

Please use our materials!

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We also humbly request that you email sarah.adams@olin.edu if you use these materials, as we are tracking their impact and how far they travel!





COW EVOLUTION

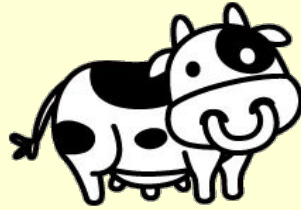
COW EVOLUTION





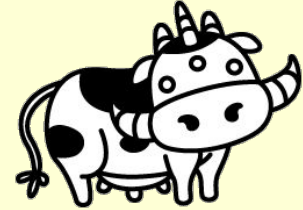
calf

- needs a nap
- wears the same outfit every day
- always a little nervous



adult cow

- constant dad jokes
- still listens to the same music they did when they were in middle school
- instinctively holds up peace sign in any photo taken of them



mooseek

- “haha have you seen this meme”
- chaotic energy
- always procrastinating on something



caproviner

- loves to garden but keeps killing their house plants
- always orders food instead of cooking it
- wants to be friends with everyone



mamooth

- snacks 24/7
- confused all the time
- great fashion sense, but it's never consistent



alpacow

- has 37 unread books that they keep meaning to start reading
- starts most convos with “hey, fun fact-”
- has cool energy, is secretly a giant nerd

