Specific Gravity: Into the Black Hole of Brewing

MEAD!

Dave Aronson, King Bee,
Sum of a Batch Mead School

Image: https://www.flickr.com/photos/historiska/6881055549

Speaker notes

Welcome to Specific Gravity: Into the Black Hole of Brewing MEAD!

I'm Dave Aronson, a Mensan and a mazer. That was originally a word for a certain type of cup or bowl, often used for drinking mead, but now also means a person who brews mead. For many of us . . .

Image: https://i.imgur.com/VOYovPU.gif

Speaker notes

. . . scientifically-minded folks, learning the concept of specific gravity is the event horizon, where we really get sucked into the hobby.

Before we get started, I want to answer the big question on everybody's mind: sorry, no, I'm not giving out samples . . . at least, at this talk. But, I'll be around for the rest of the RG, and if you're lucky, you might catch me with some to share.

Some of you may have attended my talk here a few years ago, Drink Like a Chinese Egyptian and so on Viking, on the history and making of mead, but many of you probably didn't, so we'll start with a quick recap of the major points.

Speaker notes

Mead is an alcoholic beverage, somewhat like wine, but made by fermenting honey rather than fruit. It's generally thought to be the world's oldest alcoholic beverage. The earliest evidence we have for its production dates back to about 7,000 BCE, in . . .

@davearonson

Image: https://picryl.com/media/communist-china-2

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Speaker notes

. . . China! In every place with bees productive enough for humans to harvest enough honey to make it, mead has made its way into the culture, including . . .

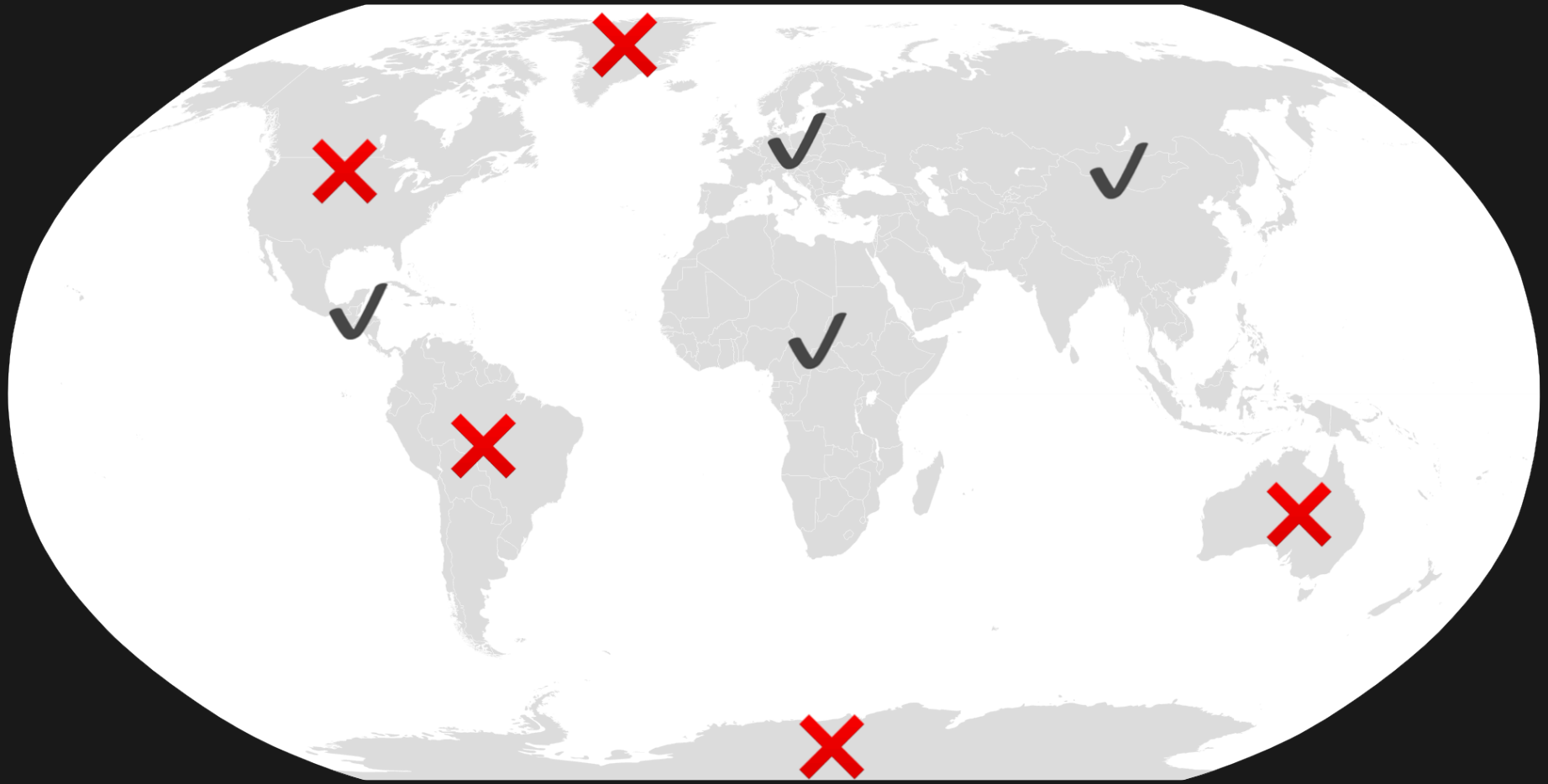

Image: https://pixabay.com/vectors/world-map-globe-geography-earth-47959/

Speaker notes

... all over Europe, Asia, Africa, and even parts of Central America! Of course these widely varying cultures made it in widely varying ways, including the sweetness, strength, and what else they added to it. It can range from bone-dry to cloyingly sweet, negligibly alcoholic to about 20%, even more if fortified, plain to strongly flavored, and still to highly carbonated, and it can be served chilled, room temperature, or warmed.

@davearonson

Image: https://commons.wikimedia.org/wiki/File:Honey-Fruit-Mead-Brewing.jpg

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Speaker notes

Making it can be quite simple. At its simplest, you just mix up a little honey, some water, and some yeast, ideally cover it so bugs don't get in, but don't seal it up tight so the CO2 can't escape, let it sit for a while, probably a few weeks or so, somewhere around room temperature, away from direct sunlight, and . . .

A B V

Images: AOL guy (forgot source) + https://pixabay.com/vectors/white-wine-wine-glass-drink-303169/

Speaker notes

... ta-dah, You've Got Mead! However, it will have a layer of sludge on the bottom, composed mainly of dead yeast, some live yeast, and assorted other things from the honey, like some proteins and pollen and so on.

Most of the rest of my previous talk, was mostly lists of what cultures drank it how, various other choices, how to make a simple small batch at home with only things you'll find at a typical grocery store, and some details of how hobbyists like myself would do it differently. So this talk is mainly on one of the two most important things about actually brewing mead. To touch briefly on the other one, which is actually more important, that is . . .


