

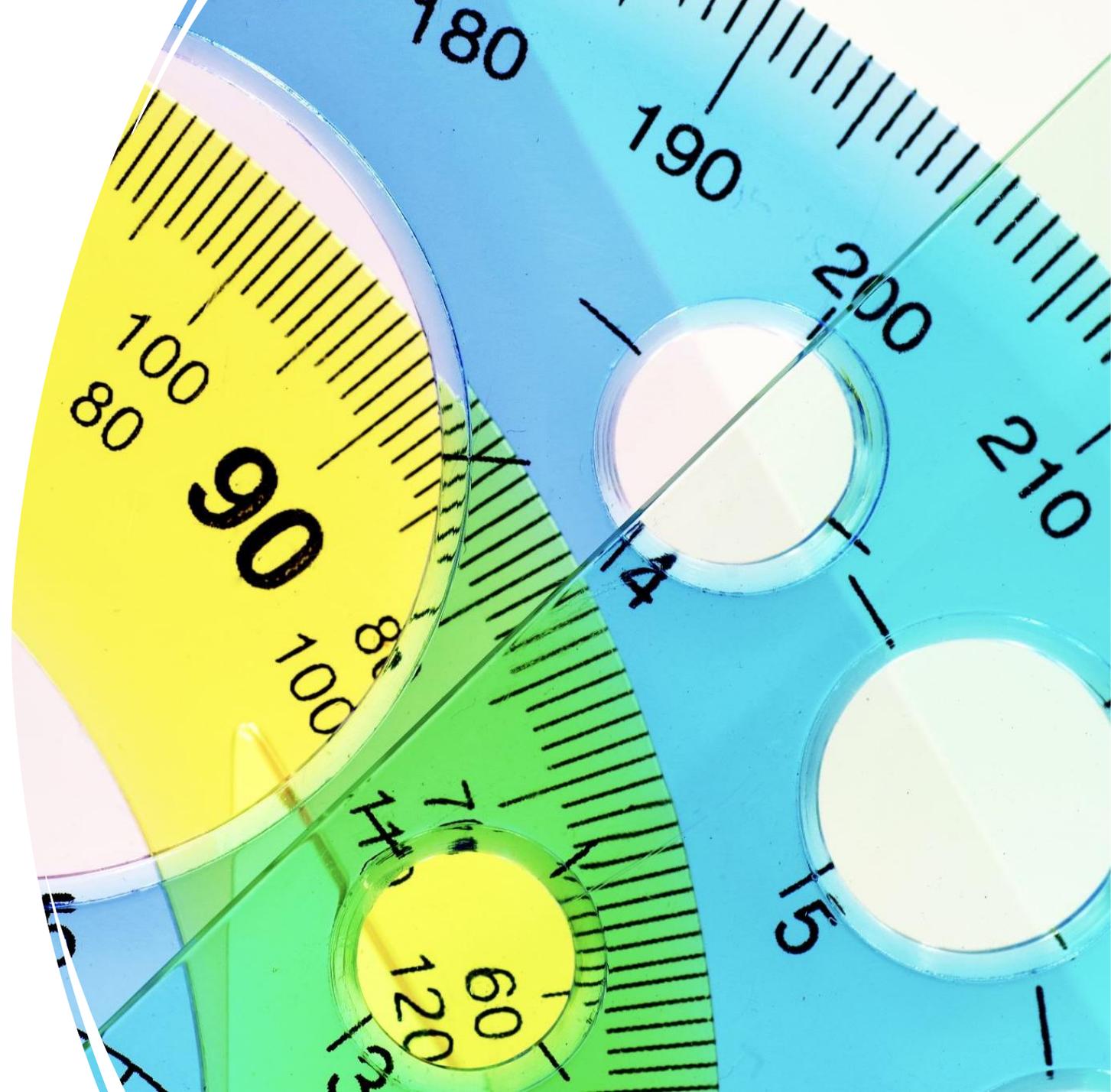
APPLYING METHODS OF NATURAL SCIENCES IN BUSINESS RESEARCH

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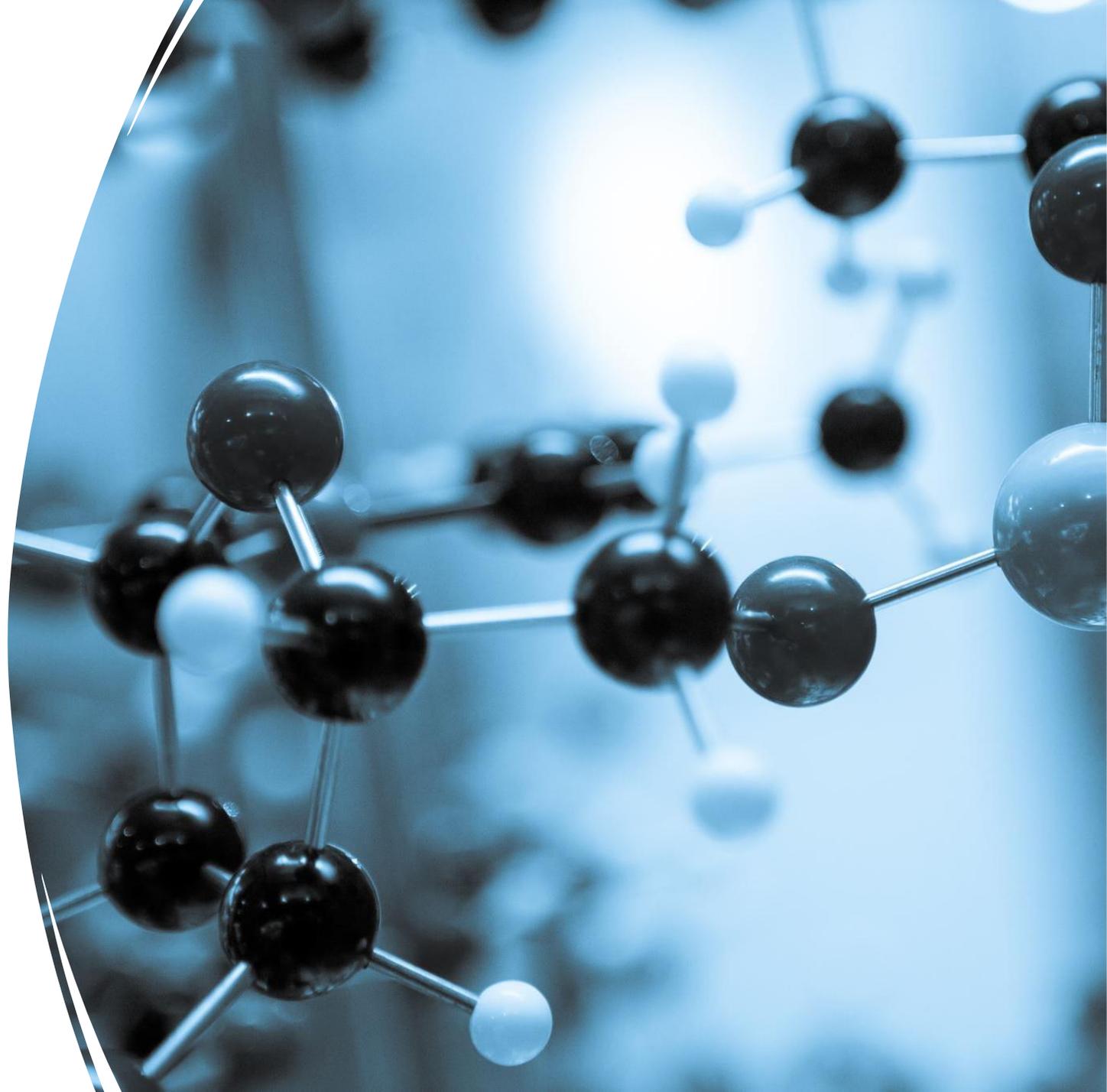
NATURAL SCIENCES: SPECIFIC FEATURES

- 3000+ years old
- Measuring instruments
- Diverse approaches
- Structure and laws
- Methodology



Examples of natural sciences based approaches

- Bioeconomics
- Econophysics



Famous approach: experiment

Full experiment: Hothorne

- Experiential setting
- Dependent variable
- Independent variables
- Control group

Quasi experiment: de Soto

- Experiential setting (not possible)
- Dependent variable
- Independent variables
- Control group (not possible)



Biology and economics

In nature, we see groups of different organisms working together to best utilize the resources needed to sustain life, while still promoting a "survival of the fittest" framework.