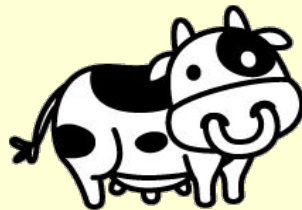
HOW IT WORKS



stage 0

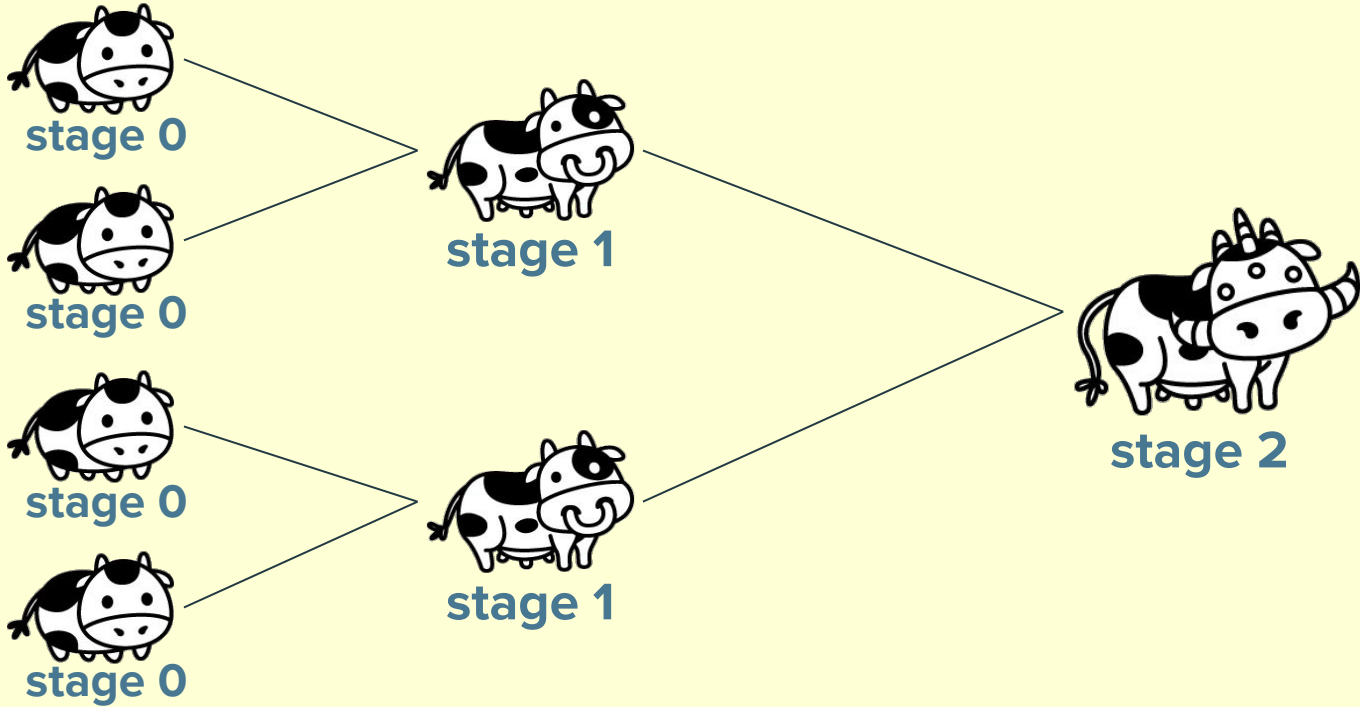


stage 0

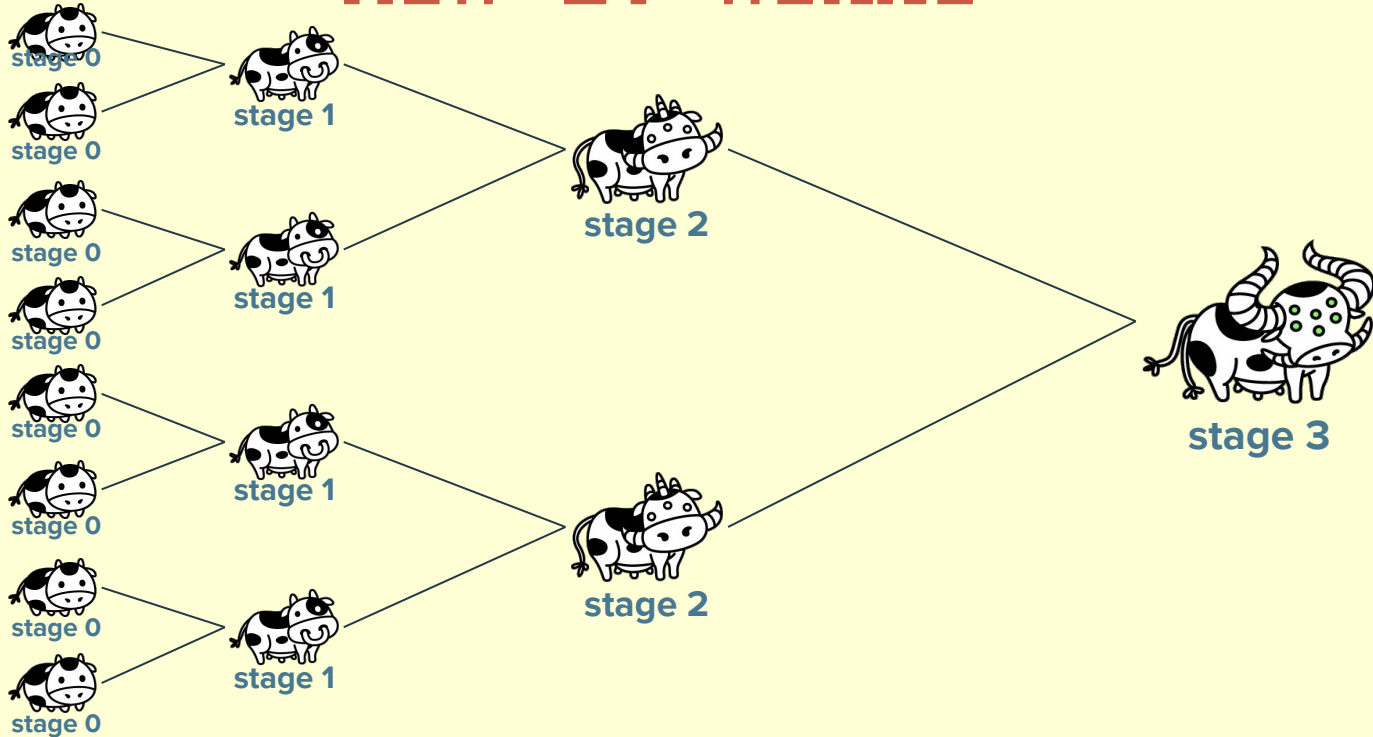


stage 1

HOW IT WORKS



HOW IT WORKS



**THE COSMIC
COW**



**EVOLUTION
STAGE 24**

A decorative header consisting of two mirrored rows of vertical bars in teal, dark blue, green, orange, and red, arranged in a stepped pattern.

A LIFETIME OF COWS

Overarching goal: If we ignore all of the upgrades that can be purchased and just combine cows, how long would it take to get the cosmic cow and beat the game?

WHAT'S YOUR GUESS?

Before we do the math, how long do you think it would take to get to the cosmic cow? Hours? Days? Weeks?

Throw your guesses in the chat!