SANITIZE
ALL THE THINGS!
imgflip.com

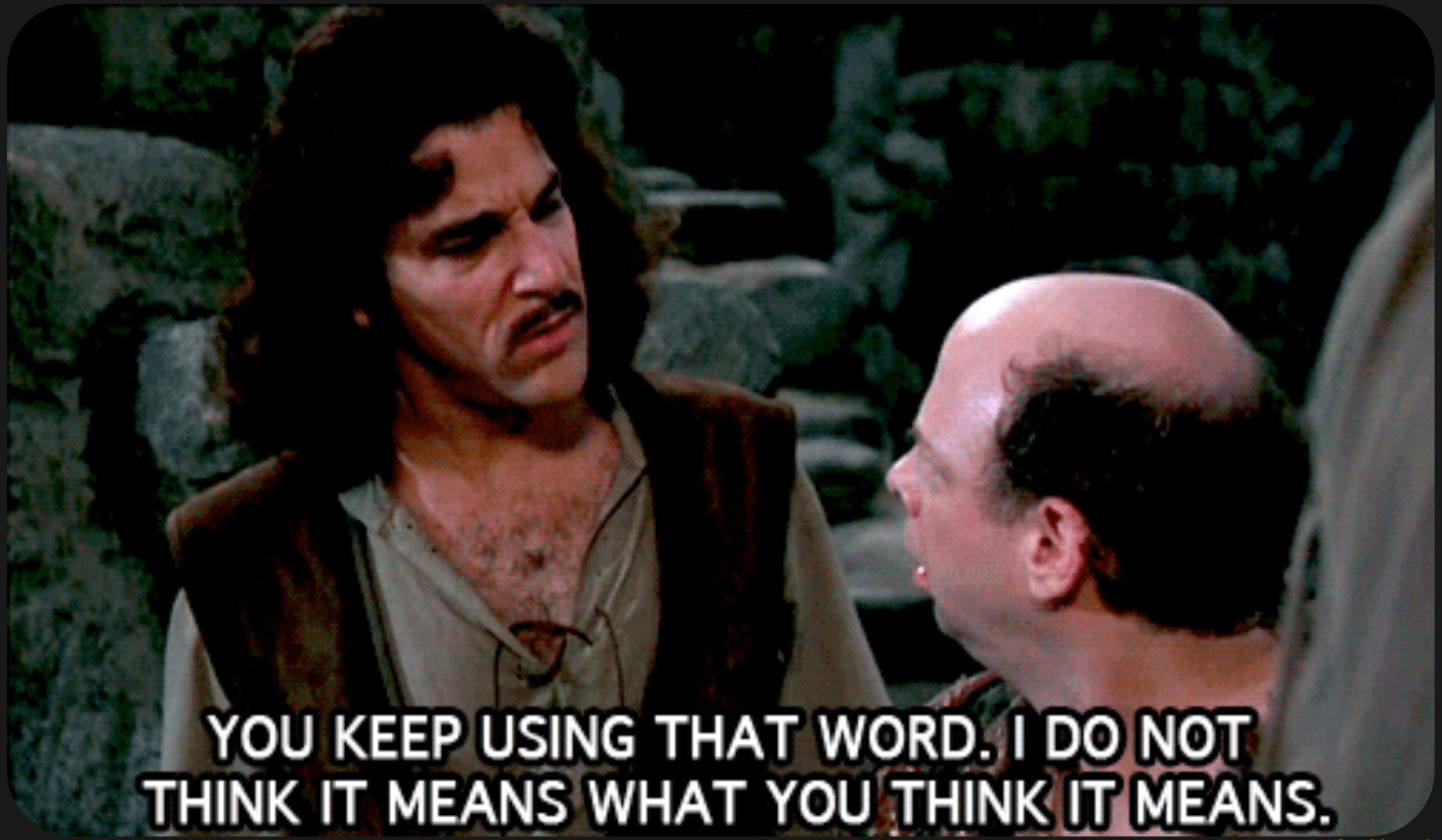
Speaker notes

. . . sanitizing your equipment, but there's not really all that much to say about that. Mainly, to quote . . .


JUST DO IT.

Speaker notes

. . . Nike, Just Do It. But what do I mean by "sanitizing"? What's the difference between "sanitized" and "clean"? In the brewing world, the word "clean" . . .


YOU KEEP USING THAT WORD. I DO NOT
THINK IT MEANS WHAT YOU THINK IT MEANS.

Speaker notes

. . . doesn't mean what you think it means. There are basically four levels of cleanliness we refer to: dirty means there is visible grime on something, clean just means there isn't, but means nothing about microbes, so we want things . . .


SANITIZED
FOR YOUR PROTECTION

Speaker notes

. . . sanitized, which means as free of microbes as reasonably practical without major effort and expense. You may recall me using the term "very clean" in my previous talk; that's basically laymen's terms for this. The last level is . . .

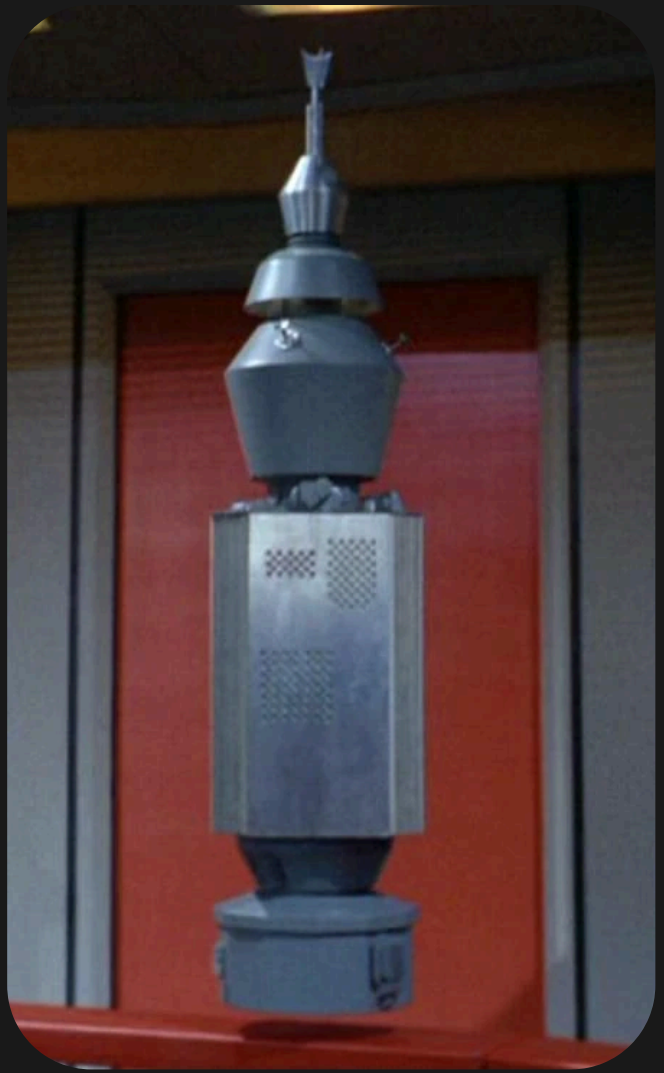


Image: from https://memory-alpha.fandom.com/wiki/Nomad - used w/o permission

Speaker notes

. . . "sterilized", and we mention it mainly in the context of what we don't need to achieve. This isn't open-heart surgery, so we don't need to autoclave everything. In fact, sanitizing isn't strictly necessary, but not doing so risks the mead getting some kind of infection, which will ruin it, so you can consider it cheap and easy insurance.

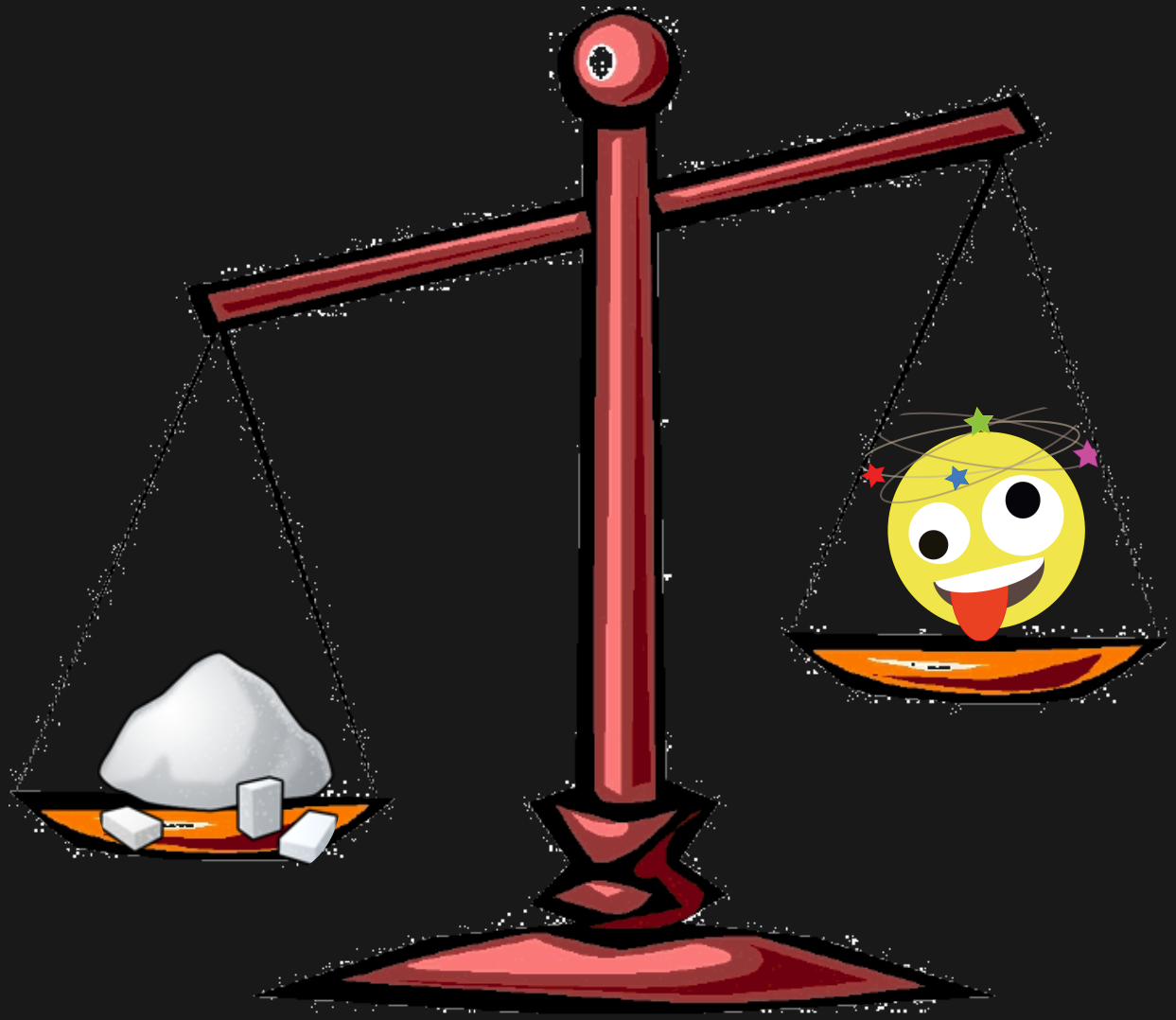
So how do we sanitize our equipment? There are sanitizing solutions, usually sold as . . .

