

Queen Rearing and Honeybee Breeding

A Detailed Introduction

<http://BeeUntoOthers.com/queenrearing.pdf>

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Golden Rule Honey

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Why Raise Your Own Queens?

- “Queen Rearing Is Too Important A Task To Leave To Someone Else.” - James Powers
- An Important And Rewarding Dimension Of Keeping Bees
- Allows The Beekeeper To Build On Genetics (Instead Of Replacing Them)
- Nutrition Is Paramount, Mating, *Then* Genetics...Grow Your Own Pays Off With Queen Rearing
- You Can Raise High Quality Queens With Minimal Expense And Work
- The Beekeeping Industry Needs More Actual Breeders...There Is Room Commercially
- Now That You Know How, You Won't Be Able To Help Yourself

What You Can Expect

- If You Prepare Properly, You Will Be Able To Raise More Queens Than You Can Use
- A Reasonably Well Mated Queen With Moderate Genetics Will Perform Well
- If You Maintain Stock From Year To Year And Apply Some Selection Pressures, You Will Develop Your Own Somewhat Uniform Strain

How Queens Are Raised By The Beekeeper

- Queens are raised by bees as part of a system. This system has to be in place, primed, nourished, and well provisioned. Only after there is a “queen shaped hole” in the system will the system produce a queen.
- What is required for Rearing Queens?
 - At least one strong hive
 - More queens require more resources
- Timing for making up cell builders, mating, checking and not disturbing the new colony.
 - Make up cell builders a day or two before grafting...they should “feel” ready for cells
 - Place grafted cups into cell starter immediately after grafting (the sooner the better)
 - Check after a day or two (and move to finisher if applicable)
 - Leave until 9 or 10 days after grafting, then move to queenless or queenright colonies, cell incubator frame, or incubator
- Introducing via different methods
 - Direct Release
 - Indirect Release
 - Emerge/Release

Methods Overview

- Walk Away Split
 - Simple To Perform
 - Leaves Queenless Half Without A Laying Queen For 3+ Weeks, No New Bees For 1.5 Months
 - Can Forestall Swarming Urge, Break In Brood Cycle
- In its simplest form, a walk away split is just that...split the colony, and walk away.
- Most beekeepers take care to balance the various resources (comb, stores, pollen, laying queen, brood, foragers, house bees) appropriately between the parent colony and the split. Most importantly, if both parts of the split have eggs, open brood (with adhering bees), pollen, honey, and plenty of bees to cover the brood and stores, then it doesn't really matter where the queen is..Whichever half of the split is without a queen will raise one.
- The downside of the walk away split is that it takes about 6 weeks before any of the bees in the split will be replaced by emerging brood....this is a long time when bees are dying of old age in the meantime. It is helpful if you can add a frame of capped brood about three weeks after making the split...this gives a boost of young bees to act as nurse bees to the brood that the newly mated queen will be laying.



Methods Overview

- Harvest Cells
 - Saves Time Over Walk Away
 - Usually Produced Out Of Abundance
 - Requires No Planning...“Split Of Convenience”
 - Can Be Used In Conjunction With Swarm Prevention
- Sometimes during an inspection one finds queen cells (swarm or supersedure) and in order to increase the number of hives, make up a nucleus colony, or to deal with a swarming situation, the beekeeper decides to use these cells to make a split.
- One must be careful here. Capped queen cells go through a period of being quite fragile before they are “ripe”. When you come across a capped queen cell on a frame during an inspection, you usually don’t know exactly how old it is, so you don’t know when it will emerge, and when it is fragile.
- The bees are pretty good at hiding queen cells in corners here and there...you might not see it until you have already shaken bees off of the frame. Keep this in mind...if you expect to find queen cells, and you have plans to use those queen cells, then take more than normal care not to jar or bump frames, and use a brush (or a tuft of tall grass) instead of shaking frames to remove the bees.

Methods Overview

- Force Cells
 - Are Produced Out Of Abundance
 - Can Be Timed For Proper Handling
 - Can Be Made Available For The Convenience Of The Beekeeper
 - Comb Can Be Trimmed For Better Results
- If you want to raise a few queens from one colony, and don't want to mess around with grafting, graftless systems, or other complicated manipulations, you can force the bees to produce swarm cells through crowding.
- Essentially, take bees that are occupying 2 or more boxes of eggs, brood, and stores. Simply remove most of the boxes, leaving behind a single hive body (with a top and bottom) overflowing with bees, and at least 6 frames with eggs and open brood in the middle...also making sure there is honey and pollen on the outside frames.
- The open brood will keep the bees in the hive (even if they are bearded out all over), and the crowded conditions will cause the bees to raise queens in earnest from the young larvae. This method almost guarantees well fed queens (as there is an overabundance of resources)...one could also trim some of the comb in the middle of the box (as in the Miller method) to make it easier to cut out cells, as they will tend to be right where the comb is cut.

Trim Comb



Crowd the Bees



Cells You Can Use!



Methods Overview

- Hopkins Method
 - Requires Either Sacrificing A Comb, Or Modifying A Super
 - Most Cells With The Least Amount Of Work
- Miller Method
 - Eggs/Young Larvae Are Prepared Or Found On New Comb
 - Comb Is Trimmed To Eggs Or Youngest Larvae
- Alley Method
 - Specific Aged Eggs Are Procured
 - Eggs Mounted To Comb
- Smith Method
 - Eggs Prepared As In Alley Method
 - Strips Of Comb Attached To Bars
- Doolittle Method
 - Grafting Works Well
 - Can Be Done With No Prep Work

Methods Overview

- Common Aspects
 - Bees Must Want Queens
 - Larvae Of Proper Age Are Offered
 - Must Be Enough Resources Available For The Number Of Queens Being Raised...More Than A Few Requires That Extraordinary Conditions Be Constructed
 - Cells Must Be Separable Enough

Grafting Tools and Supplies

- Grafting Tools
 - Traditional
 - Plastic
 - “Natural” “Homemade”
 - “Chinese Grafting Tool”
- The most commonly seen grafting tool is either manufactured or homemade out of metal (preferably stainless steel, but common paper clips are also used). Known as a “grafting needle” or a “German grafting tool”, it is essentially a small “scoop” or “spoon” bent in such a way that it can be slid under the larvae to remove it, and slid out from under the larvae to place it in a queen cup. Generally, grafting with this type of tool requires priming the cup.
- I am sure that if one is really doing a lot of grafting (hundreds of cells/day) that this is the most efficient way to go. With that said, most breeders we know are of modest size, and have no need (or resources) to graft every day, or to graft that many cells. Other tools offer other advantages (such as the ability to graft without priming), and are found to be more useful for most (not all) small to modest sized breeders.