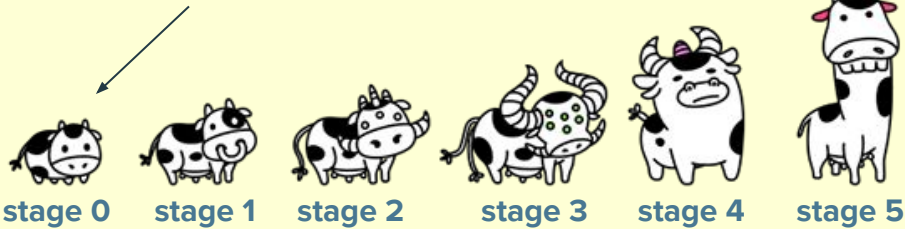


STAGE 24

QUANTIFYING COW CREATION

Can you come up with a pattern that relates how many baby cows (stage 0) it takes to make each larger cow?

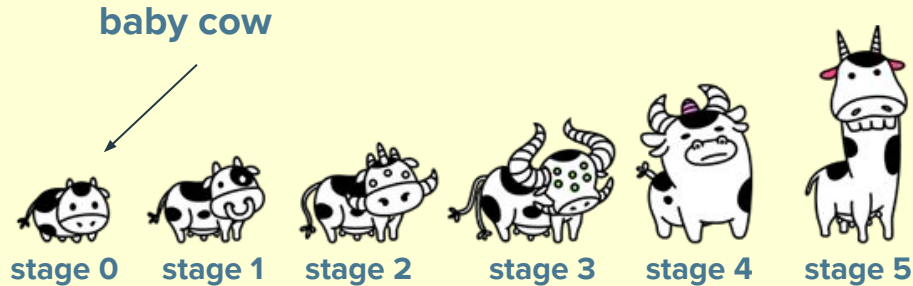
baby cow



X (evolution stage)	Y (number of baby cows required)
0	1
1	2
2	4
3	8
4	
5	
6	
7	
8	
9	

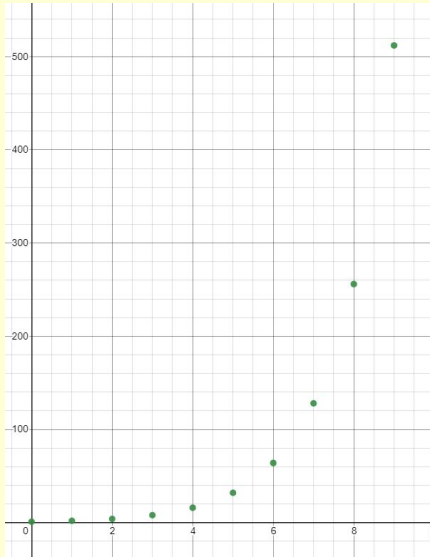
DESMOS

Grab the link in the chat. We'll start by filling in the table that relates how many baby cows (stage 0) it takes to make each larger cow.



Give students this special Desmos template

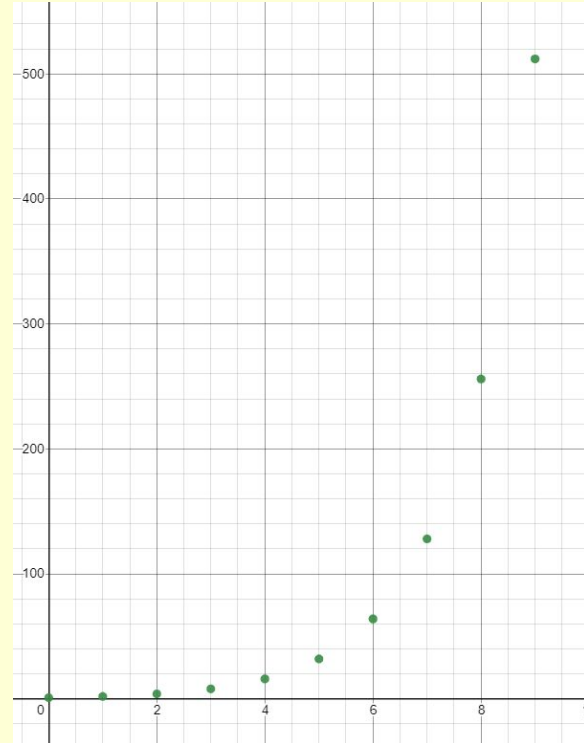
- <https://www.desmos.com/calculator/squxbe3yp3>

