

*Computing at High End:  
Fastest, Cheapest, Soonest?*

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Retread

**Congratulations**  
**on 30 years of leadership in**  
**Computing**  
**Computing**

# So, how is retirement?



Up early in CO

Bluebonnets in Chappell Hill, TX



Dirt Candy

Salishan done right



Fishing in MO



So, it's OK.

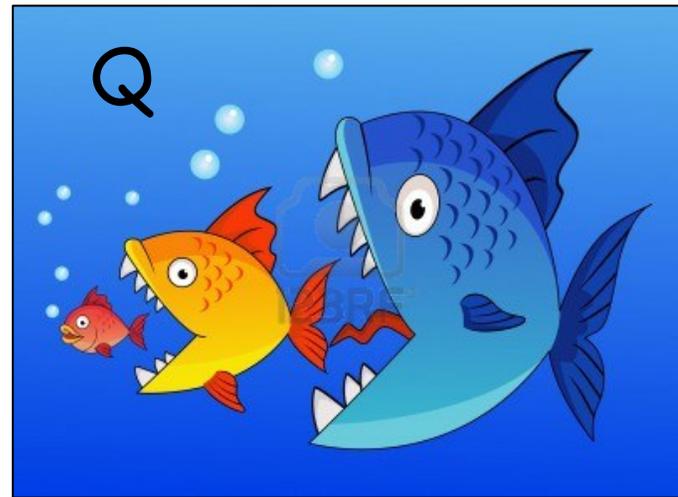
# Scope, Schedule *and* Budget?

Our history of acquisition of high-end computing and advanced technology is replete with examples of constraining *scope, schedule and budget*, leaving open no path to success when things do not go as planned.

*"Plans go to hell as soon as the first shot is fired."*  
Jack Reacher.

*"Any sufficiently advanced technology proposal is indistinguishable from the truth."*  
see Arthur C. Clarke.

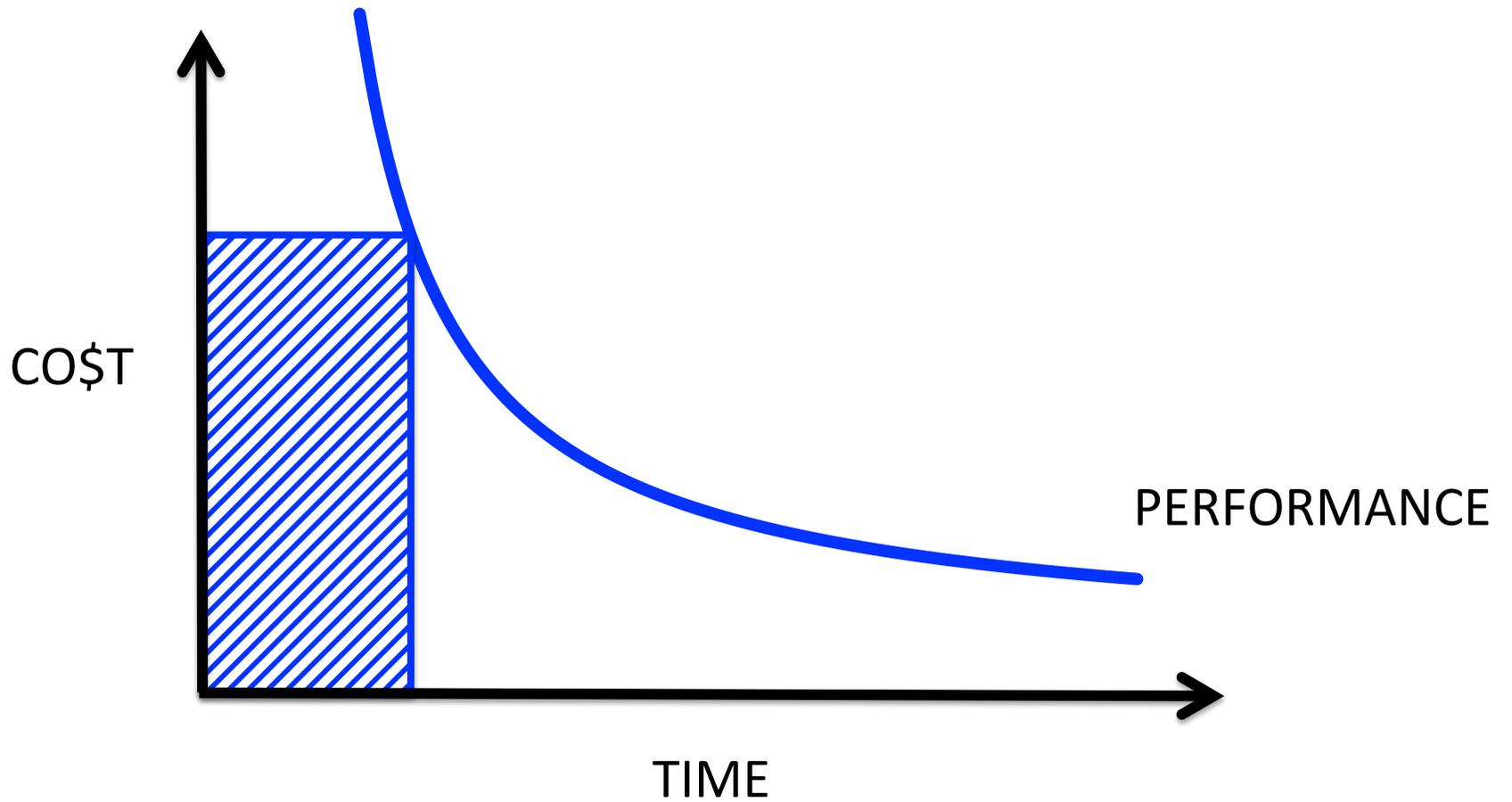
I am sure this has never happened to you