Image: adapted from https://www.northernbrewer.com/products/star-san w/o permission but it's fair use

Speaker notes

. . . concentrates, so we mix up some reasonable quantity each time, and make sure that every surface that will touch our mead is wiped or sprayed or soaked with sanitizer. This one, Star-San, is a very popular colorless, odorless, tasteless, non-toxic, no-rinse, foaming sanitizer, and it's pretty cheap.

Moving on to the main topic, the most basic aspects of a batch of mead are the sweetness and strength. These are a . . .



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Images: https://pixy.org/src/424/4246773.gif + https://www.free-emoticons.com/view/6625/ + emoji

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Speaker notes

. . . balance. Given a set amount of honey, we can make it stronger, but that will make it drier, or we can make it sweeter, but that will make it weaker. So how do we plan what a batch of mead will be like, monitor the progress, and measure the strength and sweetness? It all boils down to the concept of specific . . .

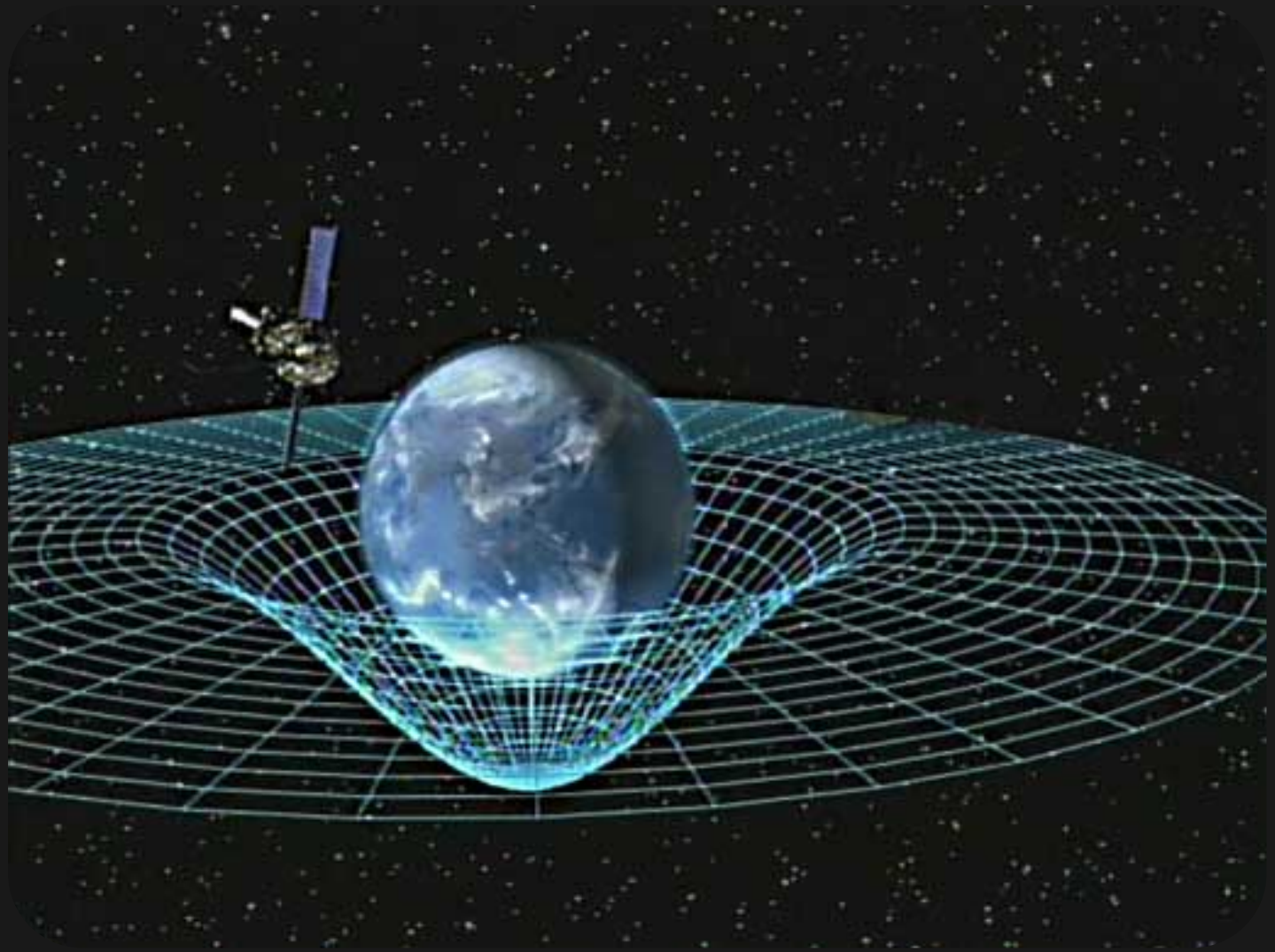


Image: https://www.flickr.com/photos/nasablueshift/7754612868

Speaker notes

. . . gravity, usually abbreviated SG. No, I don't mean as opposed to general gravity; as you may recall from high school physics class, the specific gravity of a substance is its density divided by that of water. So, something twice as dense as water will have an SG of 2, something one-tenth as dense as water will have an SG of one-tenth, and so on. The SG of honey varies fairly widely, due mostly to moisture content, but it's usually about . . .

