

# Spider Pharm's Fruit Fly (*Drosophila melanogaster*) Culture Techniques.



This is just one of an incredible number of ways to raise fruit flies. It has many advantages, a few disadvantages and you may want to compare it with other techniques to find out what is best for you. A good list of resources for this available online, on the WWW Virtual Library *Drosophila* page at <http://ceolas.org/fly/>.

We have been raising fruit flies at Spider Pharm for more than quarter century to raise millions of spiders whose venoms are being used in research.

We like to use wild types because of their vigor and developed our own methods for raising the flies on a media made from dog food. This media is more nutritious than standard fruit fly media and usually gives us better results, producing healthier spiders that grow more rapidly with less mortality and cannibalism.

We also like to harvest the maggots, not adult flies. Maggots and pupae are easy to dispense but flies will fly and are much too fast for us.

<b>Contents</b>	<b>Page</b>
Fruit Fly Development	2
Supplies	3
Set Up: Getting Ready	4
In the Kitchen: Media Prep	5
Adult Fly & Maggot Care	6
Maggot Sifting & Holding Pans	7
Using Maggots and Flies for Feeding	8

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Artwork in Preparation.

## **Fruit Fly Development**

Fruit flies undergo complete metamorphosis in their development from egg to adult, with a wormlike juvenile stage that does not look at all like the adult fly.

### **Egg**

The egg are very small, longer than wide and have a pair of breathing tubes, which look something like horns or antennae. They fertilized and starts development inside the female and, in our system, are typically laid on the wood chips just above the food.

Eggs will hatch, releasing the 1st instar maggot within 16-24 hours.

### **Maggots (larvae)**

The maggots are white segmented, wormlike larvae with a pair of hooks in their mouths for digging and tearing into food and anterior (front) and posterior (rear) spiracles, which are openings for their breathing tubes. They burrow into moist fermenting and decaying organic material, taking in the liquids containing nutrients, yeast and other microorganisms.

Maggots will molt (shed skins) twice, going through three instars before they are fully grown and ready to pupate in 4-5 days.

### **Pupae**

When fully developed, the maggots will stop feeding, crawl out of the ferment and try to find a drier space to pupate and change into an adult. The larval cuticle (skin) will harden to protect the fly that will take about 4-5 days to develop inside.

### **Adult Fly (imago)**

The pupal case will split open, releasing a pale and shriveled fly in a process called eclosion. The wings of the fly will expand and the cuticle with harden after eclosion and the fly will be very hungry, requiring food and water almost immediately. Sugar-water will keep them alive at first but they will need more nutritious food later to produce eggs.

You should see a lot of courtship behavior, males chasing females, after one day and some of the females should start to lay eggs a day later or two days after eclosion.

Each female should be producing about 25 eggs per day by day 3 or 4 and may produce as many as 500 eggs during her lifetime.