Grafting Tools and Supplies

- Cell Cups
 - Traditional Wax
 - Plastic
- Cell Bars
- Cell Bar Frames
- Lighting
- Magnification

Grafting Tools and Supplies

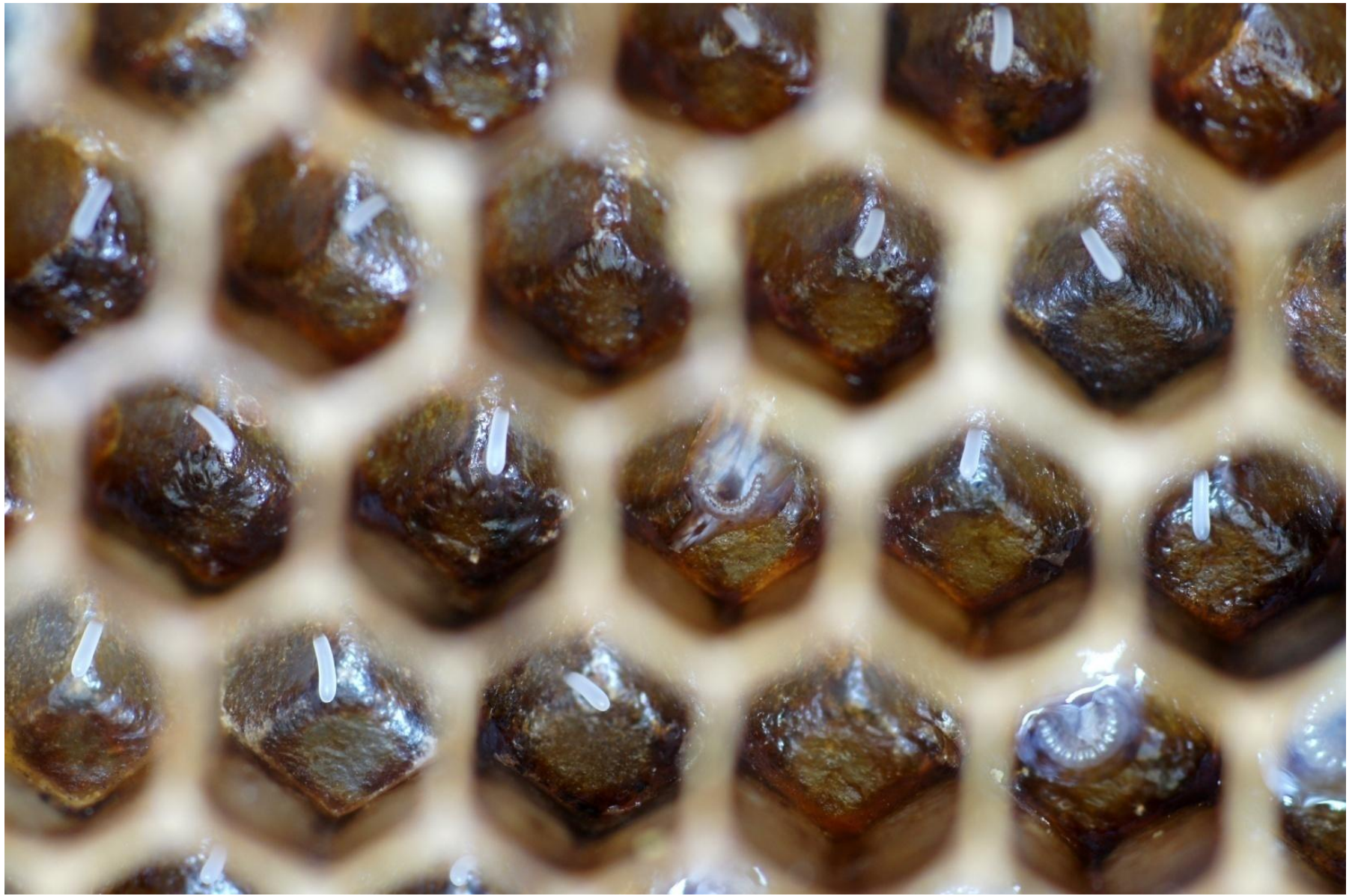
- Larvae
 - Be Prepared Or “Catch As Catch Can”
 - Proper Age Larvae Helps With All Methods
 - Old Dark Comb Makes Things Easier

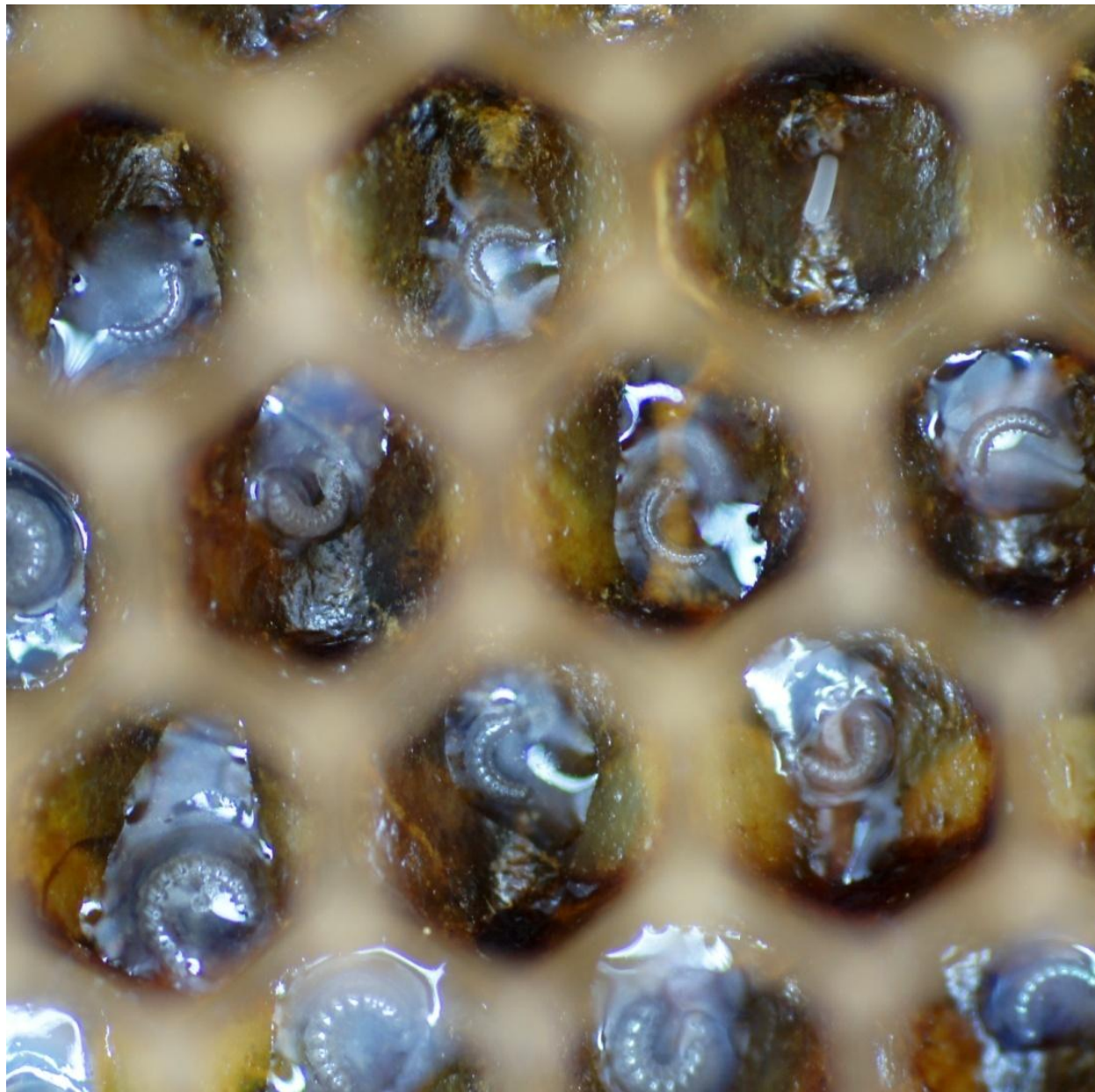
Setting “The Mood”