Substance	SG
Honey	1.425
Water	1.000

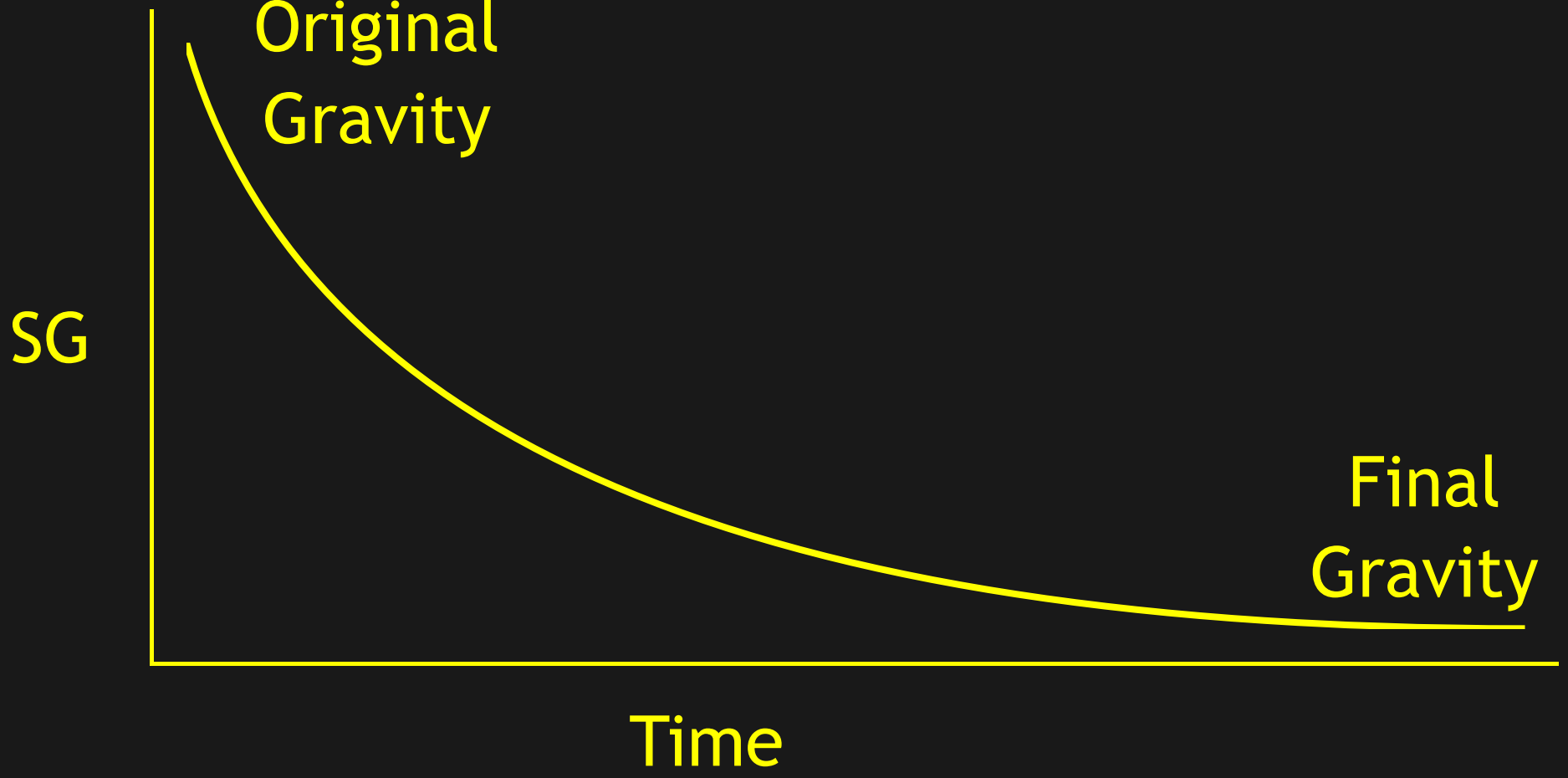
Speaker notes

1.425. That very conveniently works out to just a hair under 12 pounds per gallon, so we often use that as a shortcut. Even without that shortcut, it also works out to about 1.5 ounces avoirdupoids, in other words, standard weight ounces, per fluid ounce (don't get me started on our stupid American units of measure). The SG of alcohol, specifically ethanol, the kind of alcohol we can safely drink, within reason, is . . .

Substance	SG
Honey	1.425
Water	1.000
Ethanol	0.789

Speaker notes

. . . 0.789. So, if we mix up some honey and water, it's going to be denser than water, in other words its SG will be greater than 1. As those sugars, and some water, get converted to ethanol, and some CO2 that escapes, the overall SG . . .


Original
Gravity
SG
Final
Gravity
Time

Speaker notes

. . . decreases, from the start, where we measure the Original Gravity or OG, to the finish, where we measure the Final Gravity or FG. We can make use of this fact to tell when it's done, because the density will be stable, rather than continuing to decrease. We usually consider it finished fermenting if the SG is the same between two readings at least three days apart.

Furthermore, the SG roughly corresponds to how sweet it is, since the vast majority of what affects it in this case, other than water and alcohol, is sugar. As I mentioned earlier, there are some other things in honey, but they're a tiny proportion, compared to the sugar. So, we usually just ignore them and assume that everything above an SG of 1 is sugar. There are also other factors that affect perceived sweetness, like acids, tannins, alcohol, and temperature, but ignoring those, there isn't an official scale, but many people use roughly . . .

Low	High	Sweetness
-----	1.000	Too dry
1.000	1.010	Dry
1.010	1.015	Off-Dry
1.015	1.020	Semi-Sweet
1.020	1.030	Sweet
1.030	1.040	Dessert
1.040	-----	Call the Dentist!

Speaker notes

. . . this chart.

But all that is about the finished product, so how do we plan it out to wind up there? First we have to figure out how much sugar is going to get converted into alcohol, and then how much honey we need to put in, in order to provide that much sugar. The math is easier if we stop thinking in absolute numbers for a moment, and think more about change in SG, in units called . . .

1 Gravity Point (GP): 1/1,000 of a unit of SG (milli-SG?)

Speaker notes

. . . Gravity Points, usually appreviated to GP. These are each one-thousandth of a unit of specific gravity, so you can think of them as sort of a milli-SG. If it helps you remember it, you can think of Specific Gravity being so valuable in your quest for mead, that it's worth a thousand Gold Pieces. We can figure out the percent alcohol by volume, or ABV, from the . . .

$$\Delta SG = OG - FG$$

Speaker notes

. . . drop in SG, or delta-SG, the original gravity minus the final gravity. To figure out the %ABV after fermentation, we . . .

$$\%ABV = \Delta SG \ / \ 7.62 \ GP/\%$$

Speaker notes

. . . divide that drop by 7.62 GP per %ABV. We can plan our delta-SG, by flipping that formula around, and . . .

$$\Delta SG =$$

$$\%ABV * 7.62\ GP/\%$$

Speaker notes

. . . multiplying our desired ABV by 7.62. For instance, if we want 12% ABV, we need . . .

$$\Delta SG =$$

$$12\% * 7.62\ GP/\% =$$

$$91\ GP$$

Speaker notes

. . . 12 times 7.62 or 91.44 GP worth of sugar, which we can just round to 91, we're not usually very precise about this, in addition to any sugar we want left over, or added later, for sweetness. So, supposing we want it around the middle of the semi-sweet range, at 1.017, we need a total of . . .

91 + 17 = 108

(so SG 1.108)

Speaker notes

. . . the 91 GP for alcohol, and 17 GP for sweetness, for a total of 108 GP's worth of sugar, meaning we should start with an SG of 1.108. But how much honey do we need to put in, to get to that?

425 GP / 11.9 lbs

=

35.7 GP/lb

Speaker notes

As I said before, honey weighs a bit under 12 pounds per gallon. It's actually about 11.892. If we divide its sugars, the 425 GP from its SG of 1.425, by 11.892, we get 35.7 GPs per pound. This means that . . .

$$\frac{\text{pounds/gallon} * 36\ \text{GP/lb/gal}}{\Delta SG}$$

Speaker notes

. . . each pound of honey, contained in each gallon of your honey-water mixture, what we call the "must", contributes about 35.7 gravity points, and to make the math easy we usually just round that to 36. (You may hear some people say 35, but they're dividing by 12, not 11.892, getting 35.4.) For instance, . . .

3 pounds/gallon

* 36 GP/lb/gal

---

108 GP

=> SG 1.108

Speaker notes

. . . if we use three pounds of honey per gallon of must, then the specific gravity of our must will be somewhere around 1.108. (And yes, that's why I chose that particular desired sweetness.) Actually it would be 1.107 if we're being more precise and not using the shortcut, but that's another story. This ratio is actually about typical, and very convenient. Once again, honey weighs very close to twelve pounds per gallon. So, three pounds is about a quart. This makes for an easily remembered volume ratio of 3 parts water to 1 part honey. We can scale it up and down, and just keep to that ratio, or tweak the ratio up or down a bit if we want it drier or sweeter.

Before we move on, one very important factor here is that I'm speaking of each pound of honey per gallon of must, not of just the water that goes into the must! That is a very common mistake among new mead-brewers. If we mix three pounds of honey and a gallon of water, we get a total volume of five quarts, not four. So, the total added gravity would only be four-fifths of this calculation, for a net SG of 1.086.

But there is another very important factor that I haven't yet mentioned, though I did mention it in the previous talk. Different strains of yeast have different . . .