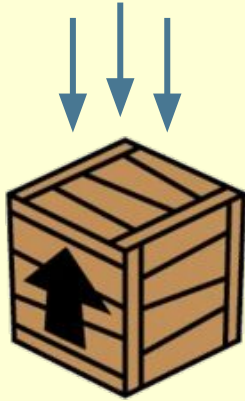


X (evolution number)	Y (number of baby cows required)	doubling	exponentials
0	1		
1	2	2	2^1
2	4	$2 * 2$	2^2
3	8	$2 * 2 * 2$	2^3
4	16	$2 * 2 * 2 * 2$	2^4
5	32	$2 * 2 * 2 * 2 * 2$	2^5
6	64	$2 * 2 * 2 * 2 * 2 * 2$	2^6
7	128	$2 * 2 * 2 * 2 * 2 * 2 * 2$	2^7
8	256	$2 * 2 * 2 * 2 * 2 * 2 * 2 * 2$	2^8
9	512	$2 * 2 * 2 * 2 * 2 * 2 * 2 * 2 * 2$	2^9

X (evolution number or rank)	Y (number of baby cows required)
0	1
1	2
2	4
3	8
4	16
5	32
6	64
7	128
8	256
9	512

$$y = 2^x$$





CRATES FALL EVERY
3 SECONDS

baby cow



stage 0



stage 1



stage 2



stage 3



stage 4



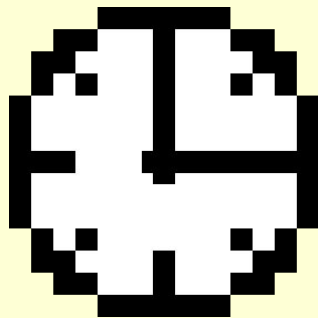
stage 5

cosmic cow



stage 24

$$y = 3 * 2^x$$



1 YEAR, 31 WEEKS and 1 DAY

$$3 \cdot (2^{24}) = \text{about } 583 \text{ days}$$



FACTORING IN THE STORE

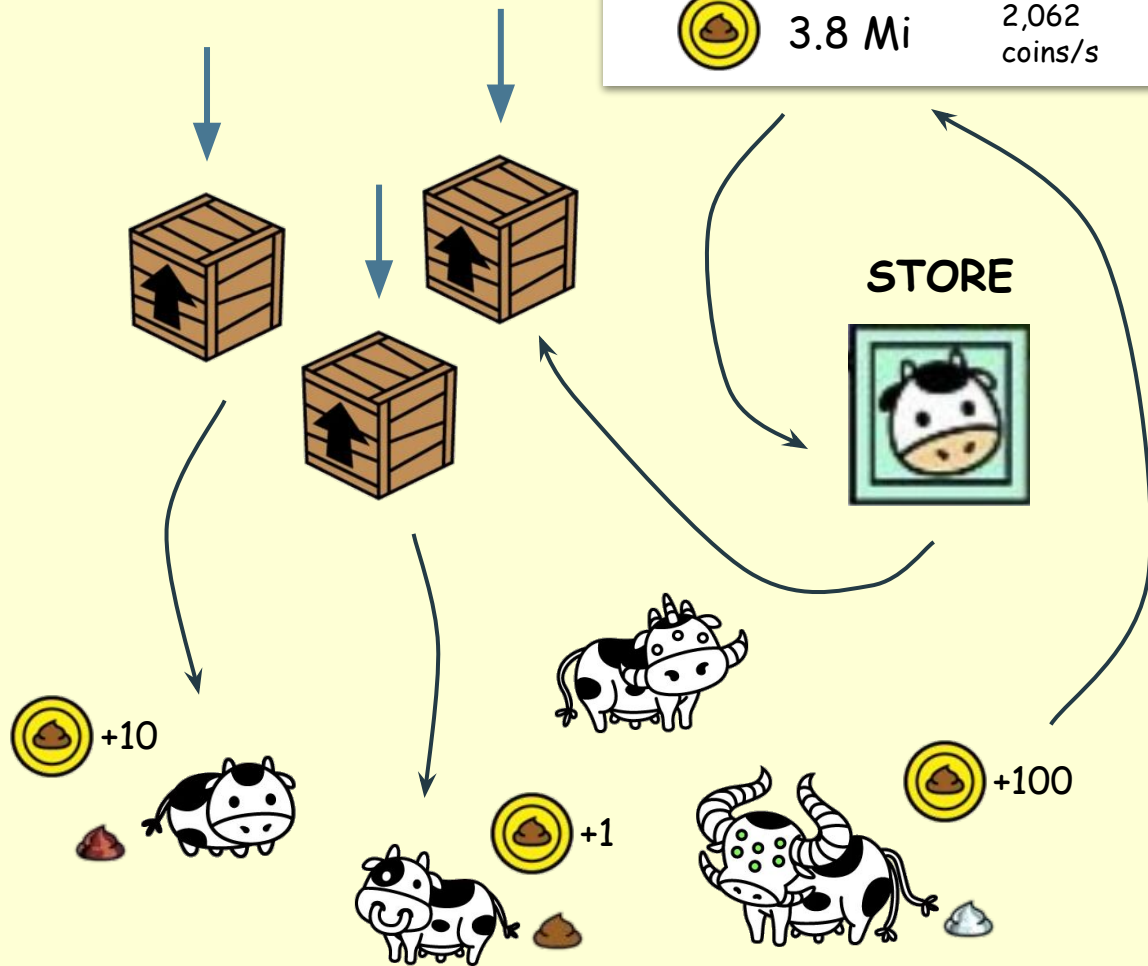


Overarching goal: You can buy cows! Can we determine strategies for which cows to buy in order to beat the game faster?





3.8 Mi

2,062 coins/s



	1	2	3
Baby Cow	560	640	740
Adult Cow	1,570	1,800	2,070