Like behavioral finance and other applied economic schools, bioeconomics is another example of economic theory branching out of classical boundaries and attempting to better explain the complex economies of today.



Biology-based research methods



Neural networks

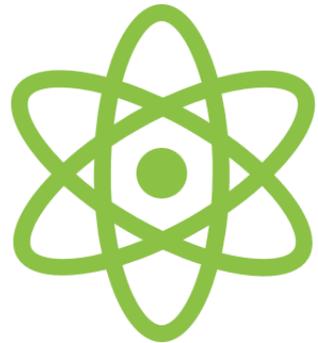


Virus spreading

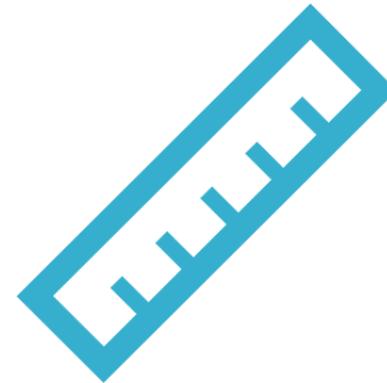
Econophysics

- More than anything, physicists have helped to establish empirical facts about financial markets; for example, that the probability of large price movements decreases in accordance with an inverse cubic power law in many diverse markets.
- Physicists have identified instructive links between markets and other natural phenomena. For example, in the period following a large crash, markets show lingering activity which follows the famous Omori law for earthquake aftershocks.
- Physicists have also helped to develop more realistic models of markets, here mostly in collaboration with economists. In the mid-1990s, researchers first demonstrated how fat-tailed dynamics could arise naturally in models that represent a market as an ecology of interacting adaptive agents.