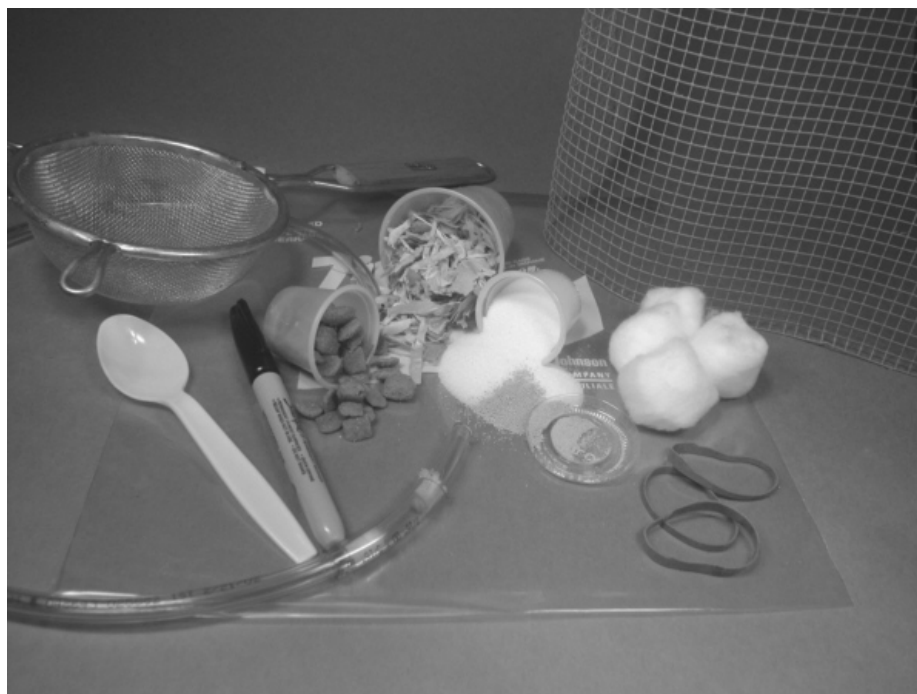
## **Timing**

Fruit flies are “cold-blooded” so rate of growth and development varies with temperature.

At 85 °F they can grow from egg to adult in about 8 days and start laying eggs on the 10th. At 68-70 °F they may need more than 15 days for development. They will breed and develop at temperatures as low as 55 °F and may be sterilized by temperatures above 90 °F.

Flies from shipped pupae should begin to emerge within 1-3 days. Add 3-4 days

# Supplies



## Containers

- ☞ 1 oz portion cups
- ☞ 1 cup plastic water cups
- ☞ 1 Gallon clear plastic zipper bags

## Food

- ☞ Sugar
- ☞ Water
- ☞ Purina® HiPro dog food<sup>2</sup>
- ☞ Baker's yeast (active)

## Other

- ☞ Permanent marker pens
- ☞ Cotton
- ☞ Rubber bands
- ☞ Kitchen strainer<sup>1</sup>  
(approx. 1 mm openings)
- ☞ 1/4" Mesh hardware cloth  
(or fryer basket)
- ☞ Plastic spoons
- ☞ Plastic tubing
- ☞ Wood chips<sup>3</sup>
- ☞ Flour
- ☞ Baking soda

## Notes

## Comments

<sup>1</sup> Sieve set or kits are available from Carolina Biological, Ward's Natural Science Establishment and other sources. Alternately, you can make your own sifters from hardware cloth, window screening, wedding veil cloth and other readily available materials.

<sup>2</sup> Other brands of dog food and biscuits may work but should be checked first.

<sup>3</sup> Wood chips are sold as bedding material at most pet and animal feed stores.

Aspen chips are best and least toxic but we have also had good luck with pine chips, even though pine contains resins that may be toxic. NEVER USE CEDAR CHIPS! Cedar is very toxic to flies.

Wood chips can be pre-sifted before use to remove dust and small chips. This will make it easier to sift maggots from the chips later.

Simply shake the chips in over 1/8" or 1/4" mesh hardware cloth or use a fryer basket and keep the larger chips that stay on top.

# Set Up

## Getting Ready

### Selecting and Setting up a Space for Your Flies

#### Room

The ideal temperature for the flies is about 80-85 °F but they will breed and grow and common room temperatures, between 68 and 72 °F. The temperature should never get about 90 °F or you may sterilize the flies.

#### Lighting

The flies are attracted to lights, which makes it easy to open the cages without letting flies out. Simply turn off lights in room, point the back of the cage toward a lit window or small lamp and shake the cage a bit to scare flies towards the light. You should be able to take things in and out of the front without any flies getting loose.

Part of fly courtship behavior is visual, so it is probably a good idea to keep them in an area with good lighting most of the time.

### Cage Construction



#### Materials

2 X 1 Gallon clear plastic zipper bags  
Scissors  
Cotton (puffs or roll)  
Rubber bands  
Pan or cookie sheet

#### Procedure

Cut the bottom corners of the bags and stuff the holes tightly with cotton. Add rubber bands to provide a good seal and make sure that the cotton does not fall out.

Place the bag on a sheet, so it will be easy to move around, and add a tall jar or cup to keep it expanded.

### Simple Aspirator

#### Materials

Fine mesh cloth  
Cotton  
Scissors  
Clear vinyl tubing  
3/8" OD X 1/4" ID  
1/4" OD X 1/8" ID



#### Procedure

You can use material from nylon stockings or pantyhose or an open mesh cloth used for wedding veils.

#### Cut:

2' and 1" lengths of the narrow tubing  
1.5-2" lengths of the wide tubing.  
1" cloth squares

Insert the long piece of narrow tubing into the short piece of wide tubing. Insert a small piece of cotton into the wide tubing. This will help to filter out dust.