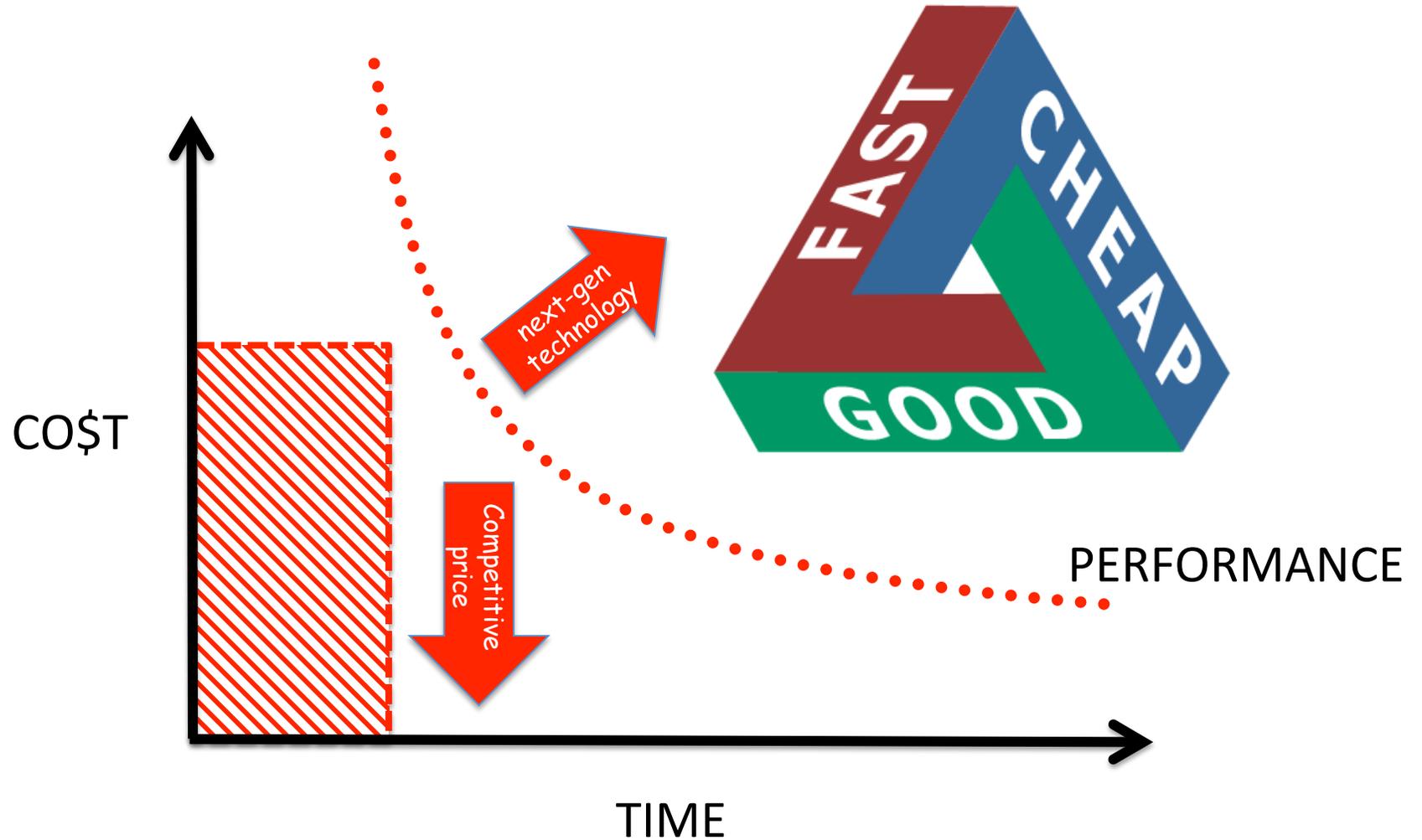
# We even tried to exclude next generation technology in procurements

