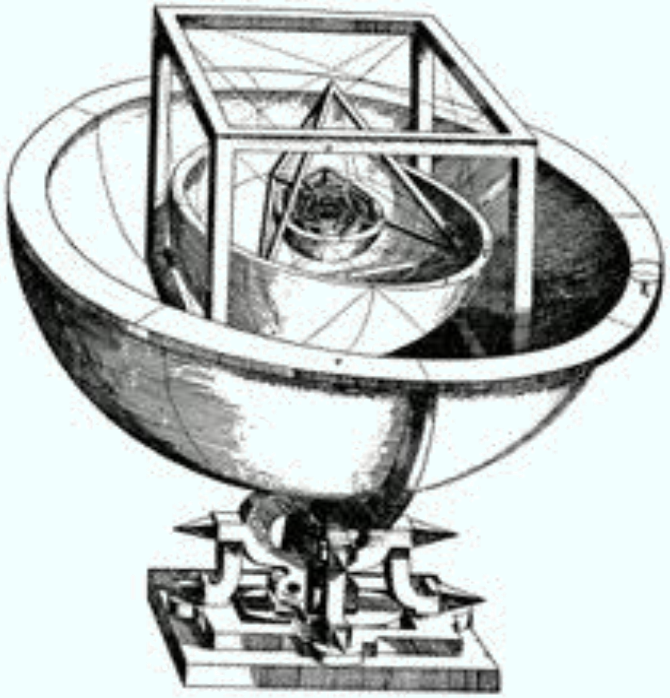
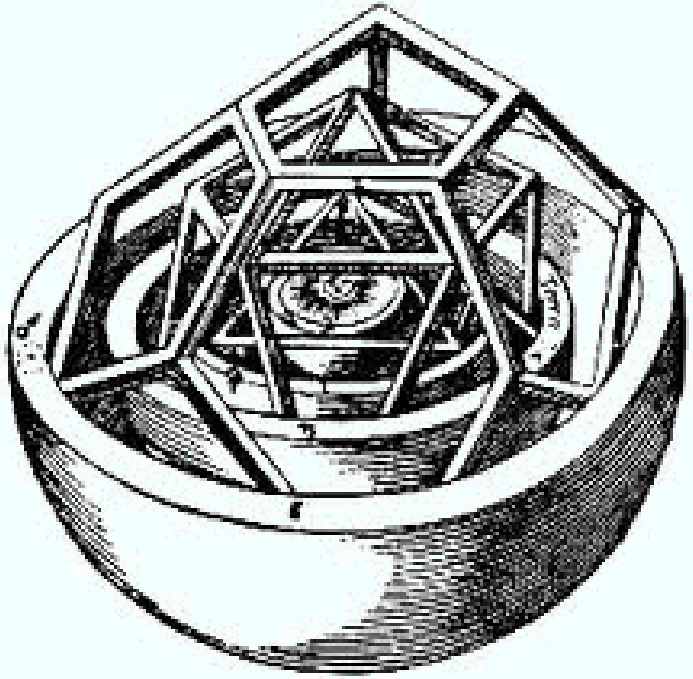
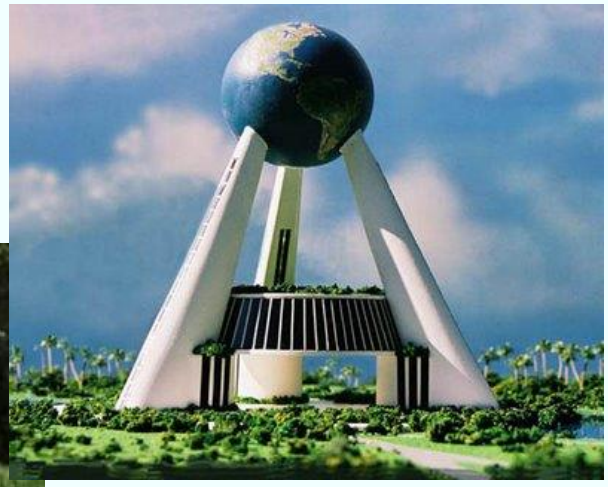
Johannes Kepler's Model of the Solar System