Cover the open end of the wide tubing with the cloth square and push it in with a short piece of narrow tubing.

Trim the cloth.

# In the Kitchen: Media Prep



## Sugar-Water & Chips

### Ingredients

1 teaspoon sugar  
3/4 ounce water  
Wood chips

### Procedure

Stir the sugar and water in a 1 ounce portion cup and loosely fill with chips.

## Soggy Dog Food

### Ingredients

2 cups Water  
1 cup Purina HiPro dog food

### Supplies

7 X 1 ounce portion cups  
7 X 1 cup containers

### Procedure

Bring water to boil on a stove, hotplate or in a microwave. Stir in the dog food, cover and allow to soak for 1 hour with occasional stirring. Add a full 1 ounce portion cup of media to each of the larger containers. Fill the 1 ounce portion cups half full. Cover the cups with lids or plastic wrap and refrigerate or freeze.



## Adding Sugar, Yeast & Chips

Sugar and yeast are added to the soggy dog food just before it is placed in the cages.

### Ingredients

Sugar  
Baker's Yeast  
Containers of soggy dog food  
Wood chips

### Procedure

Check your cages, determine how many 1 ounce and 1 cup containers of food that you will need and remove them from the refrigerator or freezer, possibly warming up frozen ones in a microwave (about 3 minutes on defrost). Make sure that they do not get too hot if you use microwave. The temperature should be under 105 °F (~45 °C) before you add the sugar and yeast.

### For 1 ounce cups:

Mix a large pinch of yeast with 1 level tablespoons of yeast and stir this into the soggy dog food. Push a few wood chips into the dog food and loosely fill the cups with extra wood chips.

### For 1 cup containers:

Mix a pinch of yeast with 2 level tablespoons of yeast and stir this into the soggy dog food. Do not add wood chips yet, you'll do that later after you add the maggots.



# Adult Fly & Maggot Care



1 gram fruit fly pupae  
as shipped by Spider Pharm

## When the Pupae Arrive

Check the temperature of the pupae if the package feels cold or hot. The flies can tolerate temperatures as low as 25 °F or as high as 92 °F for brief periods. They will probably be frozen if their temperature is below 25 °F and may have been sterilized, if not killed, if their temperature gets above 92 °F for any length of time.

Set up a clean cage, and open the vial in the cage with a second vial containing sugar-water & chips. The adult flies will need the sugar and water shortly after eclosion. 1 gram of pupae per gallon cage seems to be a good number and you may want to set up more cages or use larger cages if you have more pupae.

## When the Flies Start to Emerge (Eclose)

The flies will survive on sugar-water for some time but they will need better food for good egg laying. You may also want to add a cup of baking soda to the bag to absorb any odors. Some people are very sensitive to the smell.

Simply prepare a 1 ounce portion cup of soggy dog food & chips, label it with the date using a permanent marker and place it in the cage. You may also want to remove the cup of sugar-water and chips if there are not too many flies in it.

It is best to open the cages in dark rooms with a lit window or small light to one side. Position the cage with the light to the back, shake it lightly and the flies should move to back while you get in and out of the opening.

## Routine Care

We like to get a steady supply of maggots and pupae for breeding and feeding, so we like to add fresh media to each cage every day and leave each cup in the cage for 2 days. Most of the flies will have moved to the fresh food by the 2nd day, which makes it easier to remove the cup without releasing flies. This also gives us maggots of different sizes when we sift.

Simply add a fresh portion cup of media to each cage at about the same time every day and remove any cups that have been in the cage for two days or longer.

The flies will not start to lay well until the 3rd or 4th day so you can discard cups from the 1st and 2nd day. After this, transfer the 2-day old media & chips to larger cups with fresh media and chips and place the larger cups in separate cages.

Finally, check the larger cups daily. Look close and you should see large numbers of maggots on the surface of the media after one day and this is good time to stir the media & chips, spreading the media over the chips. This makes more surface area available to the maggots and openings between the chips will provide air throughout the media..

Most of the media in the larger cups should have been eaten after one more day, 4 days after egg laying started. These can be removed for sifting.

## Options

You may want to follow these procedures very closely at first, just to get a feel for things. After this, there are many options to play with and you will probably want to make numerous modifications to suit yourself and what you need to use the flies for.

For instance, you can simply discard the soggy dog food & chips media if you do not want to raise more flies.