"The preeminent requirement of this new system is the minimization of implementation risk to Los Alamos. The Conejo cluster must be delivered with proven technology that has been previously deployed by the proposer in similarly large systems that LANL can verify. We value tested technology over the most recent technology."

# Thinking Process



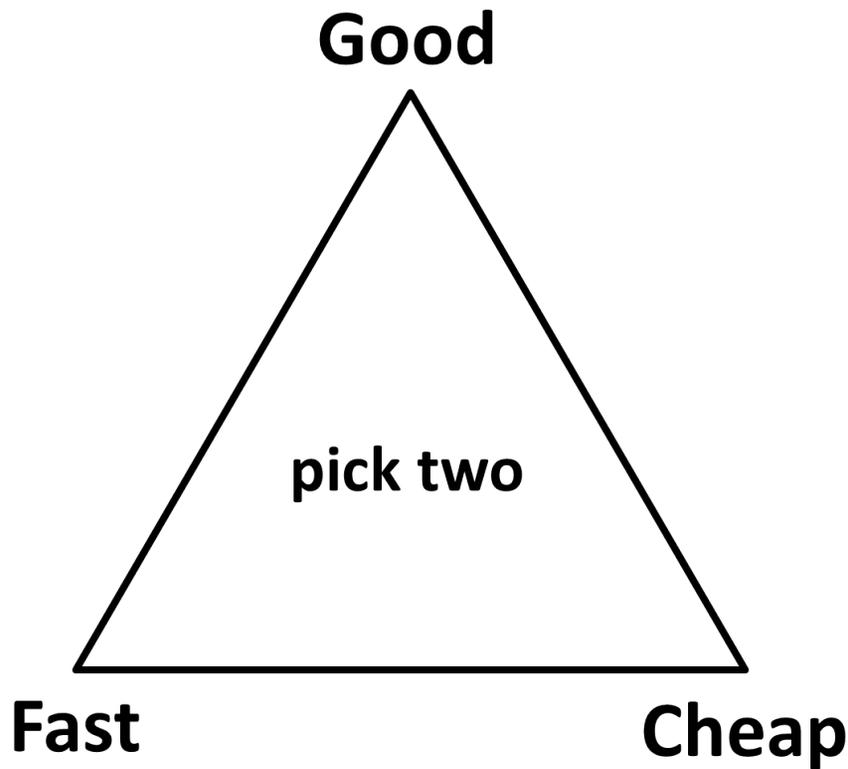
# Competitive (or Fantasy) Process



Then we select the *best-value* fantasy  
and write a contract.

