Beast Master (solution)

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Solvers are presented with an "experimental log" consisting of an Introduction and 10 descriptions of creatures, along with experimental procedures. The Introduction should easily clue solvers that this puzzle will involve Pokémon, specially the pair of games Pokémon X and Y (clued by "Kalos").

Each of the 10 descriptions clues a certain Pokémon, as well as certain Abilities they may have. All instances of the Pokémon's name are redacted, so solvers will have to figure out what Pokémon is being clued.

Each "experimental methodology" section describes a proposed breeding experiment between two compatible Pokémon, with one number being redacted. As such, solvers should calculate the correct number that would go into the redacted space, according to the actual "rules" of breeding in the Pokémon games (specifically Generation 6, i.e. Pokémon X and Y). For clarity, the way breeding works with Abilities is as follows:

Each individual Pokémon must have an Ability, and each Pokémon species can have up to 3 possible Abilities — a Hidden Ability (HA), and 2 non-Hidden Abilities (which we'll refer to as Slot 1 and Slot 2). Some Pokémon species have only one non-Hidden Ability, in which case Slots 1 and 2 will be treated has having the same Ability. Here are some examples:

Jigglypuff has 3 possible abilities: Friend Guard (HA), Cute Charm (Slot 1) and Competitive (Slot 2)

Infernape has only 2 possible abilities: Iron Fist (HA) and Blaze (fills both Slots 1 and 2)

Only the mother's Ability will affect the Ability of the offspring (i.e. the father's Ability is inconsequential). If the mother has a Hidden Ability, then the offspring will have Abilities according to the following probabilities:

Hidden Ability: 60%
Slot 1: 20%
Slot 2: 20%

If the mother has an Ability in Slot X, then the offspring will have Abilities according to the following probabilities:

Slot X: 80%
Other Slot: 20%

Apart from Abilities, the gender of a Pokémon hatchling is also determined randomly. Each Pokémon species has a fixed gender ratio, and hatchlings will hatch with a gender according to those probabilities.

The figures above are the foundation required for solving much of the rest of the puzzle. The next section will detail the Pokémon IDs and the calculations required to obtain the final answer.

Experiment 1
Pokémon involved: Jigglypuff

Jigglypuff has a fixed 3:1 female-to-male ratio. As such, out of 100 eggs, it is expected that the number of male Jigglypuffs that hatch is 25% × 100 eggs = **25** eggs.

Experiment 2
Pokémon involved: Aerodactyl
Mother's ability: Unnerve (HA), from "seem imposing and would scare other creatures into being unable to eat their food"

Here, we are concerned with "female [Aerodactyl] that do not scare other creatures into being unable to eat their food." Aerodactyl has a 1:7 female-to-male ratio, so there is a 12.5% that a female Aerodactyl hatches from an egg. According to the breeding rules, since there is a 60% chance of passing down a mother's Unnerve (a HA), then there is a 40% chance of an offspring hatching with an Ability that is not Unnerve. Since the Ability and gender of a hatchling are generated independently, then the expected number that is required here is 12.5% × 40% × 160 eggs = **8** eggs.

Experiment 3
Pokémon involved: Girafarig
Mother's ability: Early Bird (Slot 2). Female Girafarig have more yellow outer covering than male ones, and the female Girafarig in this puzzle "seems to sleep less than most other creatures".

Since the mother has a Slot 2 non-Hidden Ability, there is a 80% that a hatchling will be born with the Slot 2 Ability as well. The expected number required here is 80% × 25 eggs = **20** eggs.

(For interested readers, the father's Ability is Sap Sipper but is completely irrelevant here)

Experiment 4
Pokémon involved: Corsola
Mother's ability: Regenerator (HA), from "regenerate damaged portions of their bodies upon returning to their spherical cages".

For the third generation of Corsola to have Regenerator, the second-generation female Corsola must also have Regenerator, and there is a 60% of this happening. Given this, there is a further 60% chance that the third-generation Corsola will have Regenerator. As such, the expected number required here is 60% × 60% × 50 eggs = **18** eggs.

Experiment 5
Pokémon involved: Infernape

From some of the phrasing used in this section (e.g. “rate is constant and independent of any egg production, which also occur independently”) solvers may realise that puzzle involves the Poisson distribution.

If we let X be the number of Infernape eggs produced in an hour, then we can say that X is distributed according to the Poisson distribution with an unknown mean/rate λ. From the information provided, we can set up an equation to be solved:

$$P(X = 1) = \frac{\lambda^1 e^{\lambda}}{1!} \approx 0.3543$$

Probably the easiest way to solve this equation is using a numerical method or by guess-and-check, and the value of λ to be found should be 0.75. Since λ is the average rate of egg production in 1 hour, then the expected number of eggs produced in a day should be 24 × 0.75 eggs = **18** eggs.

Experiment 6
Pokémon involved: Bidoof
Mother’s ability: Moody (HA)

This part involves the negative binomial distribution, and the following explanation will use the notation found here. Here, a success is defined as an egg hatching with an ability that is not Moody, p is 40% or 0.4, and r is unknown. We can set up an equation:

$$P(X = 1) = \binom{r}{r-1}(1 - 0.4)\left(0.4^r\right) = 0.03072$$

Again, the easiest way to solve this is using a numerical method or by guess-and-check, and the value of r can be worked out to be exactly **5**.