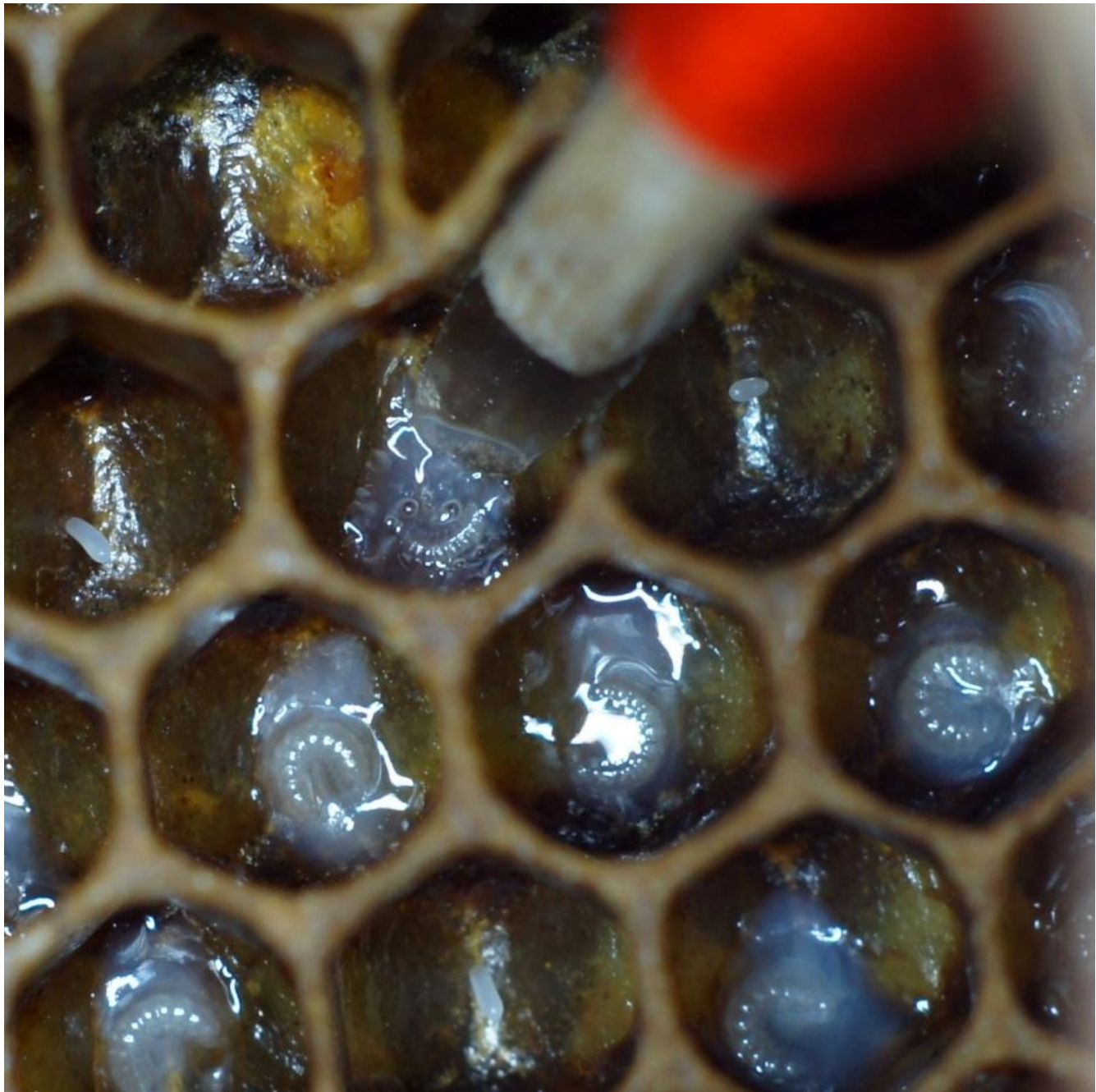
- Need Bees That Want A Queen
- Need Abundant (Overabundant) Nurse Bees
- Fresh Pollen
- Incoming Food
- Grafts Of The Proper Age