The question on the table is, 'Can we squeeze  
scope, schedule and budget and expect success?'

# Conventional engineering *wisdom*

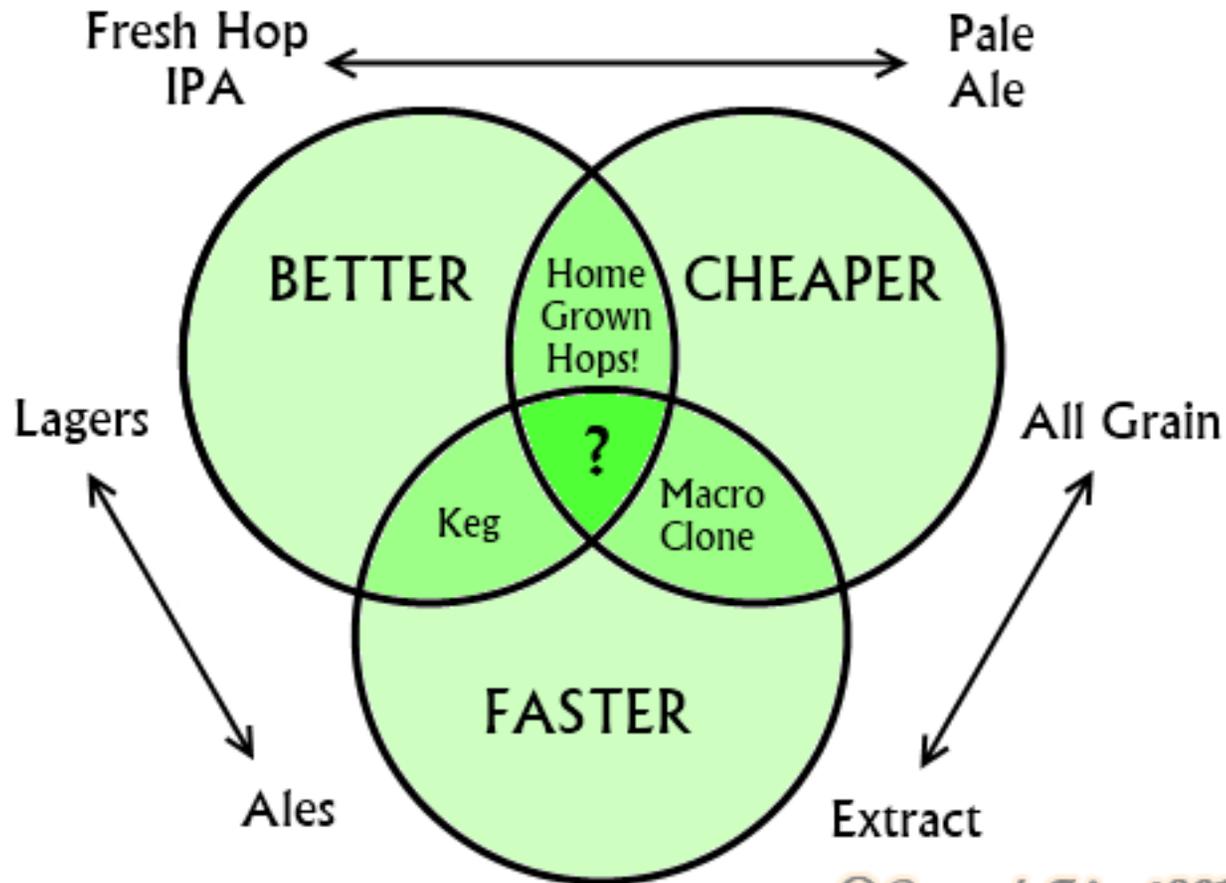


"No"



"Rarely"

# Conventional brewing *wisdom*



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"Wanna beer?"

