers (Instructor 1)	Climbing (Instructor 2)
5 mins	move rooms		
11:55-12:15	Climbing (Instructor 2)	Neuro (Instructor 3)	Genetic Markers (Instructor 1)

B) GENERAL INFORMATION

Date:

Venue:

Start time:

Set up time:

End Time:

Names & phone numbers of all volunteers:

Key names & phone numbers of host venue/organisation:

Packing and Transport of Equipment:

- Everyone: ensure everything is packed by NAME (IMPORTANT: the people leading or being present on a station should pack their own equipment personally to facilitate the setting up on-site: demount the required equipment themselves, label all cables, double-check completeness of all materials, pack them into clearly labelled boxes.

- Contact/NAME in case special permissions/arrangements are required to take out equipment of your institution at the weekend
- Contact/NAME of driver of the transport vehicle
- Contact/NAME in case special permissions/arrangements are required to park/unload at the event venue.

Other:

- Risk assessment generated and sent to event organisers/schools ahead of time
- Clarify AV equipment available on site: Can own computers be connected? What cable connectors (VGA, HDMI etc.) are used?
- All presenters have been properly introduced to their activity, ideally in a training session ahead of the event.
- For school visits: teachers have been informed that epilepsy is one of the topics (may be a sensitive issue with some pupils); teachers were asked plenty of time ahead of the visit to engage pupils with the educational films and/or "Why fly?" website (droso4schools.wordpress.com/why-fly).
- On science fairs: a brief introduction to Health and Safety will be required on-site
- Ensure all equipment is PAT tested

D) General Equipment list (beyond lists provided under each activity)**:**

- XXNºXX T shirts ('*Exhibition-TShirt.pdf*' in Exhibitions folder)
- XXNºXX Handouts ('*Exhibition-Handout.pdf*' in Exhibitions folder)
- Spare bulbs and batteries for microscopes
- Spare HDMI/VGA cables and adaptors to be flexible
- USB sticks to be able to move files between computers
- XXNºXX Evaluation sheets ('*School-Evaluation.pdf*')
- Extension cables, multiple sockets, Cable reels
- Mainly for exhibitions:
  - Table lamps if the room is dark
  - Optional posters (listed as '*Exhibition-PosterXX.pdf*' files
  - Fly Stickers (*Exhibition-Sticker.pdf*)
  - A5 Hama beads pattern sheets (*Exhibition-HamaBeadPatterns.pdf*)
  - Flybox sheets (*Exhibition-FlyBox.pdf*)

C) ACTIVITIES (for further explanation see our '*Experimental-Instructions-2.pdf*' document)

ACTIVITY 1: Introductory Presentation

- Presenter: NAME
- Presentation: '*ManFly-DrosoIntroduction.ppt*'
- Accompanying movies: '*01-Fighting.wmv*', '*02-Motivation-Climbing.wmv*', '*03-FlySimulator.wmv*'

ACTIVITY 2: Explain the roots and understanding behaviour (fly cinema)

This activity is primarily for exhibitions. Suggested number of helpers: 2 people, so that 1 person can be at the poster at any given time but breaks can be taken.

Team: NAMES, CONTACTS (mobile, email)

Activity:

- Explaining the model organism: *Drosophila*
- Visitors see movies of flies showing human behaviours on screen
- Visitors see the different developmental stages of *Drosophila* and how they are maintained in the laboratory

Objectives:

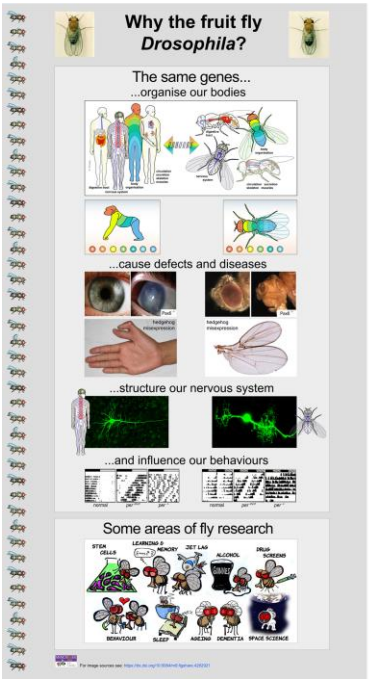
- Understand why flies have become such a powerful model organism and how they are being used - aimed primarily at adults and older children
- Appreciate the fundamental aspects of our own behaviours.