Physics-based methods



Quantum statistics

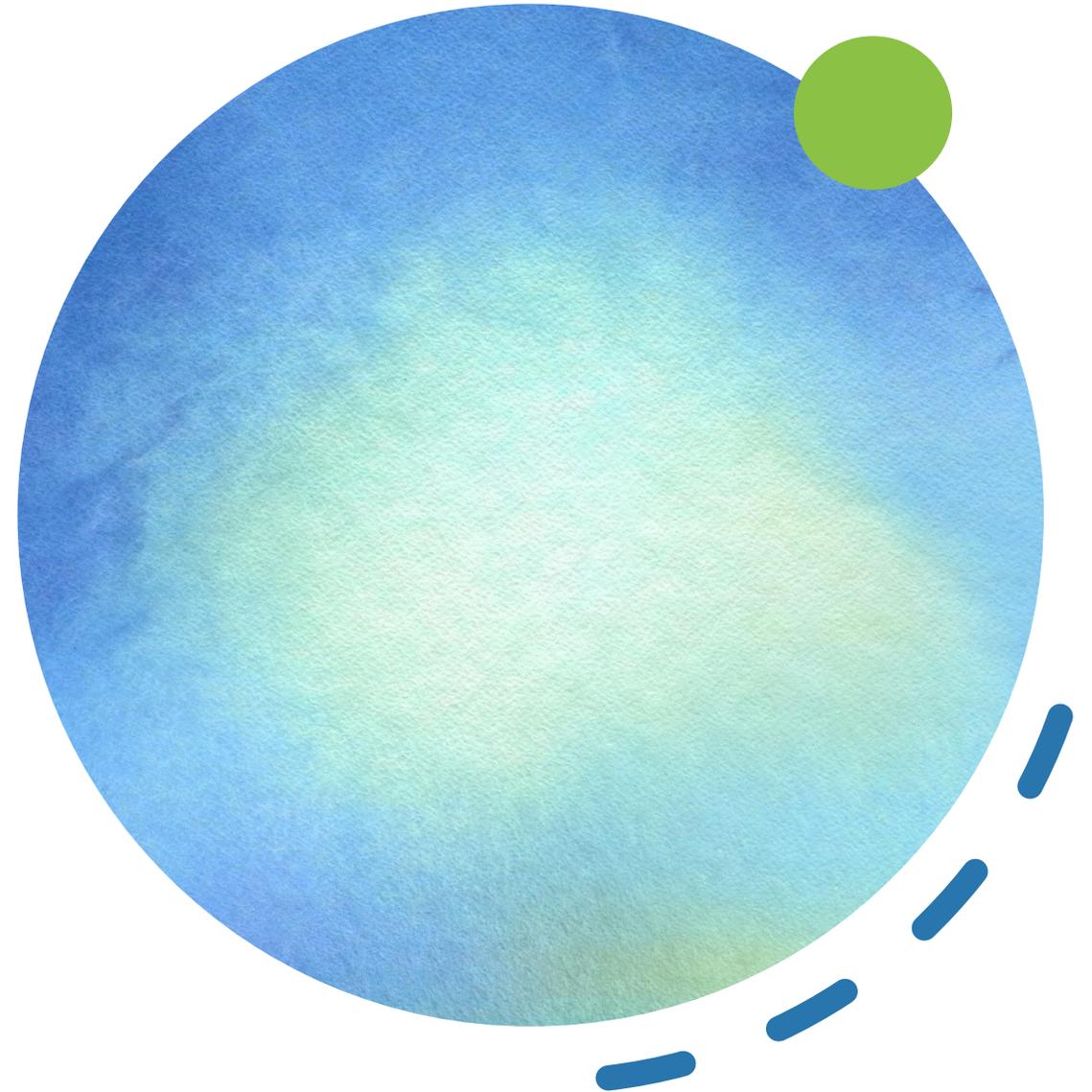


Measuring instruments

Engineering and business

“Black box”
approach

Negative
feedback
systems



Geometry
and
economics?



Econo-chemistry?