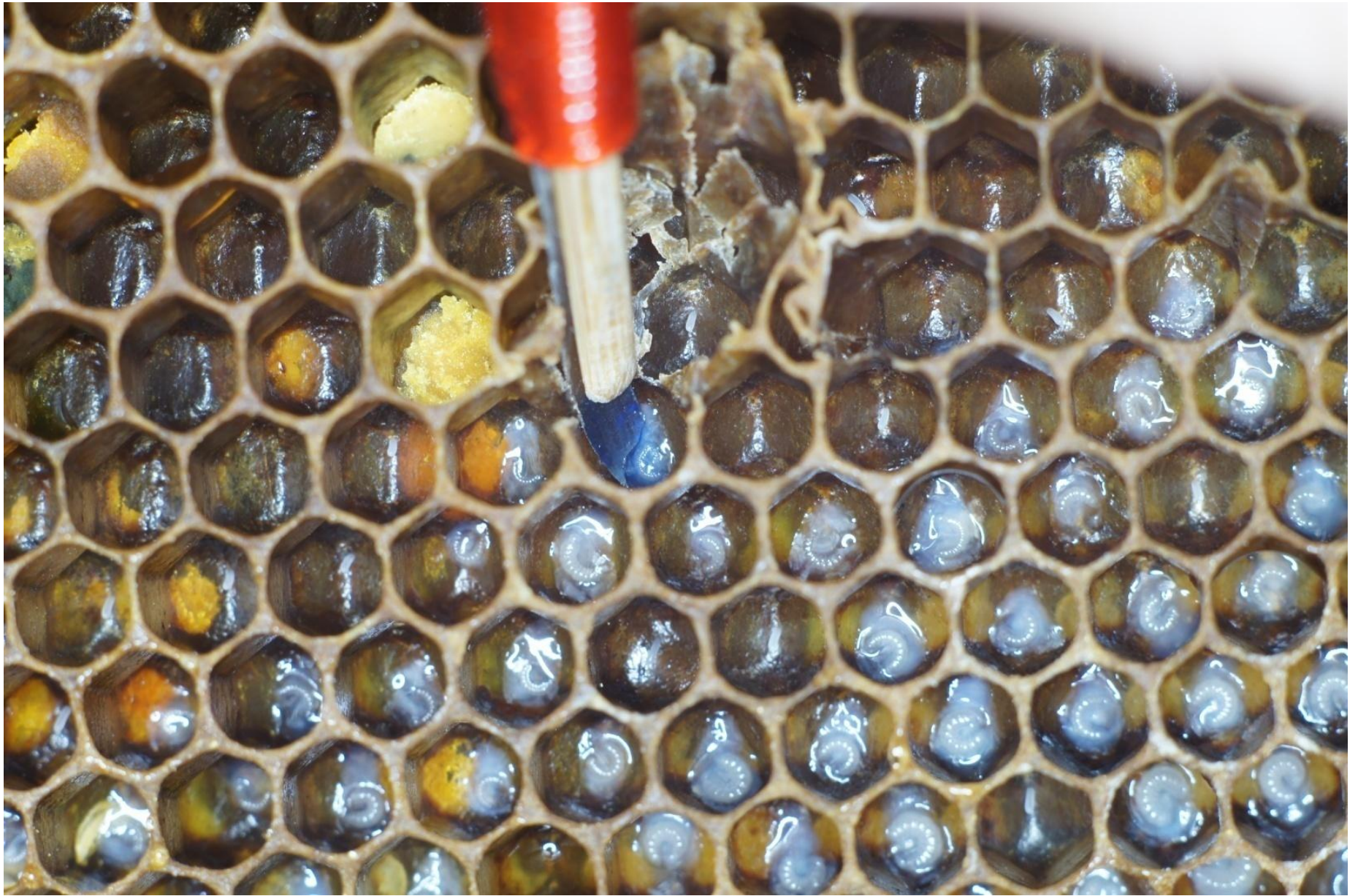
Grafting Process

- Don't Flip The Larvae!
- Larvae Requires Food
 - Priming?
 - “Double Grafting”?
 - None Of The Above?
 - Pre-feed?









Heat/Humidity

- Larvae Will Cook In The Sun
- Larvae Will Dry Out
- Larvae Will Chill
- Warm, Damp Cloth Can Cover Broodframe Or Cellbar
- Best Care For Larvae Comes From Bees

Mating Mechanics

- Virgin Emerges
- Matures/Colonized/Hardens
- Orientation Flights
- Mating Flight(S)
- Mating Environments
- Mating Nuc
- Requeening
- Outside Environment

Cell Builders

- Starter
 - Ripe With Nurse Bees
 - Fresh Pollen
 - Incoming Nectar (Or Feed)
- Refresh With Emerging Brood

Cell Builders

- Finisher
 - Open Brood Above Excluder
 - Strong Finisher Can Finish Many Cells
 - Rotate Frames So Capped Brood Is Below Excluder With Queen And Open Comb

Cell Builders

- Starter/Finisher
 - If You Only Need 1 or 2 Grafts, You Can Start And Finish In The Same Hive
 - Leave A Cell With The Starter/Finisher
- Cloake Board:
 - A Good Way To Raise Queens Without Disrupting Colonies
 - Starter And Finisher In One
 - Good Instructions: Honeybeesuite.Com/?P=829
 - Cloake Board Not Required

Drone Source

- Are There Drones Available?
- If So, Are They Desirable?
- Methods To Control Drone Population
 - II
 - Drone Saturation
 - Isolation

Broader Picture/Resources

- Older Books On Michael Bush's Website
<http://bushfarms.com/beesoldbooks.htm>
- KirkWebster.com
- Kirsten Ebbersten
- Paige and Laidlaw
- Pellett
- Upcoming Mike Palmer Book

Honeybee Genetics

- Haploid Genetics
 - Queens: “Deep And Narrow”
 - Drones: “Shallow And Wide”
- Defect, Injury, Mismating, Age, Demise, Etc.
Leads To Drone Production

Doing It Like Rabbits (Or People)

Girl Bunny 

Boy Bunny 

Egg 

Sperm 

Doing It Like Rabbits (Or People)

