M + A + T + H = love

NOTABLE Numbers

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FRIEDMAN NUMBERS

A Friedman number is a positive integer that can be written in some nontrivial way using its own digits together with the elementary operations (+, -, x, /, exponents, and grouping symbols).

DR. ERICH FRIEDMAN

There is only one Friedman number under 100.

25

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$$25 = 5^2$$

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FIND FIVE MORE

However, there are five Friedman numbers in the 120s. Can you find all five?

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SOURCES

- *Number Freak : from 1 to 200 : The Hidden Language of Numbers Revealed* by Derrick Niederman – 2009 – Penguin
- NCTM Illuminations – Brainteaser
- Erich Friedman – Problem of the Month – August 2000
- "Finding Friedman Numbers – Stem.org.uk

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HAPPY NUMBERS

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HAPPY NUMBERS

- Pick a number.
- Square each digit and add the result together.
- Use the new number and do the same again.
- If you reach 1, you have a HAPPY NUMBER.
- If you never reach 1, you have a SAD NUMBER.

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HAPPY NUMBERS

Is 13 a happy number?

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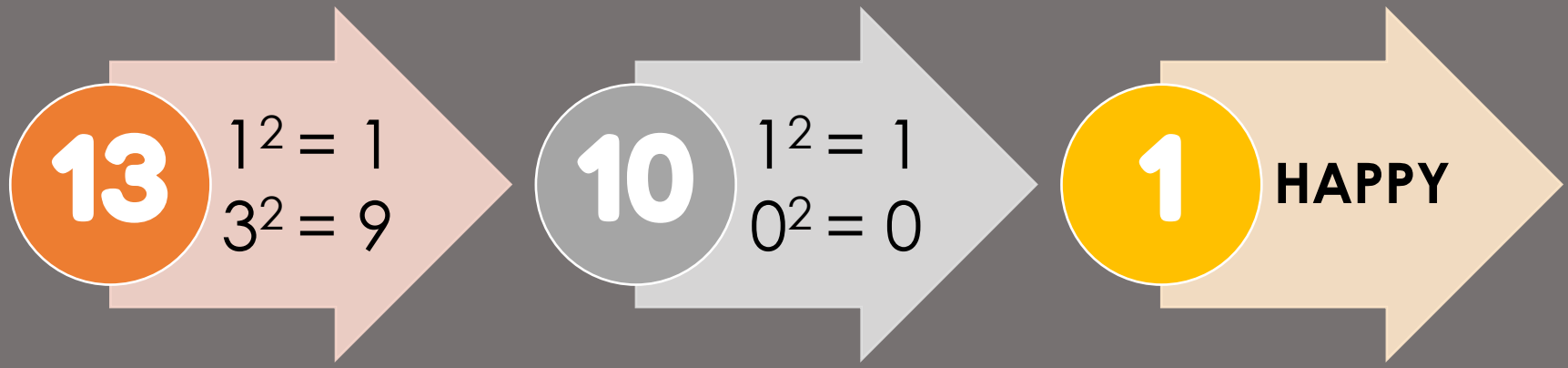
HAPPY NUMBERS



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HAPPY NUMBERS

- What is the smallest sad number?
- What is the smallest happy prime number?

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BREAKOUT ROOMS

What percent of the numbers 1-100 are happy?

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

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EXTENSION TASKS

- Is there an infinite number of happy numbers or is there a largest happy number?
- What is the smallest integer greater than 1 that, when multiplied by any happy number yields another happy number?
- Are there any pairs of consecutive numbers that are both happy? Are there strings of more than two consecutive numbers that are happy?
- What digit does not show up in any of the happy numbers under 100? Why is this? What is the smallest happy number containing this digit?

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EXTENSION TASKS

- Does happiness depend on the base in which the number is written?
- What is the maximum number of steps it takes to determine if a number is happy or sad?
- Investigate what happens when you apply the steps but cube the numbers instead of squaring them. What name would you give this type of number?

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SOURCES

- MathCounts Problem of the Week Archive – Happy Numbers – August 29, 2016
- Fred and Amy's Maths Shack – Happy Numbers
- "Happy Lessons" by Luke Robinson – *Mathematics Teaching* – September 2006 – Issue 198
- "Happy Integers" by Donald C. Duncan – *The Mathematics Teacher* – November 1972 – Vol 65 Issue 7
- *Numbers are Forever* by Liz Strachan – 2014 – Constable – Pages 107-108

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