Image: https://pixabay.com/vectors/dizzy-emoji-emoticon-funny-drunk-4653399/

Speaker notes

. . . alcohol tolerances. That's the level of alcohol at which they'll (supposedly) go dormant, rather than fermenting any more sugars. So the ABV formula is really more like ...

$$\%ABV = \min(tolerance, lbs/gal * 35.7 / 7.62)$$

Speaker notes

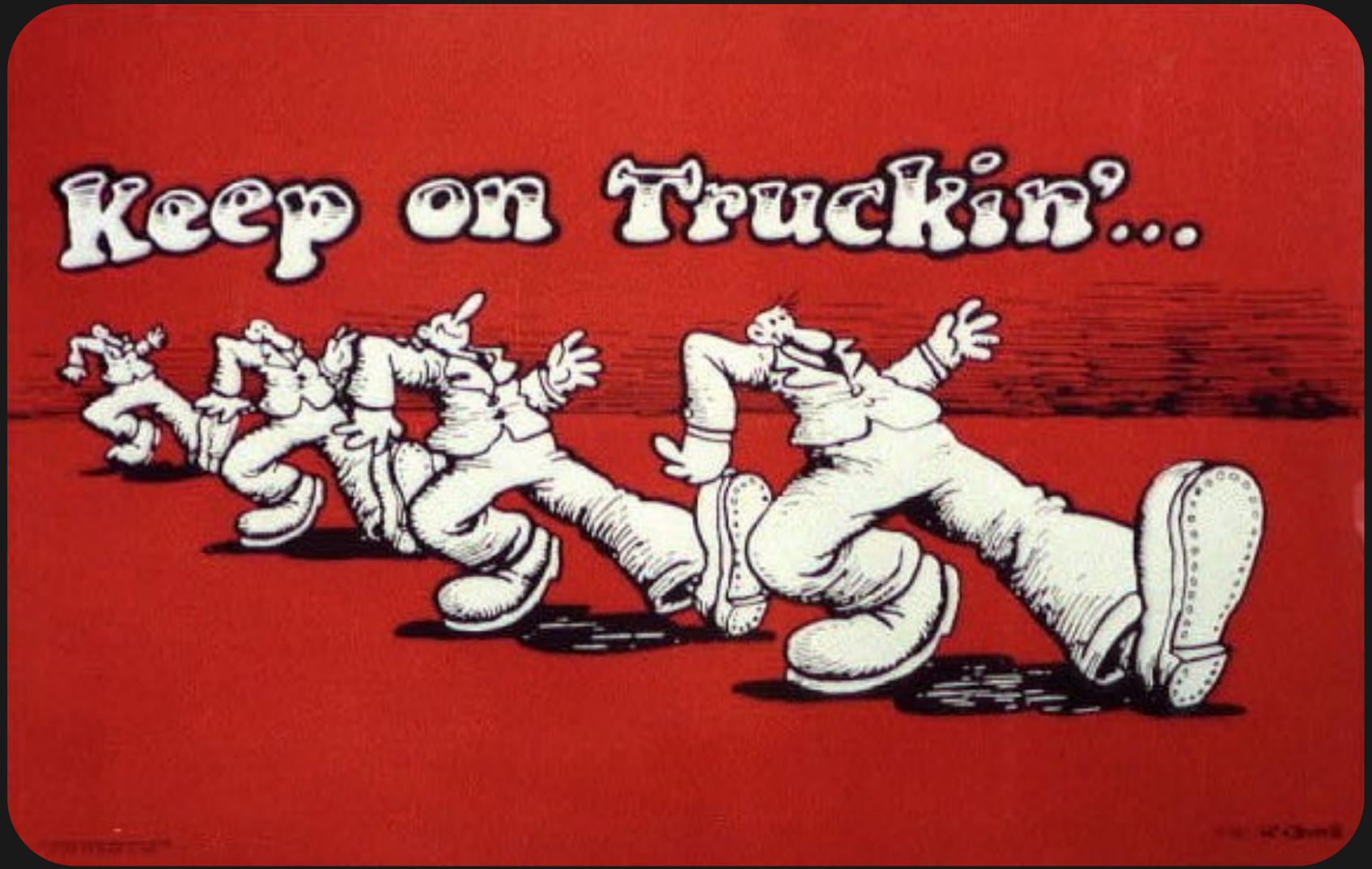
. . . this, the smaller of either the yeast's tolerance, or the alcohol we could possibly produce with the given amount of sugar.

In this particular example, we said we want 12%, so we have to choose a yeast that will stop around there. The problem is that this isn't very exact. For most yeast, their official listed tolerance is more what you'd call . . .

Image: from https://www.petticoatschmitt.com/post/rules-vs-guidelines

Speaker notes

. . . a guideline than an actual rule. It means that they'll probably stop somewhere around there, usually between 1%ABV less and 2%ABV more, with more being much more likely than less. If the yeast poops out at a lower ABV, our mead will be weaker and sweeter, because less sugar will have been converted to alcohol, and if the yeast . . .


Keep on Truckin'...

Speaker notes

. . . keeps on truckin', it will be stronger and drier, assuming there is any sugar left to convert. Many of us use a guideline of about 2% above the official tolerance. So in this case we'll probably want to use a yeast with a 10% official tolerance.

Anyway, because of this inexactness, this technique, of adding all the honey up front, for both the alcohol and the sweetness, and hoping the yeast stops at the right place, is generally called . . .

Speaker notes

. . . pitch and pray. (Those of you who saw my previous talk may recall, the act of putting the yeast into the must, is called "pitching" the yeast.)

So what should we do instead? The alternative involves something that I left out of the previous talk, stabilization. There are two main ways to do that. The first is heat (in other words, pasteurization), but this is very difficult to do correctly with equipment that most of us can afford and fit into our homes, so I'm not going to go into that. That leaves us with . . .

Image: https://commons.wikimedia.org/wiki/File:Chemicals_%288558795991%29.jpg

Speaker notes

. . . chemicals. There are two main chemical we use for this. The first is Potassium Meta-Bisulfite, often abbreviated to K-Meta, since K is the chemical symbol for the element potassium. This is an oxygen scavenger. Yeast need oxygen in order to breed, so this keeps that from happening. The other one is Potassium Sorbate, or K-Sorbate or even K-Sorb. This one prevents any existing yeast from eating. So between the two of them, they stop further fermentation. If we use only K-Meta, the existing yeast could still eat, and with only K-Sorb, they could breed new yeast that could eat. However, these chemicals are not terribly strong, at doses that won't affect the flavor or give a lot more people reactions to the sulfite, so they shouldn't be used to stop a fermentation that's still going, but rather to ensure the finality of one that's already run its course.

Not stabilizing also introduces the risk of the fermentation starting up again later. You might think that's fine, hey extra alcohol! But it might mess up our intended outcome, making our mead stronger and drier than we wanted. Worse yet, if it happens after we've already sealed it up tight, such as by bottling it, and it generates enough CO2 to create a lot of pressure, we may have on our hands what we call a . . .

Image: https://stockcake.com/i/champagne-celebration-burst_598021_93953

Speaker notes

. . . bottle bomb. This may sound like fun, like a bottle rocket, but not only do they get mead and broken glass all over the place, they can burst hard enough to cause serious injury if you get hit by the flying glass shrapnel. On the other claw, done carefully and right, this is how we get naturally carbonated mead, as opposed to force-carbing it with a CO2 tank! But it's very tricky to get right, so I'm not even going to go there in this talk. Maybe in the next one -- after I've tried it myself!

So what we do instead is . . .

- Add the "alcohol honey"
- Pitch yeast with enough tolerance
- Let it run totally dry
- Stabilize
- Add the "sweetness honey"

Speaker notes

. . . First, we mix up our inital must with just enough honey to get the alcohol we want. Then we pitch a yeast with a tolerance at least equal to that level, ideally higher just to be sure. Then we let that run totally dry. What I mean by that is that the SG should become stable somewhere around or below 1.000, meaning that it's used up all the sugars, or at least very close to it. Then we stabilize it with those chemicals, and add the honey we need for the sweetness. This last part, sweetening it back up, or sweetening it on the back end instead of the front, is what we call backsweetening. Now that may sounds a little more complicated, but really . . .