You may only want to introduce fresh media every 2-3 days if you do not need many maggots or you may be gone for a couple days. In this case, you might want to add cups of sugar-water & chips so the adults do not have to feed on food covered with maggots.

You may also want to shorten the period of egg laying if you want get maggots of the same size or if you want to get eggs of specific ages.

# Maggot Sifting & Holding Pans

## Sifting

Drying the media and maggots in flour makes sifting much easier and the sifting also removes mites, which are a common problem with fruit fly cultures. We have not had any problems with mites since we started to use flour to dry and sift the flies.

### Materials

White flour  
Ziploc® bag  
Sifters



### Add Flour

Transfer your container maggots, used media and chips to a plastic bag and add a few tablespoons of white flour. Close and shake the bag vigorously. Add additional flour and repeat until everything looks dry and there is a lot of excess dry, powdery flour after shaking.

### Remove Chips

Remove the wood chips by shaking the dry mix on the large mesh screen (e.g. 1/4" hardware cloth or fryer basket) that you used to clean the chip in the first place.

Remove the flour by shaking the maggots in the kitchen strainer.

### Alternate Method

(See the next page details.)

You can get smaller maggots by sifting the flour again on screens with smaller openings. Very small maggots may not pupate and develop into flies but they can be very useful for feeding small spiders, insects and fish. However, somewhat larger ones may still pupate and can be a good source of small flies if you need them.

You can clean the maggots even further by letting them crawl through sieves or strainers with openings slightly smaller than their diameters.

## Holding Pans

Maggots should only be stored in shallow layers and it helps to keep them in excess flour, which will absorb water and waste materials. Many will die if they are kept in deep layers since the ones on the bottom tend to become soggy and cannot get enough air.

The maggots continue to excrete water and waste after they have been removed from media and they also have tendencies to aggregate when placed in flour. Thus, you may also want to check and shake the flour and maggots periodically to prevent aggregation into large soggy clumps.

The maggots will pupate in the flour and the largest of these may be selected again, by sifting, for breeding.

### Scheduling New Cages

There are many options but, for starters, we would recommend at least one new cage, or whatever you need, each week. This will give you time to make sure that the fresh flies are doing well before you discard old cages.

Cages may be discarded after 2 weeks if you have good breeders to replace them. The flies may live for much longer but egg production tends to drop after 10-14 days and fresh flies will do better. The cages also tend to get a bit cruddy after a couple weeks.

Start to select the largest maggots or pupae 3-4 days before you want to start new cages and add about 1 gram of pupae per cage,

# Using Maggots and Flies for Feeding

## Using Fruit Fly Maggots and Flies as Feeders



Harvesting live maggots, instead of flies, simplifies just about everything and gives you a lot of choices. You can sift out maggots of different sizes to feed animals of different sizes and you can feed with maggots, adult flies or both. Uneaten maggots will pupate and your animals will get adult flies a few days later.

A big advantage is that you do not have to use an aspirator or anesthetize or cool flies to feed your animals.

Spider Pharm usually separates fruit fly maggots into 3-4 sizes:

**18 Mesh Maggots (large)** stay on top of an 18 mesh (window screening) screen when shaken.

**25 Mesh Maggots (medium)** easily shake through 18 mesh but stay on top of a 25 mesh sifter when shaken.

**35 Mesh Maggots (small)** easily shake through the 18 and 25 mesh screens but stay on top of a 35 mesh screen when shaken.

**40 Mesh Maggots (very small)** pass everything else but are retained by a 40 mesh screen when shaken.

This only takes a minute of work and about 15-30 minutes total if you use a stacking set of sifters. Simply add the maggots and flour to the top of the stack, cover and shake for about one minute. Separate the sifters, place them on separate pans or dishes and give the maggots time to crawl through.

Most large and medium maggots will pupate and the large are best to use for breeders. Medium maggots will produce smaller flies that may be used to feed smaller animals that need flying food. Most small and all very small maggots will die without pupating but are very useful for feeding very small animals, like hatchling house spiders.

Large and very small maggots should be used as soon as possible after sifting. The large ones tend to pupate rapidly and very small ones will die off within a few hours, though you may be able to keep them alive longer by keeping them at higher humidity. Medium and small maggots may last for more than a day and will also be available, as maggot-food, for longer periods of time.