Mootant	4,390	5,050	5,810
Hypercow	12,290	14,140	16,260
Mammoth	34,420	39,750	45,520
Alpacow	96,380	110,830	127,460
Boveye	269,860	310,340	356,890
Enormoos	755,600	868,940	999,290
Cowzilla	2.1 Mi	2.4 Mi	2.8 Mi
Moosa	5.9 Mi	6.8 Mi	7.8 Mi
Longcow	16.6 Mi	19.1 Mi	21.9 Mi
Dairy Daisy	46.4 Mi	53.4 Mi	61.4 Mi
Betsy	130 Mi	149.5 Mi	172.0 Mi
Uddra	364.1 Mi	418.7 Mi	481.5 Mi
Triangus	1.0 Bi	1.2 Bi	1.3 Bi
Cowtipede	2.9 Bi	3.3 Bi	3.8 Bi
Mooriel	8.0 Bi	9.2 Bi	10.6 Bi
Bahamoot	22.4 Bi	25.7 Bi	29.6 Bi



**“ALL MODELS ARE
WRONG, BUT SOME
ARE USEFUL”**

-George E. P. Box

SHOULD YOU BUY BIG COWS OR SMALL?

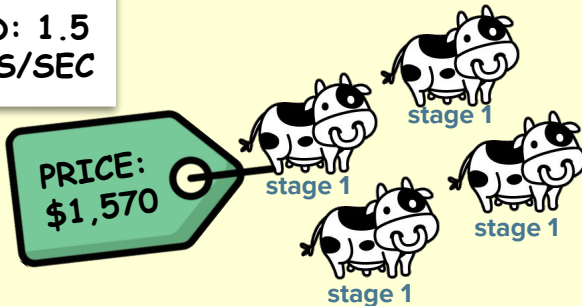
Question:

- Is it better to buy 4 **stage 1** cows, or 1 **stage 3** cow?
- Note: combining 4 stage 1 cows gives you a stage 3 cow

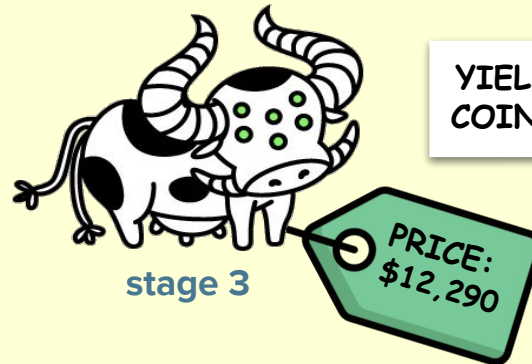
Modeling decisions:

- All cows of the same stage cost the same amount
- The player buys all the small cows at once

YIELD: 1.5
COINS/SEC



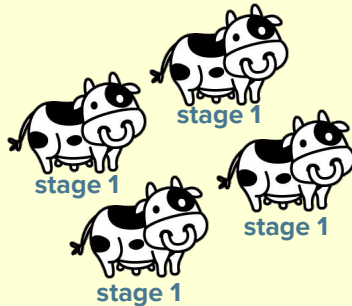
VS



YIELD: 9.5
COINS/SEC

Which option produces more coins per second?