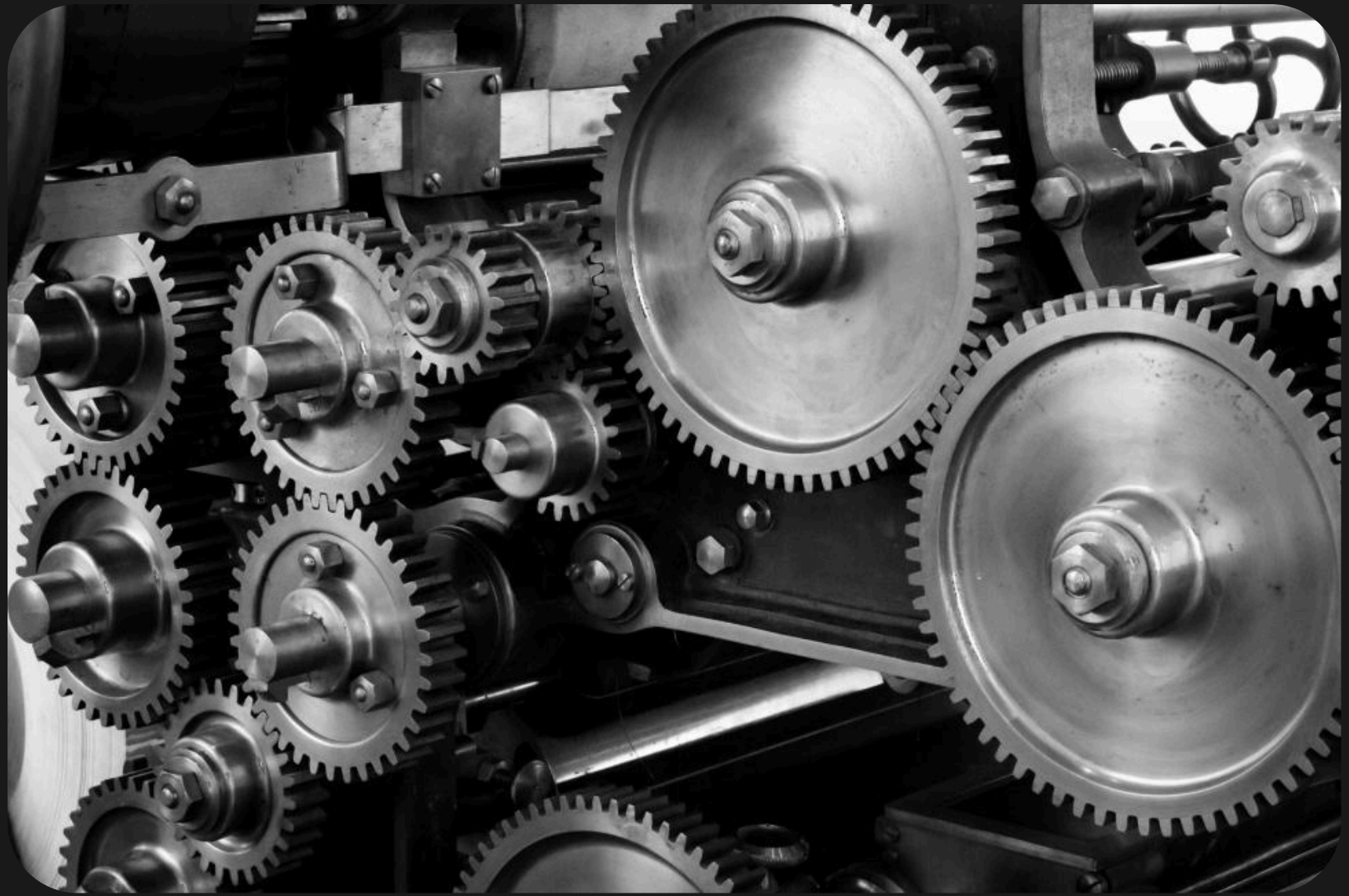


Image: https://freerangestock.com/photos/175294/complex-interlocking-gears-and-cogs-in-machinery-close-up.html

Speaker notes

. . . it's a lot more complicated! Mainly, we're adding things after the fermentation, so not only will that change the sweetness, as we intend, but also, that will reduce the alcohol level. So, we have to work backwards from our desired ending volume, sweetness, and strength, figure out what we need to add, and figure out what that means we need to start with. Suppose we add another six ounces by weight of honey, to our gallon of freshly fermented mead. That will add another four fluid ounces, for a total volume of 132 ounces, right? Nope, there's another complication. When we stabilize it, we lose some, because we do this by . . .

Image: https://m.media-amazon.com/images/I/51ZerzPSzYL._AC_SX679_.jpg

Speaker notes

. . . siphoning it from one carboy to another. We don't just put the chemicals right into the first carboy, because the layer of sludge on the bottom contains a lot of yeast, some of it still alive, and we want to minimize that, so as to maximize the effectiveness of the chemicals. We lose some mead because it's part of that layer of sludge, or it's so close to it that we can't easily siphon it off without getting some sludge too. Since the process of siphoning it from one carboy to another is called "racking", we call this "racking losses". Some people call this the "Valkyrie's Share", analogous to the Angel's Share taken out of whisky as it ages in wooden barrels. It's hard to predict how much we'll lose, so I usually estimate about a cup. Backsweetening also involves another thing we can't quite predict: . . .

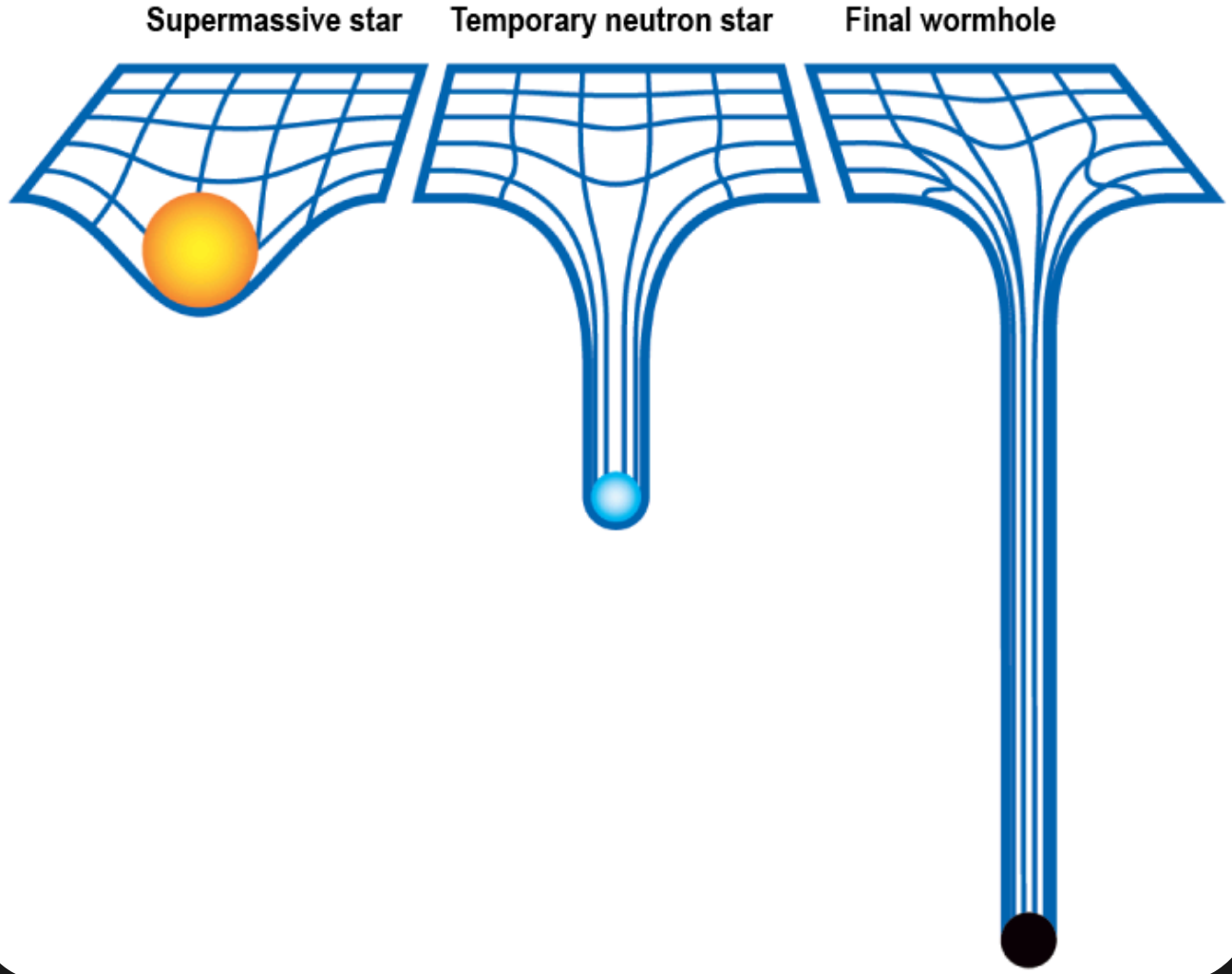


Image: https://commons.wikimedia.org/wiki/File:Deepening_gravity_well.png

Speaker notes

. . . the final gravity, or FG. It will almost certainly be in the general vicinity of 1.000, but could be anything from about 1.002 to 0.992. I usually plan on about 0.998, which is about typical. So now that we've got reasonable assumptions for both the FG and the racking losses, we can get back to planning our batch. Assuming we're still using just honey and water, we now need to figure out how much honey it would take to contribute . . .