Girl Bunny 

Boy Bunny 

Egg 

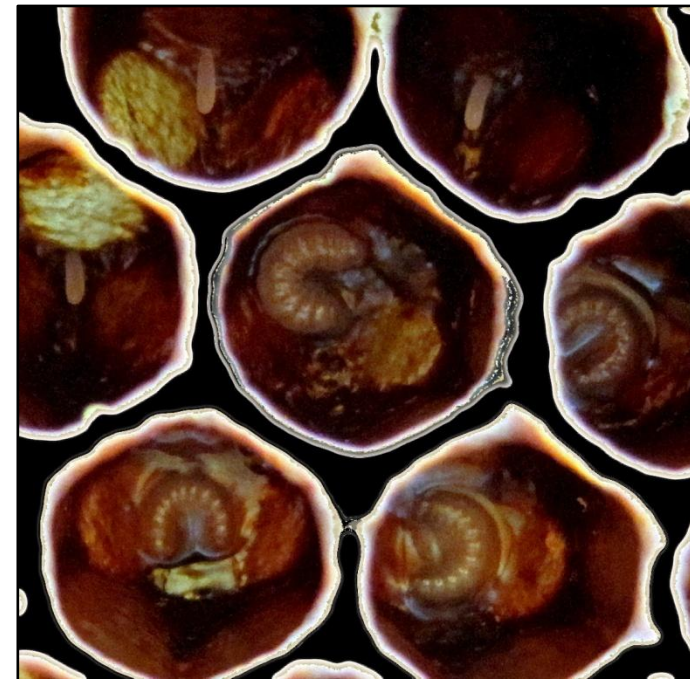
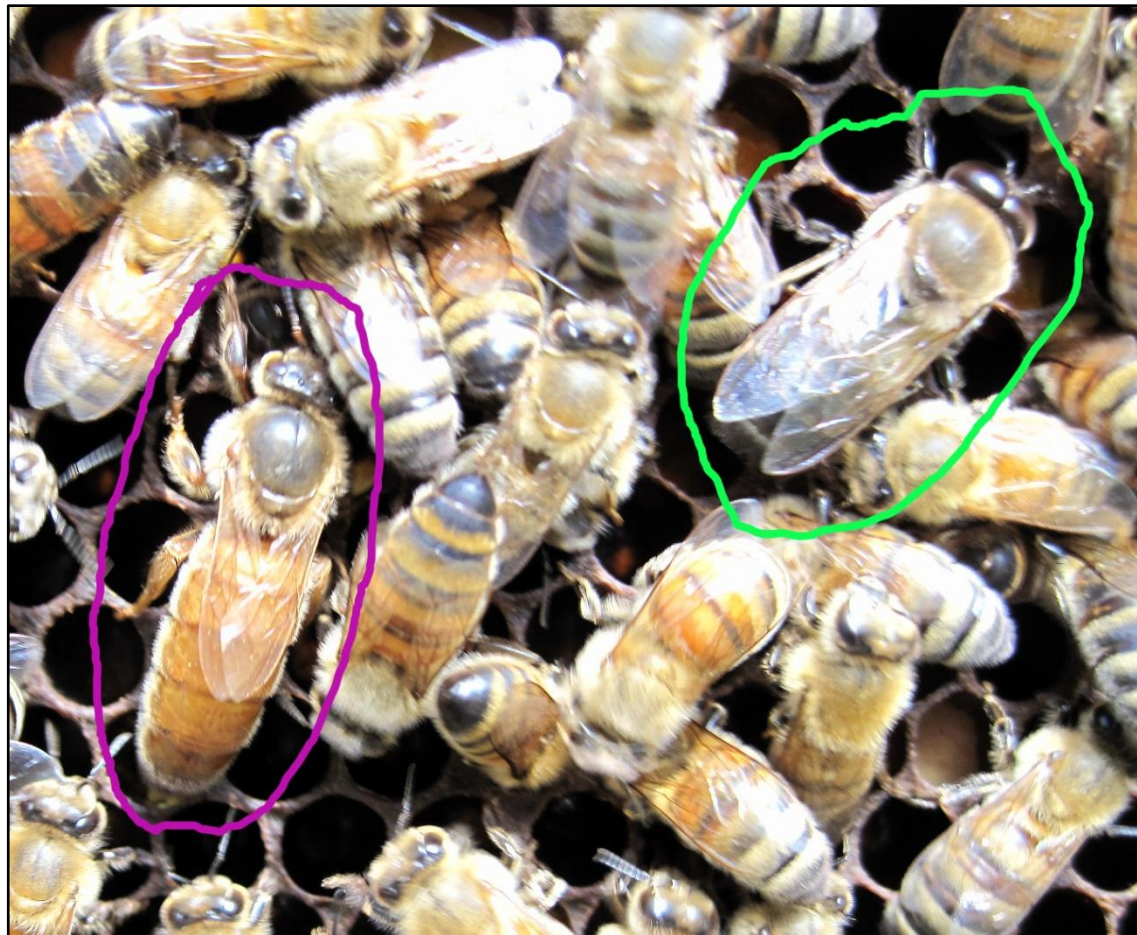
Sperm 

┌───────────┴───────────┐
"Special Hug"

┆
Baby Bunny



Caste Of Characters



Bee Genetics: The Worker

- Workers make up 80% of the colony.
- Workers do all the actual work except for laying eggs and mating with queens.
- Workers generally do not lay eggs.
- Workers Are nutritionally Stunted Queens.

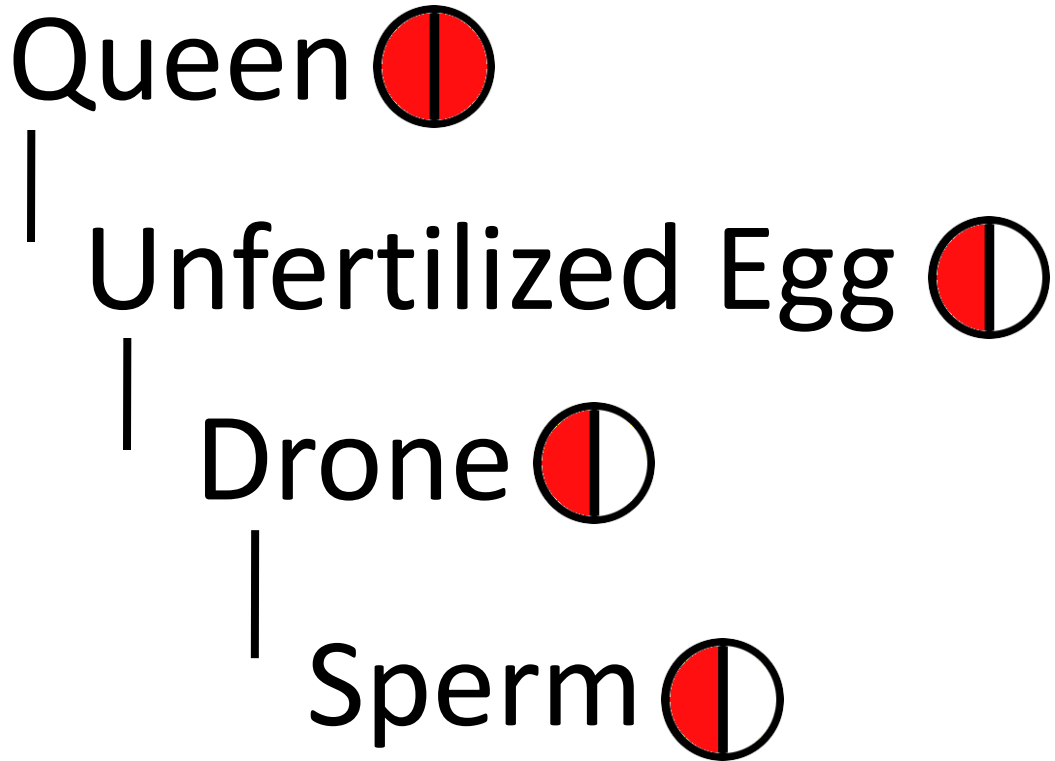
Bee Genetics: The Drone

- Drones are produced from unfertilized eggs.
- When drones mate, their penis explodes and they die :(
- All of the sperm in a given drone is identical.

