Beyond CMOS
Introductory Article Prompts Name:_____

1) What is Moore's Law?

Commented [CJ1]: Moore's Law states that the number of transistors on a microprocessor chip will double every two years or so.

2) What two major issues are causing industry to stop pursuing Moore's Law?

Commented [CJ2]: As the number of transistors grows, as a whole they generate too much heat. Also, as the technology has gotten smaller, it has become cost prohibitive to continue to scale the transistor and they begin to follow quantum uncertainties that make them unreliable.
*An increased focus on specialized chips would also be appropriate here, though not one the major reasons. (E.G. the need to conserve battery power while performing specialized app functions.)

3) Traditionally, hardware was designed first, and software was designed that would take full advantage of the hardware. How does the upcoming industry roadmap, which some are calling the More than Moore strategy, change this paradigm?

Commented [CJ3]: Since Moore's Law is starting to falter, industry is looking at having applications be designed first (e.g. analyzing big data, facial recognition, power saving for smartphones) and then designing hardware to fit these applications.

4) In the article it states that the number of transistors roughly doubles every two years. What type of relationship would that represent? (Linear, Quadratic, Exponential, Square Root? You may need to look up examples of these.)

Commented [CJ4]: This should represent an exponential growth situation, where your base would be 2 and the exponent represents the iteration number of the transistors. (Or, you could use x/2 as your exponent and have x be the number of years from where you start… $y = A(2)^{x/2}$)

5) Graph the number of transistors present on these chips created by INTEL. (http://www.intel.com/content/dam/www/public/us/en/documents/corporate-information/history-intel-chips-timeline-poster.pdf)

Chip Name	Year Produced	Number of Transistors
Intel 4004	1971	2,300
Intel 8008	1972	3,500
Intel 8080	1974	4,500
Intel 8086	1978	29,000
Intel 286	1982	134,000
Intel 386	1985	275,000
Intel 486	1989	1,200,000
Pentium	1993	3,100,000

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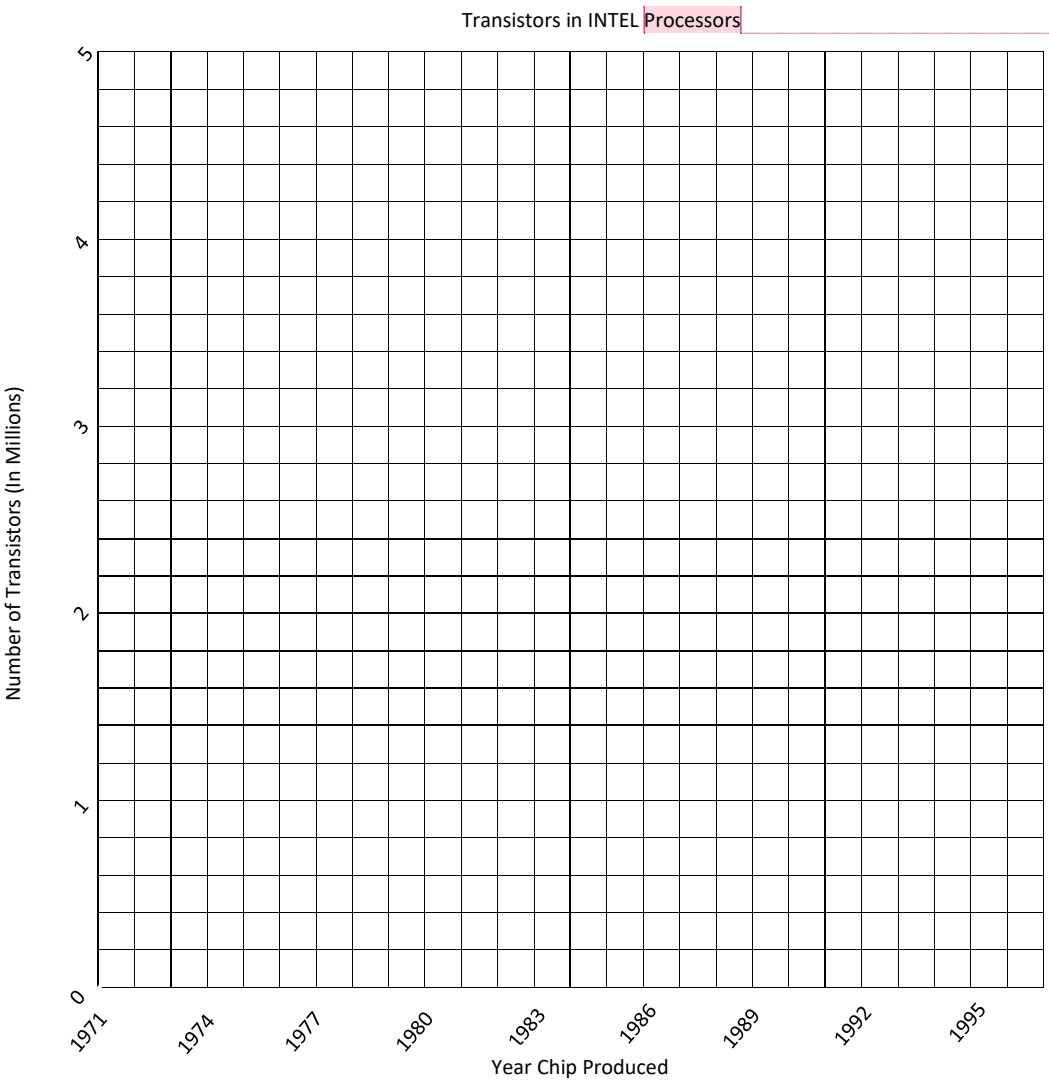
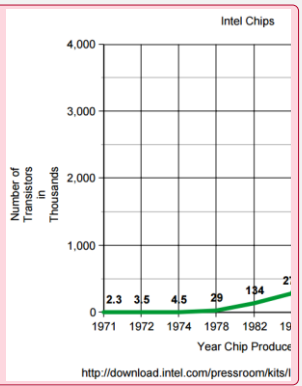
Transistors in INTEL Processors



Commented [CJ5]:



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6) Does the graph correctly show this relationship? Defend your answer, including why you did not pick the other options in question 4.

Commented [CJ6]: Yes it does. It shows the tell-tale exponential growth curve. The rate at which it increases is increasing over time. It is not straight like linear would be, It is not a parabola like quadratic, and it is curved upwards, whereas a square root graph is curved down.

7) What major design change did manufacturers make to try and combat the problem of generating too much heat? What is the drawback to this design change?

Commented [CJ7]: They redesigned the structure of the chips incorporating multiple cores/processors into chips instead of just one. (They also introduced a "speed limit", slowing the processors down.) The drawback to the multiple cores is that the program needs to be able to be split up between the cores and run simultaneously (parallelizable), however many programs are not able to do this.

8) What other solutions is industry looking at in order to combat the heat problem?

Commented [CJ8]: They are looking at using more specialized chips for specific applications.
Also referenced in the article is changing the fundamental designs (thus specialized chips), having different materials, making chips 3-D, and using quantum or neuromorphic computing.

9) Write a paragraph explaining how cell phones have effected chipmakers.

Commented [CJ9]: Cell phones have really required the chips to become specialized, not allowing manufacturers to focus on creating one or two chips to mass produce, but rather require a multitude of chips being produced at lower quantities.