Experiment 7
Pokémon involved: Emolga
Mother’s ability: Moody (HA)

Here, we are concerned with the number of Bidoof that hatch with Moody, out of an unknown number of eggs. This can be modelled with the binomial distribution with $p = 0.6$ and n unknown. We can set up an equation:

$$P(X = 1) = \binom{n}{1}(0.6)(1 - 0.6)^{n-1} = 0.1536$$

With this, n can be worked out to be exactly **4**.

Experiment 8
Pokémon involved: Heatmor
Mother’s ability: Gluttony (Slot 1)

This part also uses the binomial distribution, but with a different unknown. We have a known $n = 4$ and p is 0.8 since Gluttony is a non-Hidden Ability, and there is an 80% of a mother passing down its non-Hidden Ability. The equation that is helpful here is:

$$P(X = x) = \left(\frac{4}{x}\right)\left(0.8^{x}\right)(1 - 0.8)^{4-x} = 0.0256$$

With this, x can be worked out to be exactly **1**.

Experiment 9
Pokémon involved: Durant
Mother's ability: Truant (HA)

This part once again uses the binomial distribution. We have a known $n = 14$ and p is 0.6 since Truant is a Hidden Ability. Here, we need to solve:

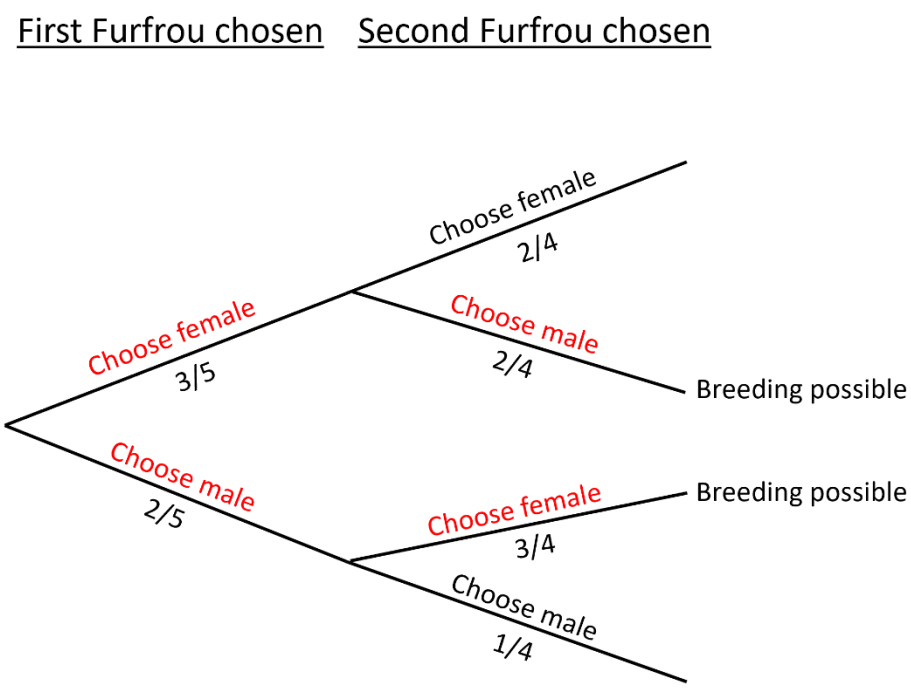
$$P(X \geq x) \approx 0.9825$$

With some rearrangement, x can be worked out to be **5**.

Experiment 10
Pokémon involved: Furfrou

There are 3 female and 2 male Furfrou to make a pool of 5, and we want to know the probability that exactly 1 female and 1 male are chosen if 2 Furfrou are randomly chosen from the pool of 5.

One easy way to solve this without exhaustively listing out each possibility (which is itself a valid approach) is using a tree:



The expected number of eggs produced is then $\left(\left(\frac{3}{5}\times\frac{2}{4}\right)+\left(\frac{2}{5}\times\frac{3}{4}\right)\right)\times(1+14)$ = **9** eggs.

To summarise the Pokémon and redacted numbers in each experiment:

Experiment No.	**Pokémon**	**Pokédex No.**	**Redacted Number**	**A1Z26**
1	Jigglypuff	039	25	Y
2	Aerodactyl	142	8	H
3	Girafarig	203	20	T
4	Corsola	222	18	R
5	Infernape	392	18	R
6	Bidoof	399	5	E
7	Emolga	587	4	D
8	Heatmor	631	1	A
9	Durant	632	5	E
10	Furfrou	676	9	I

Notice that the experiments are arranged in ascending order of the Pokémons' Pokédex number, which implies that reordering is required. Solvers may alternatively directly observe that the Pokémon each start with a unique letter from A to J, which is the correct ordering mechanism. Converting the redacted numbers into letters with A1Z26, and then rearranging in alphabetical order of the Pokémon names will yield the final answer, **HEREDITARY.**

Constructor's notes:

This puzzle idea was largely inspired by the feeder answer, and it felt like a good opportunity to write SGPH's first ever Pokémon puzzle, and one of the only (if not the only) math puzzles. It was rather heartening to see that the puzzle was solved by many teams, especially the newer ones. Hopefully this did not reignite any math-related PTSD in anyone!