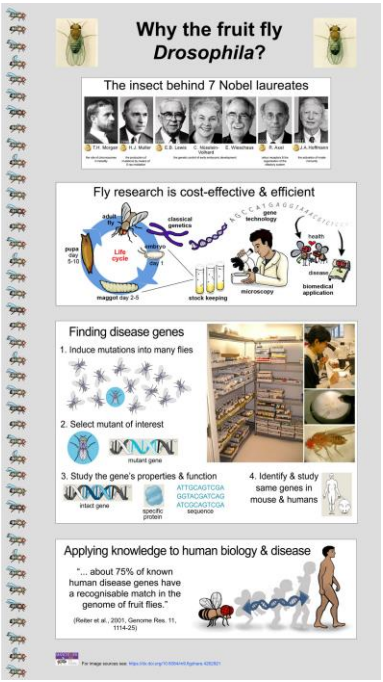
Background info:

- 'WHY FLY?' tab on droso4schools.wordpress.com

Materials:

- Two display boards (*StandWhyFly-Poster1.pdf*, *StandWhyFly-Poster2.pdf*)





- 1x table
- Fly food vials with different developmental stages
- Laptop connected to a screen via a VGA cable to show behaviour movies (*ManFly-WhyFly-Movies.ppt*, *26-BoozedFly2.wmv*, *01-Fighting.wmv, 02-Motivation-Climbing.wmv*)
- 2 sockets required (laptop and screen)

ACTIVITY 3: Classical marker mutations (fly surgery)

This activity is suitable for stands on science fairs and it part of our Genetics classes on school visits. Suggested number of helpers: 2 helpers at any given time can run 5-6 microscope stations on science fairs. In schools, up to 25 microscopes can be handled by a single presenter because the activity can be properly explained beforehand and discussed jointly (all embedded in our PowerPoint presentations for these classes)

Team: NAMES, CONTACTS (mobile, email)

Activity:

- Looking at flies under the microscope, diagnose the fly patient and tell us what's wrong, see how genetics is done using marker mutations
- Match the marker mutations of flies under the microscope with images on the form (see image)
- Enter the letters in correct sequence into the boxes at the bottom. If at least one fly displays two genetic marker mutations simultaneously, make students aware of this fact.
- Give some facts about marker mutations and their history and explain why they are important.

Objectives:

- Perform classical genetics first hand

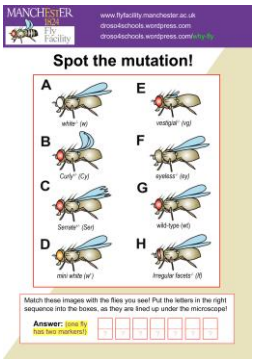
Background info:

- Not yet available on droso4schools.wordpress.com
- Some background info on alleles used:
    - The species *Drosophila melanogaster* was first described in 1830 by J.W. Meigen
    - *Curly / Cy* was first described in 1918 (Ward, 1923, *Genetics* 8, 276ff., LINK) and remains the most frequently used genetic marker
    - The dominant allele $Kr^{If\text{-}1}$ allele was discovered in 1967 (Ives, 1967, D.I.S. 42, 39, LINK) and causes less and irregular ommatidia.
    - The first *white* allele, discovered by Thomas H. Morgan in 1910 and laid the foundations for modern genetics (Allchin, 1997, *chapter 5* in *Doing Biology*, LINK)
    - *Serrate* (*Ser*, formerly *Beaded*) is a ligand of Notch; it was first described by. T.H. Morgan (Morgan, 1911, *Science* 33, 496ff., LINK), the Ser^{1} allele by Curry in 1939 (Curry, 1939, *D.I.S.*12, 45ff., not online available).
    - *vestigial* was first discovered by Morgan in 1910 (*Carnegie Inst. Wash. Publ. 278, p.150*; LINK; image taken from that publication); most used as marker is the vg^{1} allele.
    - A story to tell: some background on Notch: http://embryo.asu.edu/pages/notch-signaling-pathway-embryogenesis