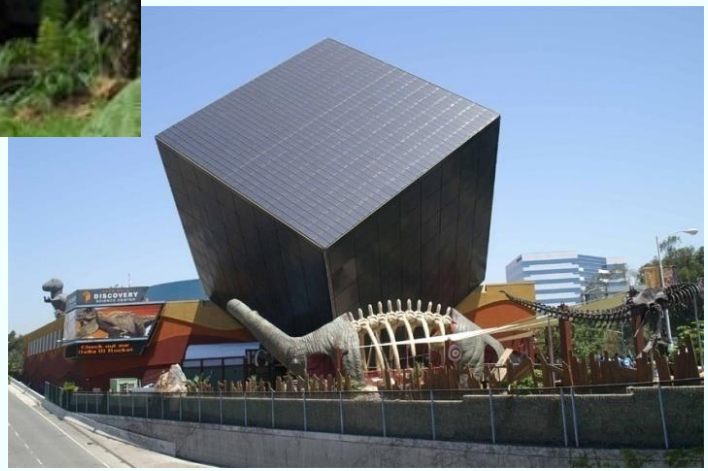
(*Mysterium Cosmographicum*, 1596)



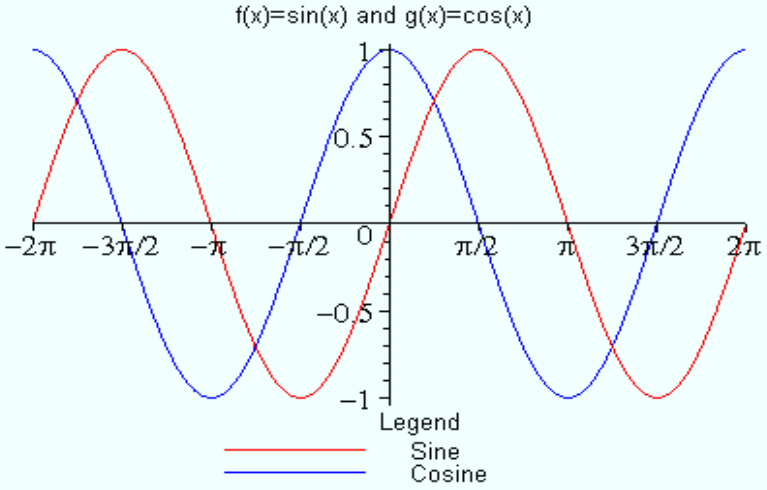


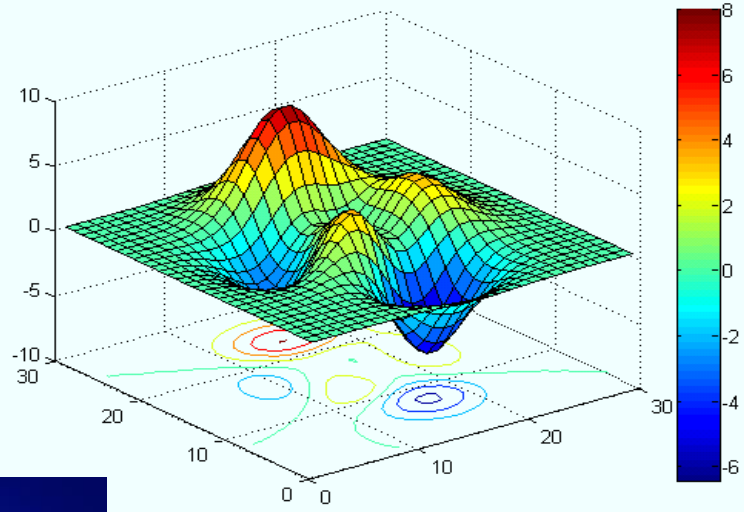
Regular Polyhedral Structures in the Real World

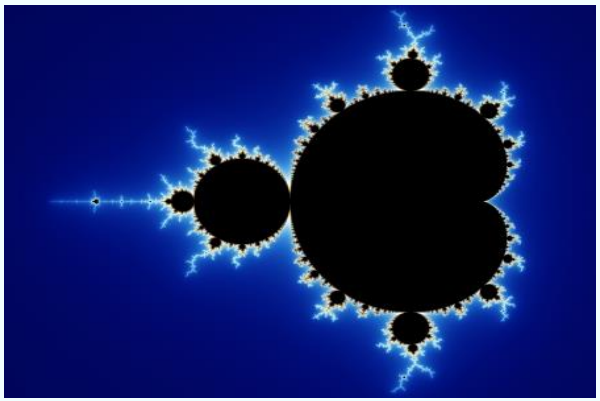




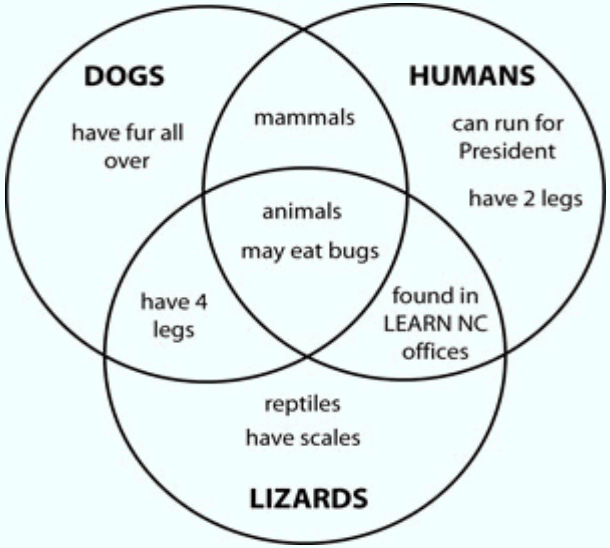
Math Models as Graphical Representations







