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NECTAR INTO HONEY

A TANK FULL OF SWEETNESS

On a warm morning a honeybee lands on a clover blossom and pushes her tongue deep into the flower, drawing up NECTAR - the thin, sugary liquid plants secrete to bribe POLLINATORS into visiting. She swallows it, but not into her gut. It goes into her CROP, an expandable pouch in the foregut that works as a portable tank, sealed off from digestion. A FORAGER, one of the older workers assigned to leave the hive, may visit a hundred blossoms before her crop is full and she turns for home.

SPELL Spell: **FORAGER**

FORAGER

SPELL Spell: **POLLINATORS**

POLLINATORS

KNOWN What is the thin, sugary liquid a flower makes to bribe insects into visiting it?

NECTAR

KNOWN What is the name of the expandable pouch in a honeybee's foregut, sealed off from digestion, that she carries her load home in?

CROP

OPEN A forager visits a hundred blossoms before her crop is full. Which hundred things would you visit if you could choose?

Open response - use practitioner judgment

MOUTH TO MOUTH

Back in the hive she does not store the load herself. She passes it mouth to mouth to a younger house bee, a transfer BEEKEEPERS call TROPHALLAXIS, and that bee may pass it on again. Each handoff mixes in saliva carrying INVERTASE, an enzyme that splits SUCROSE - the double sugar that makes up much of raw nectar - into its two simpler halves, GLUCOSE and FRUCTOSE. Those single sugars dissolve more densely and resist spoilage better, so the chemistry of honey is largely finished before the liquid ever reaches a cell.

SPELL Spell: TROPHALLAXIS

TROPHALLAXIS

SPELL Spell: INVERTASE

INVERTASE

SPELL Spell: BEEKEEPERS

BEEKEEPERS

SEMI_OPEN The enzyme in bee saliva turns one nectar sugar into two simpler ones. Name two of the three sugars in that change.

NEEDS 2 OF SUCROSE / GLUCOSE / FRUCTOSE

OPEN The nectar passes from mouth to mouth before it ever reaches a cell. What is something you have passed along that changed a little on the way?

Open response - use practitioner judgment

MATH Raw nectar can be about 70 percent water, while finished honey is about 17 percent water. How many percentage points of water are lost along the way?

53

DRYING AND SEALING

The bigger job is water. Nectar arrives as roughly seventy percent water; finished honey holds under twenty percent. House bees spread droplets across the hive's open cells and stand in ranks fanning their wings, driving a current of dry air through the comb until the load thickens. A second enzyme, glucose OXIDASE, converts a little of the glucose into gluconic acid and hydrogen PEROXIDE, pushing the acidity up and holding microbes down. When a cell tests dry enough, the bees seal it with a lid of BEESWAX - CAPPING.

SPELL Spell: BEESWAX**BEESWAX****SPELL Spell: CAPPING****CAPPING****KNOWN What kind of enzyme, named for what it does to glucose, turns a little of it into gluconic acid?****OXIDASE****KNOWN That same enzyme also makes a second microbe-fighting compound, a form of hydrogen. What is it called?****PEROXIDE****OPEN Ranks of bees stand over the comb fanning a current of dry air through it. What would you expect that to sound like?****Open response - use practitioner judgment**

MANY HONEYS

Honey is not one substance. Bees working CLOVER, BUCKWHEAT, ORANGE, or HEATHER return with different sugars, acids, and aromatics, and the jars differ in color and taste accordingly. The ratio of glucose to fructose decides texture: glucose is less soluble, so honeys rich in it drop out of solution as crystals within months, a change called CRYSTALLIZATION that spoils nothing. Some honey never starts with nectar at all - HONEYDEW honey is made from the sugary EXCRETIONS aphids leave on leaves. And if a cell is capped too wet, yeasts survive and FERMENTATION follows.

SPELL Spell: FERMENTATION**FERMENTATION****SPELL Spell: EXCRETIONS****EXCRETIONS****KNOWN What is the term for the harmless change in which glucose leaves the solution and a jar of honey turns grainy and solid within months?****CRYSTALLIZATION**

KNOWN What is the term for a honey made not from nectar but from the sugary residue aphids leave on leaves?

HONEYDEW

SEMI_OPEN Bees bring back a different honey depending on which blossom they work. Name two of those blossoms.

NEEDS 2 OF CLOVER / BUCKWHEAT / ORANGE / HEATHER

OPEN When you notice a jar of honey that has gone grainy and solid, what would you want to do with it?

Open response - use practitioner judgment

MATH A typical honey is about 38 percent fructose and about 31 percent glucose. Together, what percent of the honey is those two sugars?

69

THE JAR ON YOUR SHELF

The jar in your KITCHEN is running the same chemistry. Honey is **HYGROSCOPIC**: it pulls water out of the air and out of anything it touches, which is why bacteria dry out in it and why an open jar in a humid room thins over time. If yours has gone grainy, nothing is wrong. Set it in warm water and the **CRYSTALS** dissolve, and the honey pours as it did the day it was capped. A sealed jar kept dry and cool will outlast almost anything else in the cupboard.

SPELL Spell: KITCHEN

KITCHEN

SPELL Spell: CRYSTALS

CRYSTALS

KNOWN What is the term for a substance that pulls water out of the air and out of anything it touches?

HYGROSCOPIC

OPEN When someone sets a grainy jar of honey in warm water, what do you expect to happen first?

Open response - use practitioner judgment

MATH

A 500-gram jar of honey is about 17 percent water. How many grams of water is that?

85