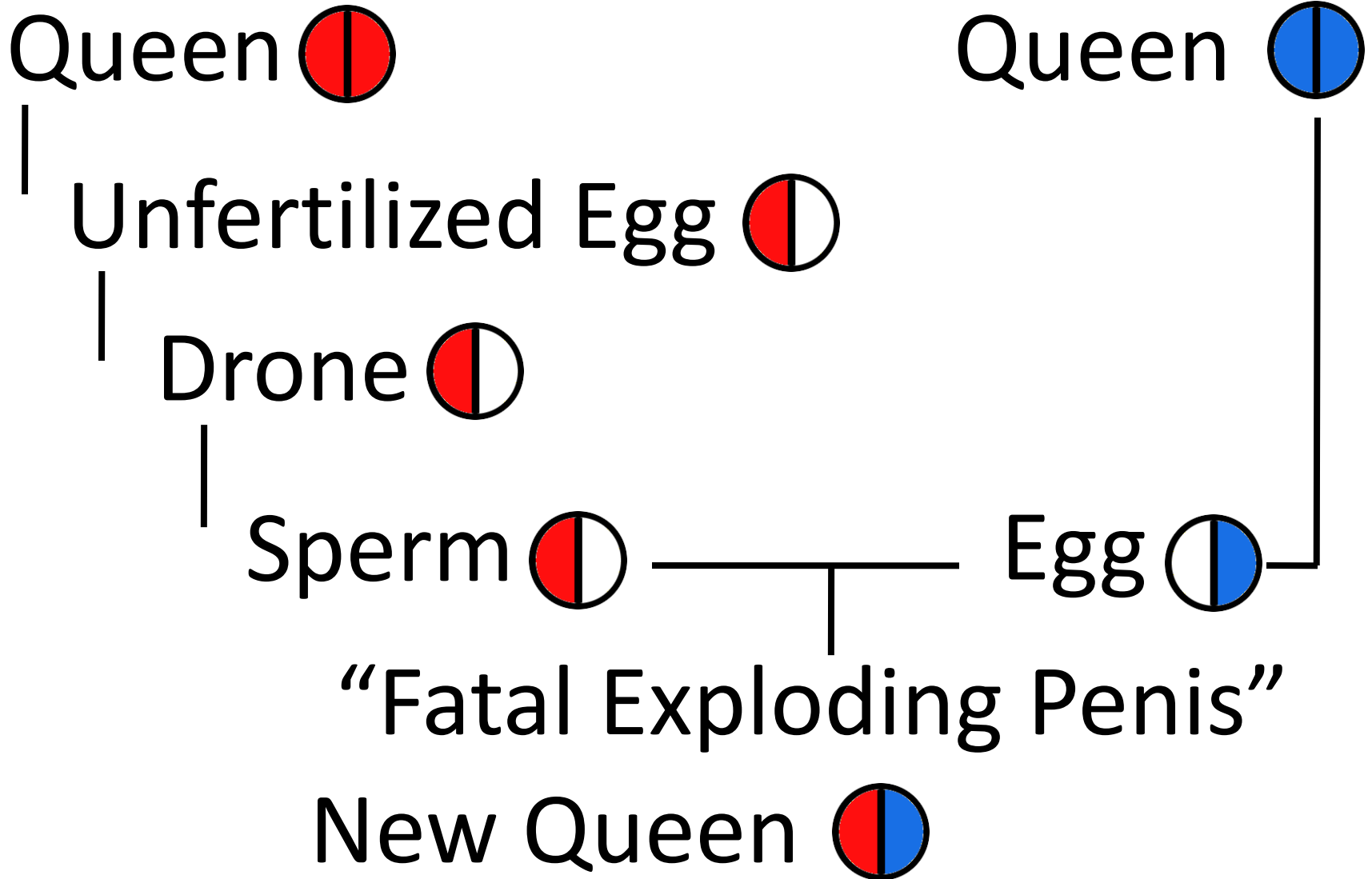
Bee Genetics: The Queen

- Queens and workers are genetically identical.
- Queens are fed a more protein rich diet than workers.
- A queen mates with 8-30 drones in her first few weeks and stores/nourishes sperm up to 5 years.

When Two Queens Come-A Courtin'



When Two Queens Come-A Courtin'



The Next Generation

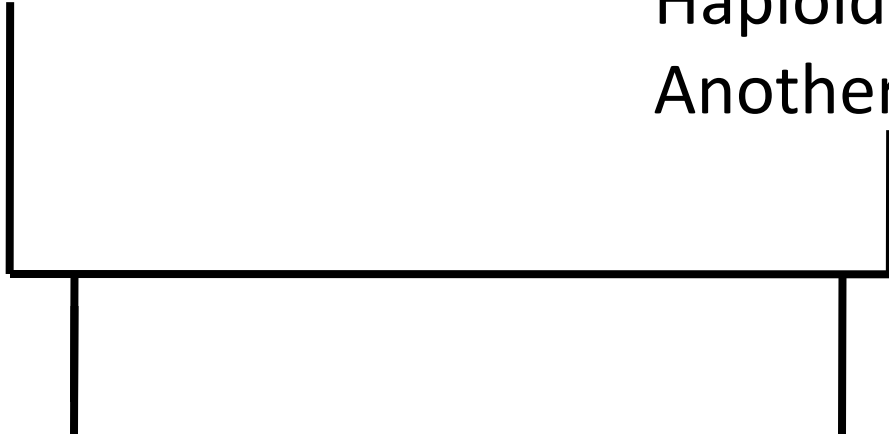
Queen 

Drone 

Haploid Clone Of
Another Queen

Queen/Worker

Drone



The Next Generation

This generation of drone is a reflection of the previous generation's success...not a new experimental combination.