Math Models as Symbolic/Tabular Representations



$$\int_a^b f(x)\,dx = F(b) - F(a).$$

Table 2. COF and values for the mixture design experiments for the mobile phase of the HPLC carbohydrate analysis

Experiments	Mobile Phases[a]	ΠRs values	COF values Rd = 1.2
1	50:10:40	1.230	0.016
2	70:10:20	1.066	-0.085
3	60:14:26	0.788	-0.422
4	60:10:30	1.206	0.005
5	55:12:33	1.071	-0.114
6	65:12:23	0.965	-0.218
7	60:11.3:28.7	1.044	-0.140
8	55:10.4:34.6	1.156	-0.037
9	65:11.7:23.3	1.037	-0.245
10	50:10:40	1.212	0.009
11	70:10:20	1.106	-0.082
12	60:14:26	0.787	-0.426
13	60:10:30	1.205	0.0042
14	55:12:33	1.073	-0.112
15	65:12:23	0.971	-0.212
16	60:11.3:28.7	1.045	-0.138
17	60:11.3:28.7	1.061	-0.123
18	60:11.3:28.7	1.058	-0.126
19	60:11.3:28.7	1.061	-0.123
20	60:11.3:28.7	1.045	-0.138

[a] acetonitrile, water and ethyl acetate, respectively.

Math Models of Nature and Architectures

Catenaries and the *hyperbolic cosine* function

$$y = a \cosh\left(\frac{x}{a}\right) = \frac{a}{2}\left(e^{x/a} + e^{-x/a}\right)$$

The Top Ten Laws of Our World

(Robert Crease: *A Brief Guide to the Great Equations*, 2009)

1. The Pythagorean Theorem $a^2 + b^2 = c^2$
2. Newton's 2nd Law of Motion $F = ma$
3. Newton's Law of Universal Gravitation $F = G\frac{mM}{r^2}$
4. Euler's Formula $e^{ix} = cosx + isinx$
5. The 2nd Law of Thermodynamics $\Delta S = \int \frac{\delta q}{T}.$

The Top Ten Laws of Our World

(Robert Crease: *A Brief Guide to the Great Equations,* 2009)

6. Maxwell's Equations

$$\nabla \times \vec{E} = -\frac{\partial \vec{B}}{\partial t} - \vec{M}$$

$$\nabla \times \vec{H} = -\frac{\partial \vec{D}}{\partial t} + \vec{J}$$

$$\nabla \cdot \vec{D} = \rho$$

$$\nabla \cdot \vec{B} = 0$$

7. Einstein's Mass-Energy Equivalence $E = mc^2$

8. Einstein's Field Equations $R_{\mu\nu} - \frac{1}{2}Rg_{\mu\nu} + \Lambda g_{\mu\nu} = 8\pi\frac{G}{c^4}T_{\mu\nu}$

9. Schrödinger's Equation $i\hbar\frac{\partial}{\partial t}\Psi(x, t) = \hat{H}\Psi(x, t)$

10. The Heisenberg Uncertainty Principle $\Delta\chi\Delta\rho \geq \frac{\hbar}{2}$

Structures of Basic Types of Models in School Arithmetic and Algebra

- Additive : $A + B = C$, $C - B = A$, $C - A = B$; $A \pm x = C$
- Multiplicative: $AB = C$, $C/B = A$, $C/A = B$; $Ax = C$
- Proportional: $A/B = C/D$, $B/A = D/C$, $A/C = B/D$, $C/A = D/B$
- Percent and percent change:

  $A \div B = c\%$, $A \div c\% = B$, $B*c\% = A$;

  $C = P \pm P*r\% = P(1 \pm r\%)$

Structures of Basic Types of Models in School Arithmetic and Algebra

- Recursive: $a_n - a_{n-1} = c$; $a_n / a_{n-1} = c$
- Linear: $Ax + B = C$; $y = mx + b$; $Ax + By + C = 0$
- Nonlinear (quadratic, power, radical, polynomial, rational, exponential, logarithmic, trigonometric, etc.)
- Absolute value and piecewise models
- Combinations of the above
- Inequality versions of the above