	1.017	SG			
-	0.998	FG	=	19	GP
/	36	GP/lb	=	0.527	lb
*	16	ozA/lb	=	8.4	ozA
/	1.5	ozA/floz	=	5.5	fl oz

Speaker notes

. . . 19 GP to a gallon of mead, to get from our estimated FG of 0.998 to our desired SG of 1.017. Fortunately we're trying to get back to a nice even gallon, so the math is easier than it would otherwise be, as we can use some of our usual shortcuts. Dividing 19 GP by 36 GP per pound gives us 0.527 pounds, which is 8.4 weight-ounces of honey, which would occupy about five and a half fluid ounces. So our last step in this whole process will be to add five and a half fluid ounces of honey, PLUS, two and a half fluid ounces of water, so that between them they make up for the estimated one cup of racking losses.

So what are we going to add that to? Since honey and water don't contain . . .

Image: https://pxhere.com/en/photo/1340922

Speaker notes

. . . alcohol, and we know how much volume we're adding, and what %ABV we want to end with, we can figure out what we have to start with. We're adding a cup of non-alcohol to 15 cups of mead, so the final ABV will be 15/16 of what we fermented to, so we should ferment to 16/15 of 12%, or 12.8%. Now we can figure out how much honey gets us that. To do that we first have to figure out our desired . . .

Image: from https://www.originalgravitypub.com/ used w/o permission as they're defunct

Speaker notes

. . . Original Gravity. To do that we multiply our desired level of . . .

12.8 %ABV

* 7.62 GP/%ABV = 97.5 GP

/ 36 GP/lb = 2.71 lbs

Speaker notes

. . . 12.8% ABV by 7.62 GP per %ABV, and get 97.5, so our OG should be 1.097 to 1.098. So how much honey do we need to get that OG? We divide that delta, the 97.5, by 36 GP per pound, and get 2.71 pounds. So how much water do we need to go with that? We could calculate it, by dividing the honey poundage by 12 pounds per gallon (or 11.892 if we want to be more precise) and subtracting from a gallon, but we can skip that math and make it a lot easier! After we've put in the honey, and maybe some water to dilute it, fill the carboy up to the one gallon mark. If your carboys don't have one-gallon marks, you can fill them up beforehand with one measured gallon and mark it yourself. To recap the recipe:

- Mix:
  - 2.71(ish) pounds honey
  - Water to a gallon
- Ferment with a yeast of 13%+ tolerance
- Stabilize and backsweeten with:
  - 5.5 ounces honey
  - 2.5 ounces water

Speaker notes

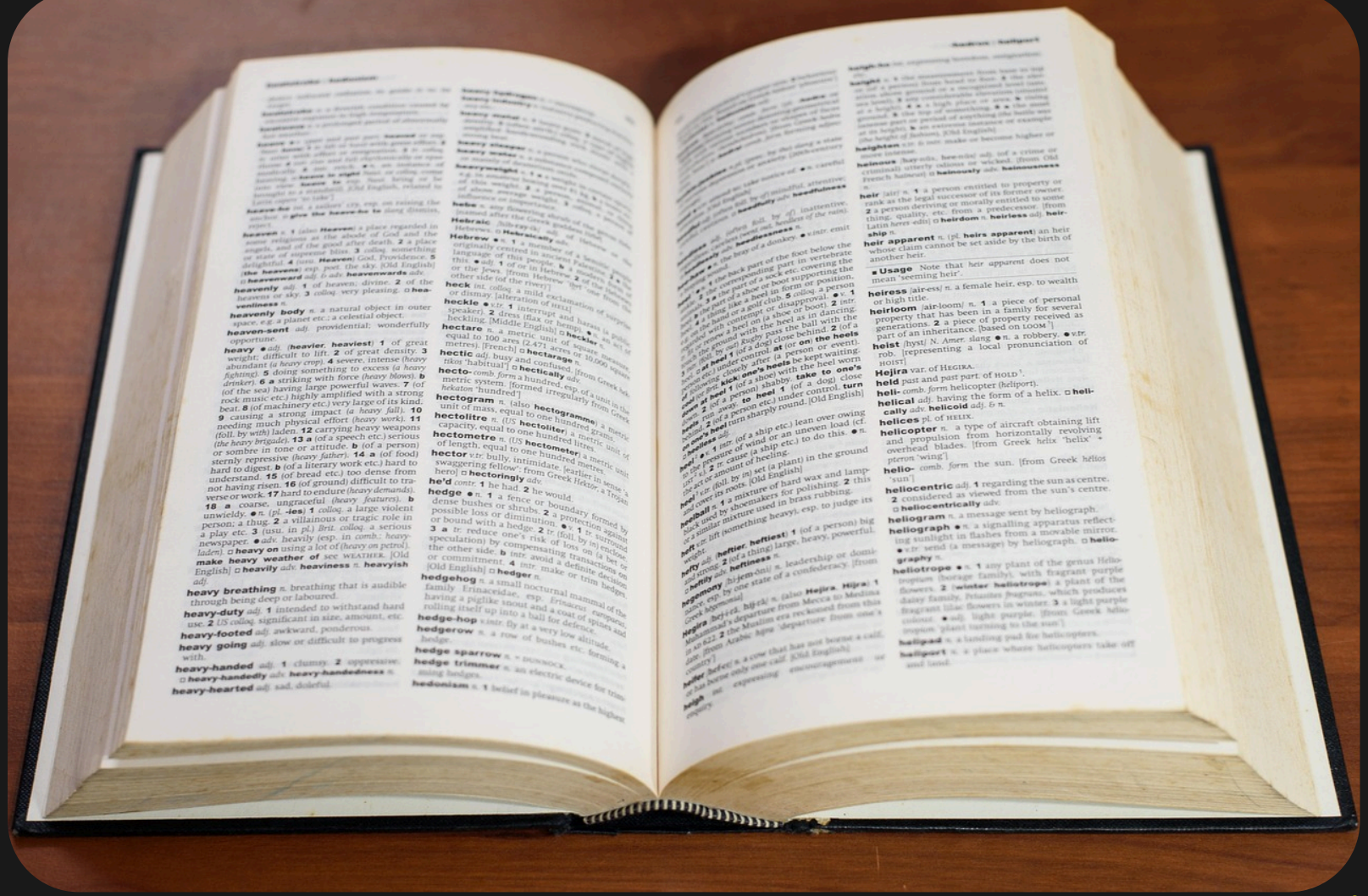
. . . we mix up 2.71 pounds of honey (feel free to use two and three quarters if more convenient, it will only make about one and a half GP's worth of difference), and however much water it takes to make a gallon, ferment that with a yeast strong enough to pretty much guarantee 12.8%, stabilize, and backsweeten with five and a half ounces of honey and bring it all back up to a full gallon with two and a half ounces of water, or whatever we need after the actual racking losses.

Now, what if we're not just using honey and water? How does that change things? If we're just using herbs or spices, that's no problem. Just sanitize them (a quick dip in sanitizer should do), plop them in after the fermentation and racking are done, so the taste doesn't get carried off by the CO2, taste it once in a while to see if it's how we want, and take them out when it's done. But . . .

Image: https://pixabay.com/photos/fruit-juice-fresh-juice-juice-5388892/

Speaker notes

. . . fruits are a different matter! They contribute some sugar we need to account for, and if we're not using dried fruit, they contribute some liquid as well, especially if we're using fruit juice instead. We can also also flavor meads with lots of other things, some of which contribute liquid or sugar or both or neither, maybe even some alcohol, such as extracts. To work through an example, let's suppose we want to make a pyment. If you saw my previous talk, you may remember that that's a mead made with also grapes, or at least grape juice, which we'll do for convenience and precision. That leads to a . . .