Periodic Table of Elements

1 H Hydrogen 1.01 1s ¹																	2 He Helium 4.01 1s ²						
3 Li Lithium 6.97 [He] 2s ¹	4 Be Beryllium 9.01 [He] 2s ²																	5 B Boron 10.81 [He] 2s ² 2p ¹	6 C Carbon 12.01 [He] 2s ² 2p ²	7 N Nitrogen 14.01 [He] 2s ² 2p ³	8 O Oxygen 15.99 [He] 2s ² 2p ⁴	9 F Fluorine 18.99 [He] 2s ² 2p ⁵	10 Ne Neon 20.18 [He] 2s ² 2p ⁶
11 Na Sodium 22.99 [Ne] 3s ¹	12 Mg Magnesium 24.3 [Ne] 3s ²																	13 Al Aluminum 26.98 [Ne] 3s ² 3p ¹	14 Si Silicon 28.08 [Ne] 3s ² 3p ²	15 P Phosphorus 30.97 [Ne] 3s ² 3p ³	16 S Sulfur 32.07 [Ne] 3s ² 3p ⁴	17 Cl Chlorine 35.45 [Ne] 3s ² 3p ⁵	18 Ar Argon 39.95 [Ne] 3s ² 3p ⁶
19 K Potassium 39.1 [Ar] 4s ¹	20 Ca Calcium 40.08 [Ar] 4s ²	21 Sc Scandium 44.96 [Ar] 4s ² 3d ¹	22 Ti Titanium 47.87 [Ar] 4s ² 3d ²	23 V Vanadium 50.94 [Ar] 4s ² 3d ³	24 Cr Chromium 51.99 [Ar] 4s ¹ 3d ⁵	25 Mn Manganese 54.94 [Ar] 4s ² 3d ⁵	26 Fe Iron 55.845 [Ar] 4s ² 3d ⁶	27 Co Cobalt 58.93 [Ar] 4s ¹ 3d ⁷	28 Ni Nickel 58.69 [Ar] 4s ² 3d ⁸	29 Cu Copper 63.55 [Ar] 4s ¹ 3d ¹⁰	30 Zn Zinc 65.38 [Ar] 4s ² 3d ¹⁰	31 Ga Gallium 69.72 [Ar] 4s ² 3d ¹⁰ 4p ¹	32 Ge Germanium 72.63 [Ar] 4s ² 3d ¹⁰ 4p ²	33 As Arsenic 74.92 [Ar] 4s ² 3d ¹⁰ 4p ³	34 Se Selenium 78.98 [Ar] 4s ² 3d ¹⁰ 4p ⁴	35 Br Bromine 79.9 [Ar] 4s ² 3d ¹⁰ 4p ⁵	36 Kr Krypton 83.8 [Ar] 4s ² 3d ¹⁰ 4p ⁶						
37 Rb Rubidium 85.47 [Kr] 5s ²	38 Sr Strontium 87.62 [Kr] 5s ²	39 Y Yttrium 88.91 [Kr] 5s ² 4d ¹	40 Zr Zirconium 91.22 [Kr] 5s ² 4d ²	41 Nb Niobium 92.91 [Kr] 5s ¹ 4d ⁴	42 Mo Molybdenum 95.95 [Kr] 5s ¹ 4d ⁵	43 Tc Technetium 98 [Kr] 5s ² 4d ⁵	44 Ru Ruthenium 101.07 [Kr] 5s ¹ 4d ⁷	45 Rh Rhodium 102.91 [Kr] 5s ¹ 4d ⁸	46 Pd Palladium 106.42 [Kr] (5s ⁰) 4d ¹⁰	47 Ag Silver 107.87 [Kr] 5s ¹ 4d ¹⁰	48 Cd Cadmium 112.41 [Kr] 5s ² 4d ¹⁰	49 In Indium 114.81 [Kr] 5s ² 4d ¹⁰ 5p ¹	50 Sn Tin 118.71 [Kr] 5s ² 4d ¹⁰ 5p ²	51 Sb Antimony 121.76 [Kr] 5s ² 4d ¹⁰ 5p ³	52 Te Tellurium 127.6 [Kr] 5s ² 4d ¹⁰ 5p ⁴	53 I Iodine 126.9 [Kr] 5s ² 4d ¹⁰ 5p ⁵	54 Xe Xenon 131.29 [Kr] 5s ² 4d ¹⁰ 5p ⁶						
55 Cs Cesium 132.91 [Xe] 6s ¹	56 Ba Barium 137.33 [Xe] 6s ²	57–71 Lanthanides	Lu	72 Hf Hafnium 178.49 [Xe] 6s ² 4f ¹⁴ 5d ²	73 Ta Tantalum 180.95 [Xe] 6s ² 4f ¹⁴ 5d ³	74 W Tungsten 183.84 [Xe] 6s ² 4f ¹⁴ 5d ⁴	75 Re Rhenium 186.2 [Xe] 6s ² 4f ¹⁴ 5d ⁵	76 Os Osmium 190.23 [Xe] 6s ² 4f ¹⁴ 5d ⁶	77 Ir Iridium 192.22 [Xe] 6s ² 4f ¹⁴ 5d ⁷	78 Pt Platinum 195.08 [Xe] 6s ² 4f ¹⁴ 5d ⁸	79 Au Gold 196.97 [Xe] 6s ² 4f ¹⁴ 5d ⁹	80 Hg Mercury 200.59 [Xe] 6s ² 4f ¹⁴ 5d ¹⁰	81 Tl Thallium 204.38 [Xe] 6s ² 4f ¹⁴ 5d ¹⁰ 6p ¹	82 Pb Lead 207.2 [Xe] 6s ² 4f ¹⁴ 5d ¹⁰ 6p ²	83 Bi Bismuth 208.98 [Xe] 6s ² 4f ¹⁴ 5d ¹⁰ 6p ³	84 Po Polonium 209 [Xe] 6s ² 4f ¹⁴ 5d ¹⁰ 6p ⁴	85 At Astatine 210 [Xe] 6s ² 4f ¹⁴ 5d ¹⁰ 6p ⁵	86 Rn Radon 222 [Xe] 6s ² 4f ¹⁴ 5d ¹⁰ 6p ⁶					



If a scientific method is proven to be true, it should work in any field of science



Colleagues had proven the research methods to be reliable, try those when you are lost



Experiments always work, but we can use quasi experiments

Questions and remarks?