Materials:

- For science fairs: one display board (*StandGenetics-Poster.pdf)*
- For schools: suitable presentation (*ManFly-Short1-GeneticsSession.pptx*, *ManFly-MixedSession.pptx*)
- 3 tables

- Up to 25 mini battery powered stereomicroscopes [1]
- One petri dish per microscope with frozen-down fly specimens in a sequence
- Optional on science fairs: stereomicroscope with light source connected to a camera to show the sequence of flies on a large screen
- Copies of the activity sheet: *StandGenetics-Sheet.pdf*
- Pens
- 3 sockets required (light source, screen and camera)
- Optional: A copy of the book 'Atlas of *Drosophila* Morphology' [2] or the poster '*Learning_to_Fly*' [3]



ACTIVITY 4: How to study nerve cells in our brain: Fly laser quest

This activity is suitable for schools as well as science fairs. In both locations, the use of transgenic flies may be questionable and should be done with particular care (e.g. transport in double containers). Suggested number of helpers: 2 people, so that one person can be at the stand at any given time. In schools, the maggot experiment ideally requires a second person in addition to the main presenter.

Team: NAMES, CONTACTS (mobile, email)

Activity:

- Demonstration of how flashing blue or red light at genetically engineered maggots or flies can change their behaviours – learn how clever genetic tools are used to study brain function.
- Use control flies to demonstrate that maggots or flies *per se* do not respond.
- The mutant larvae will contract or flies undergo seizure when hit by the light for 2-3 seconds. For maggots, repeat several times with a few seconds interval to let maggots stretch again.
- The activity with maggots can best be viewed under a dissection microscope with a camera attached so that whole audiences can follow the larval responses on a large screen. For fly demonstrations in schools, let one of the pupils come forward to observe and describe to the class what happens (the '*08b-InducedSeizure*' film has been prepared to show what happened afterwards)

Objectives:

- Visitors learn how clever genetic tools are used to study brain function.
- Understand modern tools to understand behaviour and brain function

Background info:

[1] Information about affordable microscopes: www2.mrc-lmb.cam.ac.uk/microscopes4schools/

[2] Atlas of *Drosophila* morphology: http://store.elsevier.com/Atlas-of-Drosophila-Morphology/Sylwester-Chyb/isbn-9780123846884/

[3] Download from: http://onlinelibrary.wiley.com/journal/10.1002/%28ISSN%291526-968X/homepage/free_posters.htm

- 'L3-NEURONS' tab on droso4schools.wordpress.com
- **Channelrhodopsin** is an ion-channel that opens upon illumination by blue light. This ion-channel protein was isolated from green algae. These algae need to move towards the light to be able to make sugar (like plants they perform photosynthesis). They use the Channelrhodopsin (ChR) as a light sensor, which tells them if they are moving towards the light. When ChR is activated by light, the channel opens, ions flow into the algae activating their tails (flagella) and the algae swim.

  We can put this ChR into the brain cells of flies! The mechanism is the same. When we illuminate the cells with blue light, the ChR is activated. The channel of ChR is opened and ions enter the brain cells and activate it. Because the brain cell is connected to many other cells via synapses (see activity on paralysis), it can affect many other brain cells as well. Therefore, we can use ChR like a switch, to turn neuronal activity "on" (active) or "off" (inactive).

  How can we make sure Channelrhodopsin is in the right cells? While all cells of an organism have the same genes, only a few of them are used in each cell type. Each gene codes for a protein (very simplified!!!) that is made by the cell. When we insert the gene for the ChR protein and couple it to mechanisms that ensure this gene is 'expressed' in the right cells, ChR will be artificially produced specifically in this cell type.

  Explanation why using *elav-GAL4* and *pickpocket-GAL4* leads to different phenotypes: *elav* and *pickpocket* are two different genes that are expressed in different parts of the fly body, and we use the mechanisms underlying this specific pattern to drive expression of ChR. Elav is expressed in all brain cells, activating all brain cells. Expressing ChR in this way will lead to the contraction of all muscles, hence of the maggot. Pickpocket is expressed in cells that sense a strong touch, and activating ChR in these cells makes the larvae react as if it has just been poked. The normal reaction to being poked is to corkscrew and/or roll away.