# Faster, Better, Cheaper (FBC)

- Dan Goldin instituted "Faster, Better, Cheaper" in 1992 as NASA's new business model
- There were 16 missions from 1992 to 1999
  - Five missions to Mars
  - Four Earth orbiting satellites
  - Three space telescopes
  - Two comet and asteroid rendezvous
  - One mission to the moon

– And an

ion propulsion\_\_ test vehicle

The image shows a musical score for the phrase "ion propulsion test vehicle". It consists of two staves: a treble clef staff on top and a bass clef staff on the bottom. The key signature has one flat (B-flat). The melody is written in the treble clef, starting with a whole note chord (F4, Bb4), followed by a half note (Bb4), a quarter note (C5), a quarter note (D5), and a quarter note (E5). The bass line starts with a whole note chord (F4, Bb4), followed by a half note (F4), a quarter note (G4), and a quarter note (A4). The phrase "ion propulsion\_\_ test vehicle" is written in blue text below the notes, with a double underline under "test".

# Are NASA's experiences sociologically relevant to DOE Labs

- Centers want a long term, stable funding environment
- Centers should guard against a shift from basic research to development
- Centers have a reluctance to projectize
- Centers are stand-alone and protective in times of reduced budgets

# Report cards on FBC

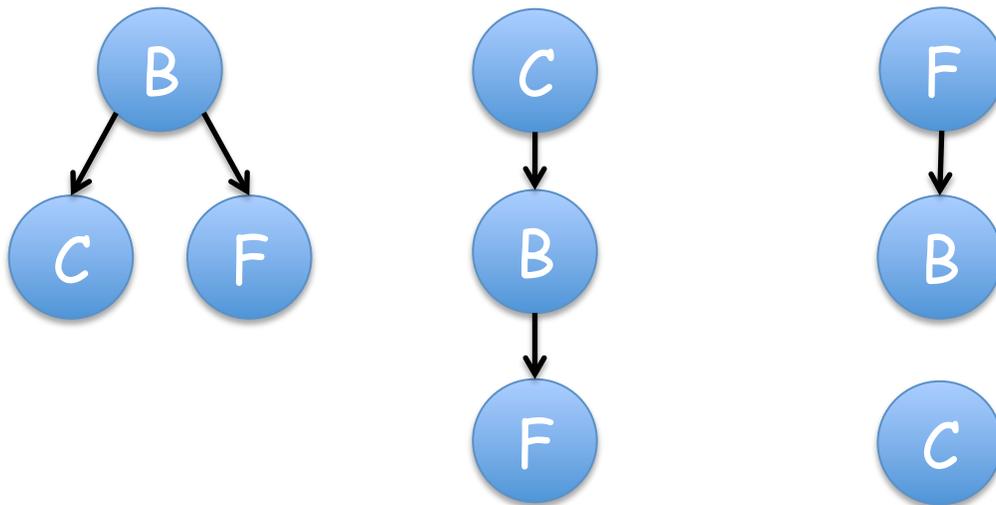
- 9/10 Missions successful in first generation of FBC
  - 5/6 Missions failed in second generation
    - MCO lost upon arrival at Mars
      - ground-based subroutine used Imperial rather than metric units to calculate small\_forces
    - MPL lost upon arrival at Mars
      - most plausible cause was early shutdown of descent engines due to faulty on-board software detection of touchdown
1. *Mars Climate Orbiter Mishap Investigation Board (1999)*
  2. *Report on project management in NASA (2000)*
  3. *Report on the loss of the Mars Polar Lander and Deep Space 2 Missions (2000)*
  4. *NASA FBC Task final report (2000)*
  5. *The lost art of program management in the intelligence community (2006)*
  6. *Can we build software faster and better and cheaper? (2009)*
  7. *Faster, better, cheaper revisited. Program management lessons from NASA (2010)*