Speaker notes

. . . definition question. If we ferment grape juice with a drop of honey, what do we get? That's not mead, that's wine! So at what point does it start being mead? Some legal jurisdictions have tighter rules, but the usual guideline on it being mead is that most of the alcohol came from fermenting honey. At the other end of our reductio ad absurdum, if we mix up a normal amount of honey and water, plus one drop of grape juice, and ferment that, is it a pyment? As you've probably guessed, no. What makes it a pyment is that the grapes were (or the juice was) present during fermentation, and it's the dominant flavor after fermentation, so there has to be enough to taste easily over the honey.

So now let's set about planning our batch, sticking with our previous goal of SG 1.017 and 12% ABV. Working backwards like before, we know we want something that will contribute 19 GP, in the volume of one cup, to get from SG 0.998 to 1.017, and make up for racking losses. Can we do that with . . .


TO CLOSE
TownHouse
Grape
Juice
FROM CONCENTRATE
VITAMIN C ENRICHED
NO SUGAR ADDED
Finest Quality

Speaker notes

. . . grape juice? That depends on its SG. The SGs of fruit juices vary quite a lot, even more than honey, but grape juice, the kind from the supermarket, not the kind usually meant for making wine, is typically about 1.060. So, . . .

	60	GP	(sugar in juice)
*	1	cup	(amount of juice)
/	16	cups	(one gallon total)
=	3.75	GP	(contribution)

Speaker notes

. . . if we take one cup of grape juice, and use it in a gallon of total volume, its gravity contribution would be only 3 and 3/4 GP, which falls far short of the 19 GP we want, so no. But what about grape juice . . .

Image: from https://www.kroger.com/p/welch-s-frozen-100-grape-juice/0004180011600 w/o permission

Speaker notes

. . . concentrate? The obvious question now is, what's the SG of that? Again it varies widely, but typically around 1.340. Let's see what happens if we add one six-ounce can, and two ounces of water. Looking at just the gravity contribution from the concentrate . . .

```
  340 GP   (sugar in concentrate)
* 6   fl oz (amount of that)
/ 128 fl oz (one gallon total)
= 16  GP   (contribution)
```

Speaker notes

. . . it gives us 16 GP per six-ounce can in one gallon. That's much better, but still not quite there. If we use eight ounces of grape juice concentrate, that gets us pretty close, but as far as I know, grape juice concentrate doesn't come in eight ounce cans, and it's a bit inconvenient to have four ounces left over from a twelve-ounce can. We could decide that 16 GPs, or dealing with leftover concentrate, is good enough. Or, we could decide to use honey for at least some of those last two ounces. If we run the numbers with both ounces being honey, it overshoots a bit, but if we dial it back to one ounce: . . .

```
   [(6oz * 340 GP)  (sugar from concentrate)
+  (1oz * 425 GP)]  (sugar from honey)
/  128 oz           (one gallon)
=  19 GP            (net contribution)
```

Speaker notes

. . . we get exactly what we wanted. So now that we know what we need to backsweeten with, let's tackle the initial makeup. Using the same calculations as before, we know we want something that will ferment to 12.8% ABV, which will require an initial gravity of about 1.097 and a half, so how do we get there with a mix of honey, water, and grape juice or concentrate, that will have most of the sugars in the honey, and a strong grape flavor? What I usually do for this, is to take the amount of sugar we need, cut that in half, figure out how much honey we'll need to get that, bump that up to something convenient, figure out how much sugar that actually gets us, subtract that from what we need in total to find what we need from the other part, and finally figure out how to compose that.

Sticking with our calculations from last time, we need . . .

	97.5	GP		
/	2		= 48.75	GP
/	36	GP/lb	= 1.35	lb
*	16	ozA/lb	= 21.7	ozA
/	1.5	ozA/floz	= 14.4	fl oz

(call it 16 for convenience)

Speaker notes

. . . 97.5 GP's worth of sugar in total, so we cut that in half and get 48.75 GP, divide that by 36 GPs per pound to see that we need 1.35 pounds of honey, which is 21.7 ounces of weight, which occupies 14.4 ounces of volume, which we'll round up to 16, a nice convenient two cups. Now we check how much delta-SG that actually gets us:

```
   16  floz
*  1.5 ozA/floz = 24  ozA
/  16  ozA       = 1.5 lbs
*  36  GP/lb     = 54  GP
```

Speaker notes

Sixteen fluid ounces of honey weighs 24 ounces, which is a pound and a half, which contributes 54 GP. So now we know what we need from the grapes or juice:

128 floz - 16 floz = 112 floz

97.5 GP - 54 GP = 43.5 GP

Speaker notes

the remaining 112 fluid ounces of liquid, that contributes the remaining 43 and a half GP of sugars. If we try to do that with grape juice, and maybe some water, we're trying to solve this equation, in fluid ounces:

```
    X      (X oz juice)
*   60     (sugar in that)
/   128    (total fluid ounces)
=   43.5   (net contribution)
```

Speaker notes

The sugar in some number of ounces of grape juice, distributed over 128 ounces, contributes the GPs we want. I'll spare you the simplification steps, but it works out to 92.8 ounces, which we'll round up to 96 because that makes a nice even three quarts. That leaves 16 ounces to be made up with water. Just to be sure, we now check our work, working in pints to make the math a bit easier:

```
   [(6 * 1.060)  (grape juice)
+  (1 * 1)       (water)
+  (1 * 1.425)]  (honey)
/  8             (total pints)
=  1.098         (net SG)
```

Speaker notes

Six pints grape juice, one pint water, and one pint honey total up to 8 pints, in other words one gallon, at an SG of 1.098. Spot-on, at least to that many decimal places. To recap that recipe:

- Mix:
  - Three quarts grape juice
  - Two cups honey
  - Two cups water
- Ferment with a yeast of 13%+ tolerance
- Stabilize and backsweeten with:
  - One 6oz can grape juice concentrate
  - One ounce honey
  - One ounce water

Speaker notes

. . . mix three quarts of grape juice, two cups of honey, and two cups of water, fermented with a yeast of at least 13% tolerance, stabilize and backsweeten with one six-ounce can of grape juice concentrate, one ounce of honey, and one ounce of water.

So now you may be wondering, okay, what if we want a strong grape flavor, but we don't care if it could technically be called a pyment? Couldn't we just brew up some ordinary mead and backsweeten with the grape juice concentrate?

You're right, we could certainly do that, and call it grape mead or something like that. We could . . .

- Mix:
  - 2.71(ish) pounds honey
  - Water to a gallon
- Ferment with a yeast of 13%+ tolerance
- Stabilize and backsweeten with:
  - One 6oz can grape juice concentrate
  - One ounce honey
  - One ounce water

Speaker notes

. . . brew up some plain dry mead as in the first recipe, and then backsweeten it with the grape juice concentrate (and some honey and water) as in the second recipe. It won't have quite as strong a grape flavor, since it didn't have any grape juice in it aside from the concentrate, but it should still be quite noticeable.

Most of these . . .

Image: https://www.flickr.com/photos/dominicspics/3991341173

Speaker notes

. . . calculations may seem like a royal pain in the proverbial posterior. if you combine them with how the concepts are well known, you might well wonder, hasn't anybody made an app for this, or a website or something? Yes, of course, there are in fact many. If you want a mobile app, the one I usually hear recommended is called Brewfather, but it's aimed mainly at beer-brewing, so some parts are unneccesary, and some features are missing, that would be useful for mead. There are several websites with calculators, but honestly I found the usual recommendations rather overwhelming and confusing, especially for beginners, so I've put up a few simplified ones, on my website at . . .

SumOfABatch.com

Speaker notes

. . . SumOfABatch.com. There's also some advice on fixing a bad batch, some blog posts, and eventually maybe some videos, focused on making a small batch of mead, at home, very simply, with only things we're practically guaranteed to find at the local grocery store.

That's about all we have time for today. If you have any . . .

Any questions?

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Speaker notes

... questions, we have time for some now, and if you think of something later, I'll be around for the rest of the RG, and if you think of questions later, there's my email address. Any questions?