Materials:

- School visits: suitable PowerPoint presentation (*ManFly-Short2-NeuronSession.ppt, ManFly-NeuroSession.ppt, ManFly-MixedSession.pptx*)
- Science fairs: 1 table and Poster '*StandOptogenet-Poster.pdf*'
- The correct flies or maggots, readily crossed and fed with retinal (see our '*Experimental-Instructions-2.pdf*' document for details)
- Centrifuge tube lids, painted black with a colour resistant felt pen attached to a petri dish
- A pair of forceps.
- Tube of water
- Standard stereomicroscope [4] with light source, camera [5] and screen.
- 470nm LED [6] with power supply [7]
- 4x sockets required (LED power supply, light source, camera and screen)

[4] Dissection microscope: http://www.leica-microsystems.com/products/stereo-microscopes-macroscopes/routine-manual/details/product/leica-mz6

[5] Camera: http://www.leica-microsystems.com/products/microscope-cameras/life-science/details/product/leica-ic80-hd/

[6] Suitable blue LED: www.thorlabs.de/thorproduct.cfm?partnumber=M470L2

[7] Suitable power supply: www.thorlabs.de/thorproduct.cfm?partnumber=LEDD1B

ACTIVITY 5: Action Potentials and Seizures

This activity is ideal for science fairs and schools. On science fairs, ideally 2-3 helpers should be at the stand at any given time, but additional helpers are required so that brakes can be taken. In schools, this activity requires only the presenter, but time is required to exchange fly tubes on the pupils' desks in between consecutive classes.

Team: NAMES, CONTACTS (mobile, email)

Activity:

Hands-on experience to learn about epilepsy research using the fly.

- Always use one *(bang senseless) (bss^{1})* vial together with one wild type vial.
- Visitor holds fly vials from the top and shakes vigorously from the wrist as shown in our video '*06-ShakingFlies.wmv*'. The *bss^{1}* flies fall to the ground due to seizure, whereas the wild type flies are unaffected.

Objectives:

- Learn how model organisms as be used provide treatments to disease
- Learn how neurons can generate action potentials

Background info:

- 'L3-NEURONS' tab on https://droso4schools.wordpress.com
- **What happens during seizure? What regulated the cell activity?** Our theory is that a lot of brain cells become active at the same time, or a smaller number synchronise their activity. When brain cells are activated, the area inside the cell (intracellular environment) becomes positively charged compared to the fluid surrounding them (extracellular environment). To keep it easy, we use only sodium ions that are positively charged to explain flow of charges (others important ions include Calcium and Potassium, in a crude way Sodium excites the cell, Potassium calms the cell down and Calcium makes the cell transmit the signal to the next cell by transmitter release). When cells are activated they accumulate more sodium inside their cell body: they are positively charged. This sodium is removed again and the cell is less positive and thus inactive. This is extremely simplified!

  How can ions, like sodium enter or exit a cell? Brain cells (and other cells) have specific proteins in their surrounding envelope (cell membrane). These proteins form little channels that can allow ions to pass through the membrane. These proteins are called ion channels. They are not always open, so ions can not always pass. This is very important because the cells need to regulate their activity and certain ions (like sodium) will make them active when they enter the cell. So, normal ion channel regulation is crucial to stop hyperexcitability and prevent seizures!

  Why do *bss* mutant flies fall over? The *bss* mutant flies have a problem with their sodium channel (called *paralytic/para* in flies). When the channel is activated by an electrical signal it does not close fast enough. Too much sodium can enter the brain cell and it can become too active. If this would only happen in one brain cell, it would not cause a seizure. But this sodium channel problem is present in many brain cells, so a great part of the network of cells is affected and this leads to the whole system becoming hyper-excitable. This means that a small signal can produce a larger than normal response in the brain. The flies can cope with this when they are not stressed. However, any stimulus that leads to the activation of many brain cells at the same time (e.g. shaking) overloads the nervous system causing a seizure due to this sodium channel problem.