# and now, the rest of the story.

- *Faster, Better, Cheaper* was successful as a motto for cultural change at NASA
  - “sociological and cultural - not procedural”
  - Amazon produced 5,127 matches to “Books/FBC”
    - Making marriage work in retirement
    - Faster, better, cheaper and sexier
- “The challenge bar was raised too high for some of the second-generation Missions. The cost cap challenges were too great, along with ... escalating requirements.”
  - And in the case of the Mars Missions, a constrained schedule

# and the answer is ???

- Different motivational phrases
  - “Mission success first”
  - “Slow down”
  - “Back to basics”
- Partial orderings of FBC



# The details confirm some things we have known all along

- Contingency
  - Project and program should hold adequate contingency reserves to assure that missions success is achievable
- Scope
  - Make sure that scope fits within constraints
- Staff
  - Absolutely key ingredients are qualified staff and an environment that makes them want to come to work
- Partnership
  - Must be communication and partnership among contractors, centers and HQ

# Happy Iodine Anniversary

1 1IA 11A	2 IIA 2A											13 IIIA 3A	14 IVA 4A	15 VA 5A	16 VIA 6A	17 VIIA 7A	18 VIIIA 8A		
1 <b>H</b> Hydrogen 1.0079	2 <b>He</b> Helium 4.00260											6 <b>C</b> Carbon 12.011	7 <b>N</b> Nitrogen 14.00674	8 <b>O</b> Oxygen 15.9994	9 <b>F</b> Fluorine 18.998403	10 <b>Ne</b> Neon 20.1797			
3 <b>Li</b> Lithium 6.941	4 <b>Be</b> Beryllium 9.01218											11 <b>Na</b> Sodium 22.989768	12 <b>Mg</b> Magnesium 24.305	13 <b>Al</b> Aluminum 26.981539	14 <b>Si</b> Silicon 28.0855	15 <b>P</b> Phosphorus 30.973762	16 <b>S</b> Sulfur 32.066	17 <b>Cl</b> Chlorine 35.4527	18 <b>Ar</b> Argon 39.948
19 <b>K</b> Potassium 39.0983	20 <b>Ca</b> Calcium 40.078	21 <b>Sc</b> Scandium 44.95591	22 <b>Ti</b> Titanium 47.88	23 <b>V</b> Vanadium 50.9415	24 <b>Cr</b> Chromium 51.9961	25 <b>Mn</b> Manganese 54.938	26 <b>Fe</b> Iron 55.847	27 <b>Co</b> Cobalt 58.9332	28 <b>Ni</b> Nickel 58.6934	29 <b>Cu</b> Copper 63.546	30 <b>Zn</b> Zinc 65.39	31 <b>Ga</b> Gallium 69.732	32 <b>Ge</b> Germanium 72.64	33 <b>As</b> Arsenic 74.92159	34 <b>Se</b> Selenium 78.96	35 <b>Br</b> Bromine 79.904	36 <b>Kr</b> Krypton 83.80		