**YIELD: 1.5
COINS/SEC**
(for 1 cow)

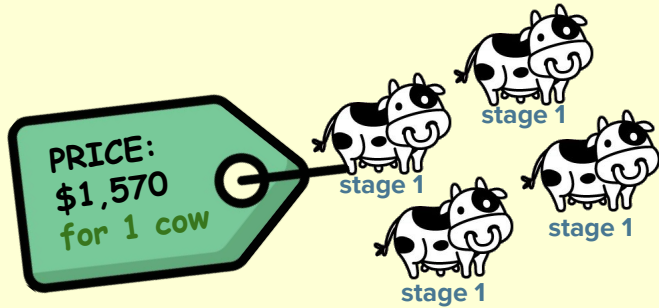


VS

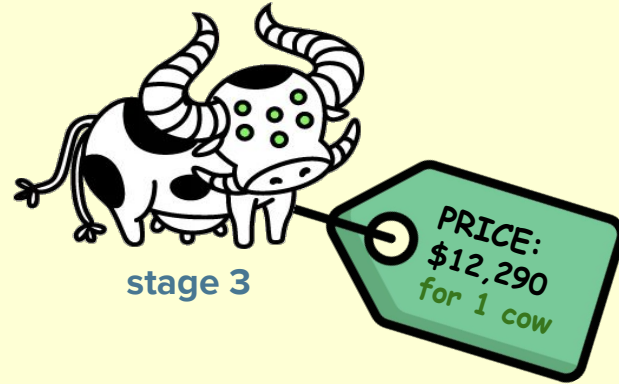


**YIELD: 9.5
COINS/SEC**
(for 1 cow)

Which option costs you less?

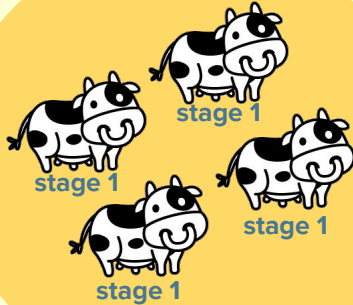


VS



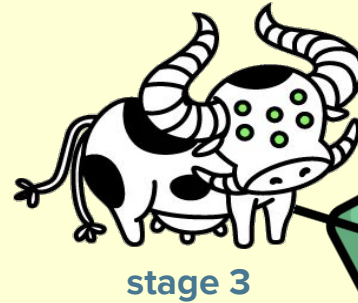
Little cows are a better deal!

YIELD: 9.5
COINS/SEC
(for 4 cow)



PRICE:
\$6,280
for 4 cow

VS



YIELD: 9.5
COINS/SEC
(for 1 cow)

PRICE:
\$12,290
for 1 cow


Now, let's remove the assumption that all cows of the same stage cost the same amount

YIELD: 1.5
COINS/SEC



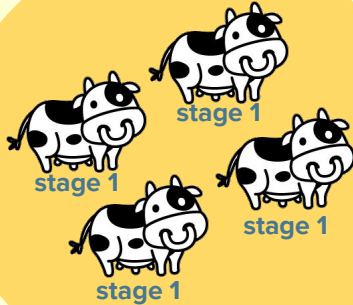
YIELD: 9.5
COINS/SEC



	1	2	3	4	5	6
Baby Cow	560	640	740	850	980	1,130
Adult Cow	1,570	1,800	2,070	2,380	2,740	3,150
Mootant	4,390	5,050	5,810	6,680	7,680	8,830
Hypercow	12,290	14,140	16,260	18,700	21,500	24,730
Mamooth	34,420	39,750	45,520	52,350	60,200	69,230
Alpacow	96,380	110,830	127,460	146,580	168,570	193,850

Little cows are a better deal!

YIELD: 9.5
COINS/SEC
(for 4 cow)



PRICE:
\$7,820
for 4 cow

VS



YIELD: 9.5
COINS/SEC
(for 1 cow)

PRICE:
\$12,290
for 1 cow

WHAT ELSE CAN WE FIND OUT?

Lots of video games (especially phone games) use a similar click-and-wait model. This kind of logic can be applied to optimize all sorts of play tactics.

Is there another game you play a lot where you could find out something interesting with this kind of process? Or is there anything else you'd like to discover about Cow Evolution? Think of a question that interests you and use an equation to help you answer it.

THANK YOU!!!