Materials:

- School visits: suitable PowerPoint presentation (*ManFly-Short2-NeuronSession.ppt, ManFly-NeuroSession.ppt, ManFly-MixedSession.pptx*)
- Science fairs: 1 table
- 100 fresh fly food vials containing10-15 *bss*[1] mutant flies each
- 100 fresh fly food vials with 10-15 wild type flies in each
- 3x empty fly trays to store flies in sequence for recovery
- Laptop with action potential simulator software [8] and seizure movies (*Movie-Unconscious.wmv*).

[8] link to software: https://phet.colorado.edu/en/simulation/neuron

- Screen via appropriate cable connection
- 2 sockets required (laptop and screen)

Tips:

- *bss*^{1} flies will need 1 hour of recovery time before they can be re-used. Therefore, on occasions where you expect large throughput, prepare many vials of each fly stock and keep and sort them in sequence of use into recovery boxes. This way, upon re-use, you make sure that the flies with longest recovery time are used first.
- Tap the *bss*^{1} flies onto the side of the vial after shaking so that they do not get stuck in the food when they recover.
- Tape the two sets of flies with different coloured tape to distinguish the vials as well as ensuring the cotton does not fall out.

ACTIVITY 6: Paralysis

The conditions for this experiment are very similar to activity 5. On science fairs, 2 helpers at the stand at any time is usually sufficient.

Team: NAMES, CONTACTS (mobile, email)

Activity:

- Use genetics to switch off the nervous system and learn about synapse function.
- The visitor places *shibire*^{ts} (*shi*^{ts}: *shi*^{1} or *shi*^{2}) and wild type vials under their armpit ~5 min with the aim of warming them up to 37ºC. The *shi*^{ts} flies fall to the ground due to paralysis, whereas wild type flies are unaffected.

Objectives:

- To understand how we can use genetic tools to experimentally inactivate neuronal activity and why this may be important in understanding behaviours such as learning.
- To understand how synapses work

Background info:

- 'L3-NEURONS' tab on https://droso4schools.wordpress.com
- Layman's guide to synapses: www.prokop.co.uk/Research/LAYMAN/1-brain-intro.html
- **Synapses** are connections brain cells form amongst each other and also with other cell types, like muscles. The two brain cells (neurons) involved nearly “touch” each other but a tiny synaptic cleft remains between them. To pass electrical activity from one cell to the next the signal must pass the cleft to do this brain cells use chemical substances (transmitters).

  Transmitters are packaged in vesicles. When the brain cell is activated the vesicles empty their contents (the transmitter) into the synapse. The cell on the other side senses these transmitters with special proteins located at the cell surface (receptors). When enough of these receptors are activated, the receiving brain cell is activated and a new electrical signal is generated and moves down the cell.

  Synapses act like a gate, they block any weak signals and only let the strong ones through. This stops our nervous systems from being overwhelmed by every little thing we sense.

- **Shibire function:** To make new vesicles filled with transmitter, old vesicles are recycled. Parts of the cell envelope (membrane) are drawn inwards in a deep cleft (invaginated) and need to be budded to form a new, empty vesicle that can later be refilled with transmitter. The budding process needs a protein called dynamin (green). This constricts the neck of the budding vesicles and thus leads to the final detachment of the vesicle.

  In the *shi^{ts}* mutant, dynamin does not function at high temperatures. Thus, budding cannot take place and invaginated membrane-bits that cannot be detached from the membrane accumulate inside the cell. Vesicle recycling is halted and no transmitter-filled vesicles can be made. Thus transmission of activity is impossible and paralysis occurs.

Materials:

- School visits: suitable PowerPoint presentation (*ManFly-Short2-NeuronSession.ppt, ManFly-NeuroSession.ppt, ManFly-MixedSession.pptx*)
- Science fairs: 1 table
- 100 fresh vials with about 10-15 *shi^{ts}* flies in each
- 100 fresh vials with 10-15 wildtype flies in each
- 3x empty fly trays to store flies in sequence for recovery
- laptop with the '*Movie-ShibireEffect.wmv*' file, viewed on screen (check cable connection)
- 2 sockets (laptop and screen)

Tips:

- *shi^{ts}* flies will need 1 hour of recovery time before they can be re-used. Therefore, on occasions where you expect large throughput, prepare many vials of each fly stock and keep and sort them in sequence of use into recovery boxes. This way, upon re-use, you make sure that the flies with longest recovery time are used first.
- Tap the *shi^{ts}* flies onto the side of the vial after shaking so that they do not get stuck in the food when they recover.
- Tape the two sets of flies with different coloured tape to distinguish the vials as well as ensuring the cotton does not come out.