Queen/Worker

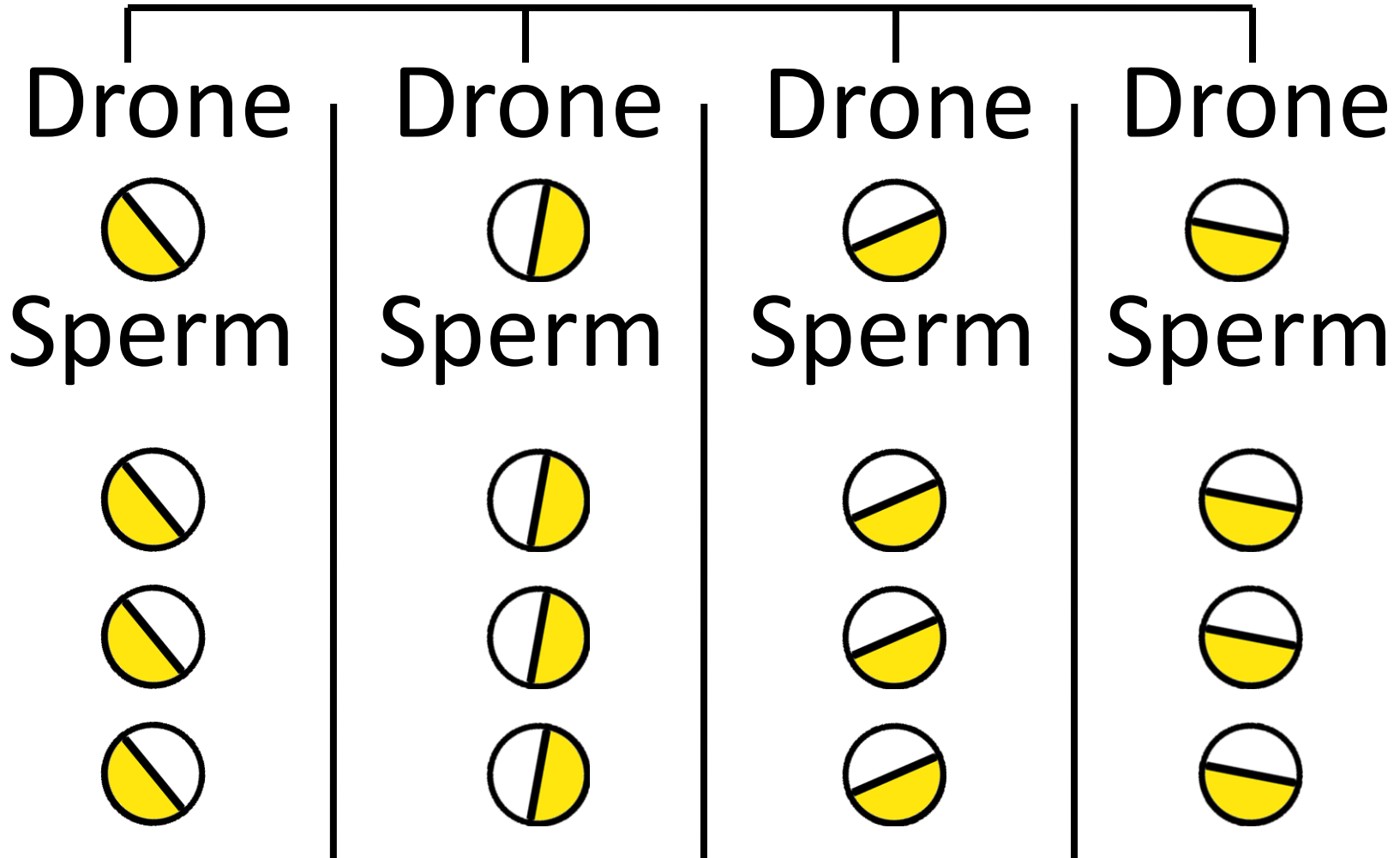


Drone



Drones Produced By A Queen

Queen 



Drones Mating With A Queen

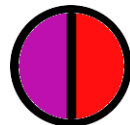
Drone Drone Drone Drone Queen



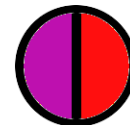
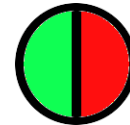
Drones



Workers

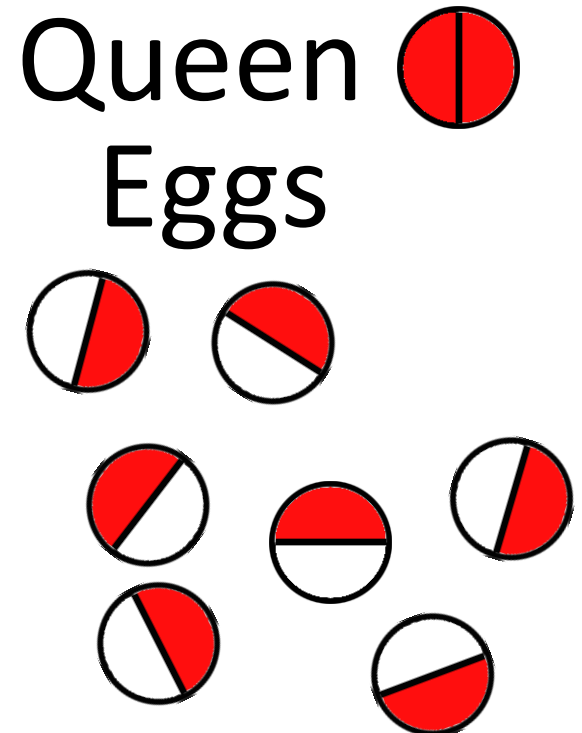


Queens



Eggs Are Different Too

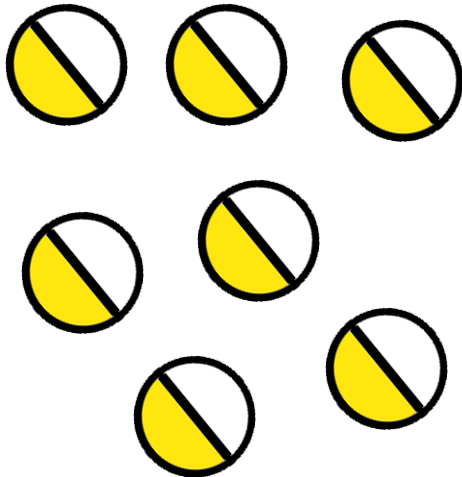
- Eggs are each different “halves” of the queen’s genes.



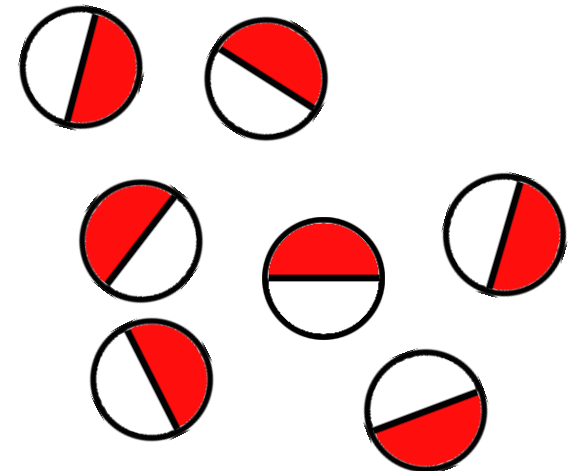
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- There is a limited set of sperm genetics in 8-30 sets of identical sperm.