### Feeding with Maggots

You may want to resift maggots again to make them easier to work with. When dry, it is easier to pour, spoon or aspirate what you need for each animal.

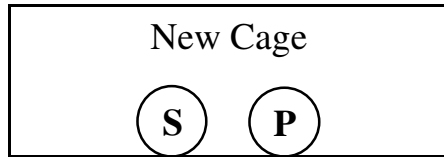
### Feeding with Pupae

Pupae are just as easy to use and you can time for the flies to emerge shortly after you add them to the cage.

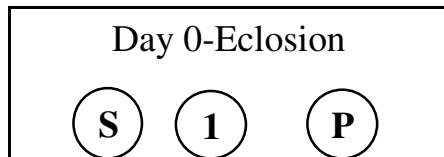
### Feeding with Adult Flies

You can use an aspirator (page 4) to dispense adult flies but we do not recommend frequent use of aspirators. They may increase your chances of becoming allergic to the flies and may also cause respiratory infections. Keep cages clean and make many aspirators, using a clean one each time you need to transfer flies. As an alternative, you can cool the flies, in the cage, in a refrigerator and collect flies in small vials for transfer.





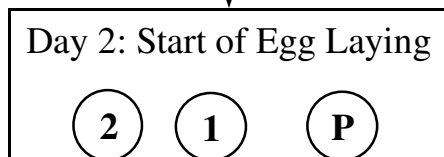
Open the vial of pupae in your new cage with a cup of sugar/water & chips.



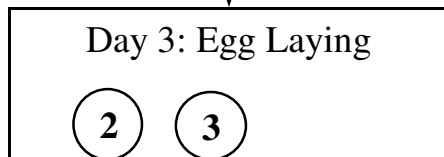
Add your first cup of dog food media when you start to see flies emerge (eclose) from their pupae.



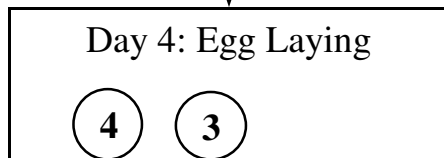
Just watch them. You may start to see some courtship activity as soon as a day after the flies start to emerge.



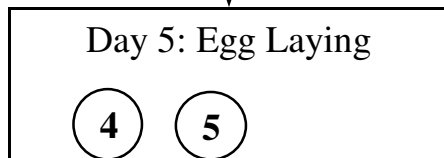
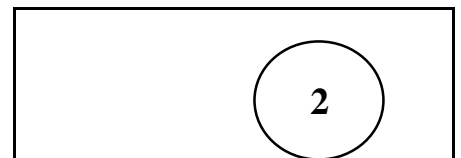
Add a 2nd cup of fly media and discard the sugar water. Some of the flies may start to lay eggs, but you won't get many yet.



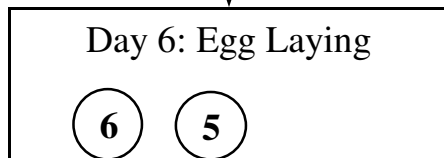
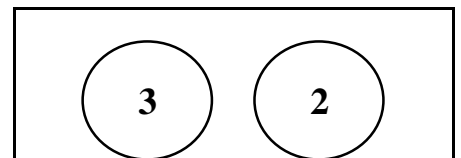
Add a 3rd cup of fly media and discard the 1st. You should be getting more eggs by now.



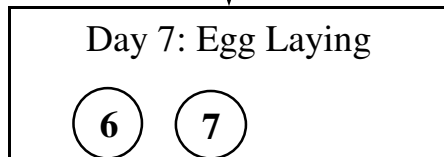
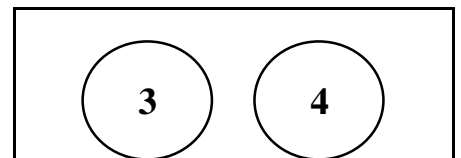
Add a 4th cup of fly media and transfer the 2nd to fresh media. Egg laying should be very good by now.



Add a 5th cup of fly media and transfer the 3rd to fresh media. You should be getting more eggs by now.



Add a 6th cup of fly media. Transfer the 4th to fresh media. Stir the chips & media in the 3rd. Sift maggots from the 2nd.



Add a 7th cup of fly media. Transfer the 5th to fresh media. Stir the chips & media in the 4th. Sift maggots from the 3rd.