ACTIVITY 7: How our brain is wired (the brain in action)

This activity is suitable mainly for science fairs. It is very interactive and very popular with kids.
Suggested number of helpers: At any given time you will need:

- 2 helpers for the Nerf gun activity
- 2 helpers for looking at specimens under the microscope
- 1 helper for the celery activity
- 1 helper for navigating Virtual Fly Brain

Team: NAMES, CONTACTS (mobile, email)

Activity:

- Interactive way to discuss the organisation of our nervous system
- Visitors can navigate through a fly brain using Virtual Fly Brain

- Visitors see a box filled with peas to illustrate the enormous amount of neurons that make up our brain or the brain of a fruit fly (used for initial engagement, preparing for the statement that these cells need to be organised into sensible centres and networks)
- Visitors can see sections of brains or preparations of the fly nervous system under the microscope
- Visitors can perform histological staining of celery to appreciate and understand the importance of staining procedures.
- Visitors are shown a series of regions of the fly brain on Trump cards and must shoot foam bullets from a Nerf gun at the corresponding regions on the Nerf poster. The aim is to hit each region in the fastest time.

Objectives:

- Understanding that our brain is subdivided into functional centres and how to discover them under the microscope

Background info:

- droso4schools.wordpress.com/l3-neurons
- The fly brain contains 250,000 neurons, whereas the human brain contains 86 billion neurons

Materials:

- 1 table
- Poster ('*StandBrain-Poster.pdf*')
- Optional further posters (*StandBrain-Anatomy.pdf, StandBrain-Histology.pdf, Exhibition-PosterBrains.pdf, Exhibition-PosterFlyBrain-2.pdf*)
- 2 sets of laminated trump cards ('*StandBrain-TrumpCards.pdf*')
- computer with **online access** for navigating virtual fly brain (www.virtualflybrain.org)
- 2 screens
- 5 school/teaching microscopes
- Extension cables for microscope with at least 10 sockets
- 5 microscopy slides with brain preparation
- Laminated photos of those preparations with annotations (to be posted next to microscope for explanation; '*StandBrain-MicroscopeSheet.pdf*')
- Handful of celery trunks
- Razor blade with one blunt end
- Staining solution (0.05% solution of toluidine blue in water)
- Protection kit (lab coats, gloves, goggles)
- Tupper ware filled with thousands of dry peas
- 3 Nerf guns with 20 times Nerf gun ammunition [9]
- Lollipops as prizes

[9] Nerf guns: https://www.amazon.co.uk/NERF-N-Strike-Elite-Jolt-Blaster/dp/B009NFH54W/ref=pd_bxgy_21_img_2?_encoding=UTF8&psc=1&refRID=NPAVYPAPV2V4PKAF64DJ

ACTIVITY 8: Modern genetic markers (the green lantern)

This activity is suitable for science fairs, but ideally requires higher-end microscopy equipment. Suggested number of helpers: 1 helper at any given time

Team: NAMES, CONTACTS (mobile, email)

Activity:

- See fluorescent flies with gleaming organs under the microscope – see how malformation can be spotted & studied at a wink of the eye.
- Visitors see brain sections and beautiful green fluorescent patterns in living animals under a fluorescent microscope
- In parallel, live movies of fluorescent fly organs are projected onto a larger screen to attract visitors

Objectives:

- Understand modern genetic tools to study patters, structure and behaviour: live observation of GFP-expressing maggots

Materials:

- Poster ('*StandGFP-Poster.pdf*')
- Optional further poster ('*Exhibition-PosterStainings.pdf*')
- 1 table
- Showing the live imaging movie
  - Laptop with the '*Movie-DrosophilaGFP-film.mpg*' file
  - either large monitor or projector and large screen; check that cable connections are compatible
- Demonstration equipment:
  - Fluorescent stereomicroscope with light source; if a camera is available then the specimens can be viewed on a screen
  - Alternatively, a Dino-Lite GFP pen [10] connected to a laptop with Dino-Lite software, potentially viewed on a larger monitor
- Vials containing 3rd instar larvae: *B19-Gal4 CD8-GFP* (larval brains), *24B-Gal4 UAS-eIF4AIII-GFP* (larval muscles); during demonstration, selected larvae can be left to crawl on apple agar plates containing yeast.
- 3rd instar larval flat preps on slides with muscle stained with phalloidin and nerves stained with anti-Fas2 antibody [11].
- Forceps to transfer larvae from vials to apple agar plates.
- Water, Petri dishes and Pasteur pipettes to wash larvae
- 6 Sockets (1x laptop and 1x PC, projector, 2x screen)

[10] Dino-lite digital microscope: http://www.dino-lite.com/products_detail.php?index_id=69

[11] For staining protocols download course manual from: figshare.com/articles/2nd_year_Genetics_practical/156395

ACTIVITY 9. Testing motor skills (fly climbing wall)

This activity is very popular in schools and on science fairs. In schools it can be carried out in two different modalities and can be combined with statistics. Suggested number of helpers: 2 helpers at any given time at science fair stands, in schools the version where images are taken, printed and analysed requires at least one additional helper apart from the presenter, the 'race' version can be done with the presenter only.

Team: NAMES, CONTACTS (mobile, email)

Activity:

- To demonstrate how simple experiments with *Drosophila* are being used to study fundamental mechanisms of ageing and neurodegeneration.
- To show how experimental data are obtained and analysed using statistics.

Activity:

- Plot your own experimental graphs and statistically compare young flies and their grandparents performing at the climbing wall – learn how to study the genetics of aging, neurodegeneration or muscular dystrophies.
- Version 1:
    - Visitor/pupil knocks the flies to the bottom by tapping the tubes firmly down and then leaving them standing upright, directly in front of the climbing wall (Climbing-(Climbing-movie.wmv).
    - Immediately, start the timer.
    - After 15 seconds take a photo of the tubes with the webcam ensuring that the bottom of the tubes is in line with the bottom of the climbing wall.
    - Print a copy of the photo and let the visitor count the numbers of flies per vertical section of the climbing wall, counting new and aged flies separately.
    - The visitor/pupil then plots their individual data on graph paper (*StandClimbing-plot.pdf*).
    - Data of all visitors are entered into a custom-made Excel spreadsheet (*StandClimbing-StatsSheet.xls*. If this process is projected onto a screen, visitors will see how the cumulative bar charts/curves gradually develop.
    - Compare the individual graphs to the cumulative plots of single groups and discuss the fundamental importance of sample numbers.
- Version 2:
    - Visitors/pupils knock flies down and measure the time until the first young and the first old fly reach the top; in school, find a common rhythm to knock down the flies simultaneously across class; have a stop watch displayed on screen that pupils can use to take the time: one pupil looks at the flies and indicates when they arrive, the other looks at the stop watch and notes down the time.
    - The data for young and old flies are plotted live on a black/white board.
- Use the results to discuss aspects of ageing or neurodegeneration (see *StandClimbing-presentation.ppt*), i.e. two examples of research areas in which climbing assays are being used.

Background info:

- 'L1-CLIMBING ASSAY' tab on droso4schools.wordpress.com

Materials:

- Science fairs: one display board (*StandClimbing-Poster.pdf*); 2x table
- School visits: suitable presentations (*ManFly-Short4-ClimbingSession.pptx, ManFly-MixedSession.pptx*)
- Per station, one climbing wall with weight (to hold it upright); on science fairs we usually use one to two stations, in schools one station for 2-3 pupils
- Old and young flies in fly food vials enough to have 10-20 flies per climbing vial. Flies can be added to empty vials as described in the *Experimental-Instructions.doc* during the set up.
- One fly mat per station to tap down flies
- 3-4 pens for science fairs, 1 pen per station in schools
- Clear sticky tape and scissors to prepare climbing vials.
- Webcam connected to laptop with imaging software and printer
- Laptop containing the excel sheet (*StandClimbing-StatsSheet.xls*)
- 1 timer
- 4 sockets (printer with dedicated screen and laptop)
- Light source