Drone 
Sperm

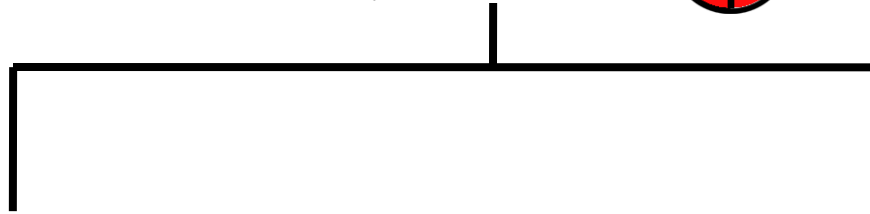


Queen 
Eggs



Queenright

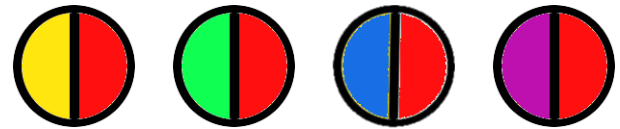
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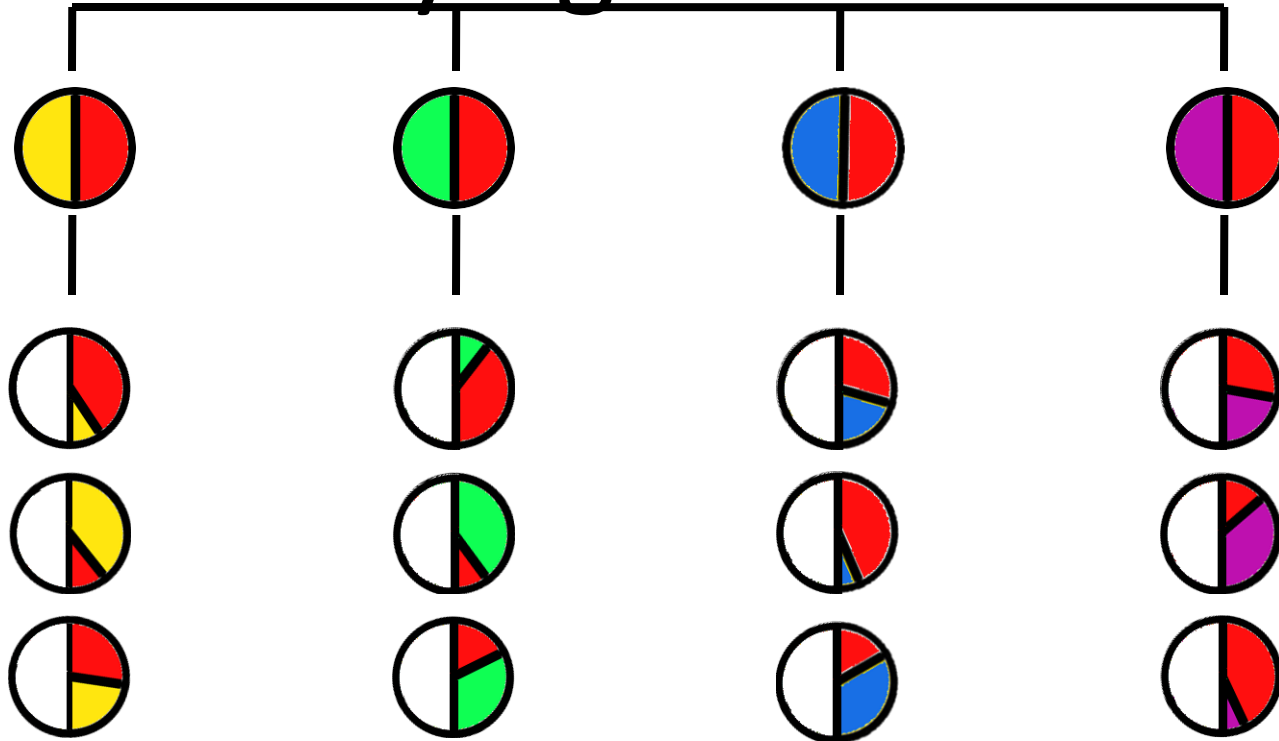
Workers



Hopelessly Queenless

Queen  Dead

Laying Workers



So What?

- All of this adds up to a variety of genetic traits for the colony to draw upon...more than any two sets of genes could provide.
- Traits that give advantage are propagated, but do not quickly crowd out other (sometimes opposing) traits that have proven useful in the past...."trait hoarding".

Where Is Mendel On This?

- Mendel turned his attention to breeding the honeybee...and failed.
 - He did not understand haploid genetics.
 - “Multiple matings” of a queen was not a “Church Friendly Concept”.

Drone Considerations

- Drone Colonies
- Drone Congregation Areas
- Saturation
- Isolation
- “Drone Right” Colonies

Breeding Honeybees

- Raising Queens (Even If Grafting On A Large Scale) Is Not “Breeding”
- Mix And Match Is Popular, But Does Not Go Far Enough
- A Breeding Program (No Matter How Small) Must Seek Some Uniformity Of Stock
 - You Must Either Start With What You Have, Or Bring In Lines To Cross All At Once...Don’t Fall For Constant “The Bee Is Always Greener” Trap
 - You Will Produce Excellent Queens With Almost Any Genetics If They Are Well Nourished And Well Bred...Uniform Or Not, But “Mishmash Genetics” Offer Nothing Predictable Genetically For Crossing
 - Uniform Stock Has Consistent Traits That Make It Desirable For Crossing

Breeding Honeybees

- Attempt To Push In The Direction Of A Natural Selection Process
 - Inbreeding Fixes Traits
 - Outbreeding Results In “Vigor”
 - Inbreeding Is Easy To Detect In Honeybees, And Easy To Avoid
 - Consider Introducing New Stock Via Drones
- No Matter How Tightly You Try To Control Things, The Bees Will Find Some Way To Defy You

Breeding Honeybees

- Assist Others
 - Virgins Are Cheap To Produce Once You Are Setup To Produce Them
 - Share Stock With Your Neighbors, These Queens Will Head Up “Drone Colonies” That Might Mate With Your Queens
- Ideally, Only Take Desirable Stock Into Your Own Operation

Breeding Honeybees

- The Economics Of Mated Queens
 - Mating Nucs Tie Up Significant Resources
 - Proper Mating/Proving Takes Significant Time
 - Require More Handling Precautions As More Resources Tied Up In Each Queen

Scale

- Even On A Small Scale, Without Grafting, One Can Raise First Rate Queens For Yourself And Your Neighbors
- With A Larger Number Of Colonies, Stock Can Be Selected And Crossed, An Actual Breeding Program Can Be Established
- Progress On The Population Scale Is Assured

More Advanced Topics

- Advanced Queen Rearing Topics
 - Genetics/Breeding
 - Rearing Queens For Drone Production
 - HYG and VSH?
 - Scheduling
 - Mating Nucs
 - Shipping
 - Support

A Localized Breeding Program
or
Is VSH for Y.O.U.?

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Traits

- Mite counts, spring buildup, frugality, brood pattern, queen age, etc.....

Meta Traits

- Survivability
- Productivity
- Temperment

HYG

- Present in all populations

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- Care must be taken to compare like to like
 - Colony strength, flow, weather, etc

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- VSH queens and breeder queens are of variable and unknown expression rates of VSH from virtually all sources
- Probably a good solution if one wants to bring in VSH breeder stock every year

The VSH X Local Genetics Trap

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5. You might as well have started with VSH expression at “mean” levels
6. ...and you have less mite resistant traits to work with

What To Do?

- Start with something
 - The queen is always greener
 - Either start with what you have, or bring in something “better”
 - Select and breed (rinse and repeat)
 - Bottlenecks are necessary
 - Some level of uniformity is the goal

Decentralize

- 10 small programs is more valuable than 1 big program
 - Genetics
 - Choices
 - Education
 - Crossing

Breeding Is A Process

- There is no “goal” ...just always “improvement”
- There is nothing you can buy that is good enough
- You can't fix a problem by turning the natural model on its head
- Everything boils down to survivability, productivity and temperment...we don't have metrics that can predict these things