37 <b>Rb</b> Rubidium 85.4678	38 <b>Sr</b> Strontium 87.62	39 <b>Y</b> Yttrium 88.90585	40 <b>Zr</b> Zirconium 91.224	41 <b>Nb</b> Niobium 92.90638	42 <b>Mo</b> Molybdenum 95.94	43 <b>Tc</b> Technetium 98.9072	44 <b>Ru</b> Ruthenium 101.07	45 <b>Rh</b> Rhodium 102.9055	46 <b>Pd</b> Palladium 106.42	47 <b>Ag</b> Silver 107.8682	48 <b>Cd</b> Cadmium 112.411	49 <b>In</b> Indium 114.818	50 <b>Sn</b> Tin 118.71	51 <b>Sb</b> Antimony 121.760	52 <b>Te</b> Tellurium 127.6	53 <b>I</b> Iodine 126.90447	54 <b>Xe</b> Xenon 131.29		
55 <b>Cs</b> Cesium 132.90543	56 <b>Ba</b> Barium 137.327	57-71 Lanthanide Series	72 <b>Hf</b> Hafnium 178.49	73 <b>Ta</b> Tantalum 180.9479	74 <b>W</b> Tungsten 183.85	75 <b>Re</b> Rhenium 186.207	76 <b>Os</b> Osmium 190.23	77 <b>Ir</b> Iridium 192.22	78 <b>Pt</b> Platinum 195.08	79 <b>Au</b> Gold 196.9665	80 <b>Hg</b> Mercury 200.59	81 <b>Tl</b> Thallium 204.3833	82 <b>Pb</b> Lead 207.2	83 <b>Bi</b> Bismuth 208.98037	84 <b>Po</b> Polonium [208.9824]	85 <b>At</b> Astatine 209.9871	86 <b>Rn</b> Radon 222.0176		
87 <b>Fr</b> Francium 223.0197	88 <b>Ra</b> Radium 226.0254	89-103 Actinide Series	104 <b>Rf</b> Rutherfordium [261]	105 <b>Db</b> Dubnium [262]	106 <b>Sg</b> Seaborgium [266]	107 <b>Bh</b> Bohrium [264]	108 <b>Hs</b> Hassium [269]	109 <b>Mt</b> Meitnerium [268]	110 <b>Ds</b> Darmstadtium [269]	111 <b>Rg</b> Roentgenium [272]	112 <b>Cn</b> Copernicium [277]	113 <b>Uut</b> Ununtrium unknown	114 <b>Uuq</b> Ununquadium [289]	115 <b>Uup</b> Ununpentium unknown	116 <b>Uuh</b> Ununhexium [298]	117 <b>Uus</b> Ununseptium unknown	118 <b>Uuo</b> Ununoctium unknown		
		57 <b>La</b> Lanthanum 138.9055	58 <b>Ce</b> Cerium 140.115	59 <b>Pr</b> Praseodymium 140.90785	60 <b>Nd</b> Neodymium 144.24	61 <b>Pm</b> Promethium 144.9127	62 <b>Sm</b> Samarium 150.36	63 <b>Eu</b> Europium 151.9655	64 <b>Gd</b> Gadolinium 157.25	65 <b>Tb</b> Terbium 158.92534	66 <b>Dy</b> Dysprosium 162.50	67 <b>Ho</b> Holmium 164.93032	68 <b>Er</b> Erbium 167.26	69 <b>Tm</b> Thulium 168.93421	70 <b>Yb</b> Ytterbium 173.04	71 <b>Lu</b> Lutetium 174.967			
		89 <b>Ac</b> Actinium 227.0278	90 <b>Th</b> Thorium 232.0381	91 <b>Pa</b> Protactinium 231.03588	92 <b>U</b> Uranium 238.0289	93 <b>Np</b> Neptunium 237.0482	94 <b>Pu</b> Plutonium 244.0642	95 <b>Am</b> Americium 243.0614	96 <b>Cm</b> Curium 247.0703	97 <b>Bk</b> Berkelium 247.0703	98 <b>Cf</b> Californium 251.0796	99 <b>Es</b> Einsteinium [254]	100 <b>Fm</b> Fermium 257.0951	101 <b>Md</b> Mendelevium 258.1	102 <b>No</b> Nobelium 259.1009	103 <b>Lr</b> Lawrencium [262]			
		Alkali Metal	Alkaline Earth	Transition Metal	Basic Metal	Semimetals	Nonmetals	Halogens	Noble Gas	Lanthanides	Actinides								