Using Images in GeoGebra for Teaching Mathematics

Andreas Lindner, Austria

Abstract

GeoGebra offers a method of inserting images into the drawing pad. These images (graphics, pictures, sketches, cliparts) can be used as a background image or can be manipulated like other objects. Photos may be rotated, reflected or fixed to a point and their size can be changed in different ways.
This allows a new access to experimental learning and should hopefully raise the motivation of students.
This way many facts in mathematics can be illustrated more lively and the use of images makes things easier to understand.
Some examples from Secondary School shall clarify this aspect of working with GeoGebra.

Submission

In many ways the use of images offers a more vivid representation of mathematics. Sometimes students do not understand the necessity of mathematical activities unless they are able to see a purpose of their activities. If there is a chapter dealing with the properties of polynomial functions it would be more understandable for most students to associate this with the course of a street (see example below).
Another important aspect of such activities is to design animations using images. The study of animations could be the initial point for further investigations. So the exploration of the curve describing the movement of a reflector of a bicycle leads from mere animation to the study of cycloids in the fields of pure mathematics (see example below).

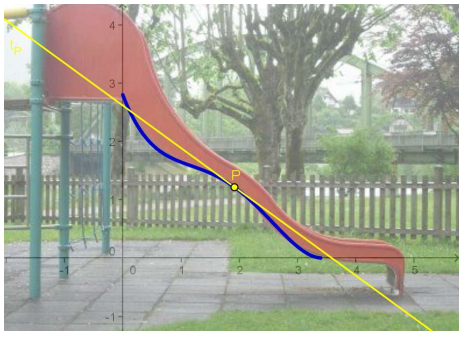
Some examples shall give an impression how GeoGebra could change the conventions of teaching maths.

Finding maxima and minima

Example: Steep slide

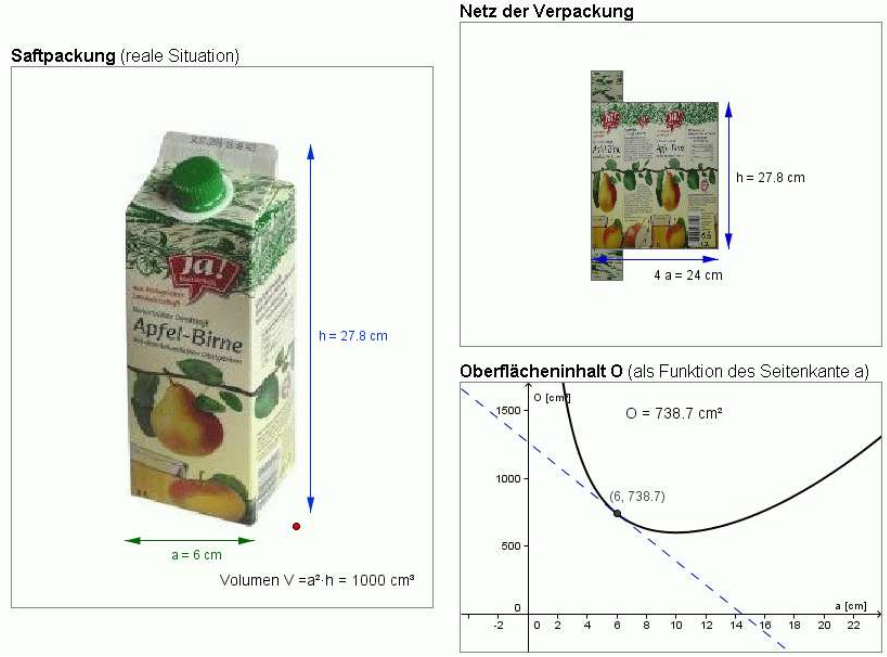
Where is the steepest place of the slide?

Find a function which describes the form of the slide.
Find experimentally the place of the greatest gradient.
Find a solution by means of differentiation.



http://home.eduhi.at/teacher/alindner/diverses/Bsp_OS/Kinderrutsche.html

Example: Optimum values
Find the minima of the surface of a juice box.



Left: juice box

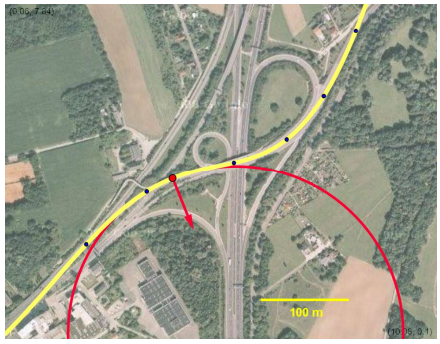
Right: net of the rectangular prism and graph of the function describing the surface.

Both applets on the right side depend on the user's activities in the left applet.
http://home.eduhi.at/teacher/alindner/diverses/optimum/tetrapak_quad.html

The properties of functions

Example: Images from Google Maps

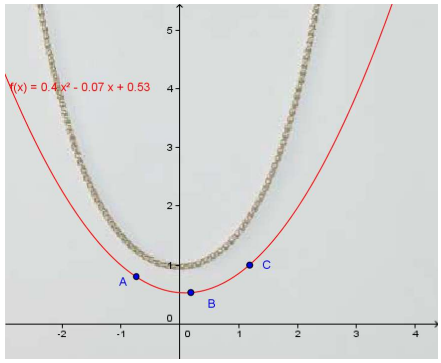
Find a function describing the course of the street in an image taken from Google Maps.
Calculate the curvature and the osculating circle at a given place.



http://home.eduhi.at/teacher/alindner/diverses/Bsp_OS/Kurvenradius_1.html

Example: Curve of a chain - Hyperpolic Cosine

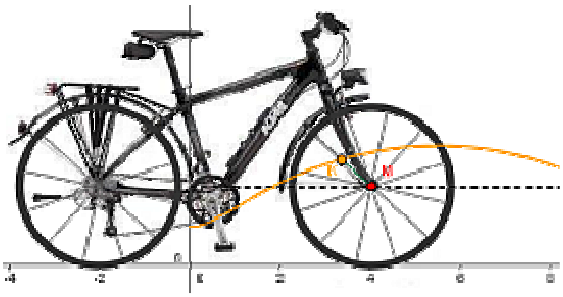
Is it possible to describe a hanging chain by a parabola?

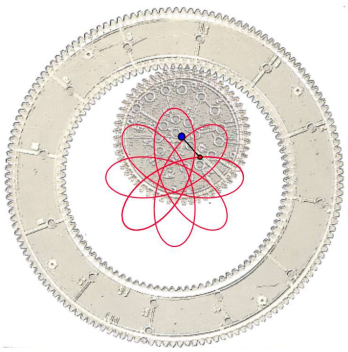


http://home.eduhi.at/teacher/alindner/Dyn_Geometrie/Kettenlinie/sites/Galilei.htm

Parametric curves

Example: Cycloids
I) Which curve is defined by the movement of a reflector?
II) What curve results when a circle unrolls on another circle?

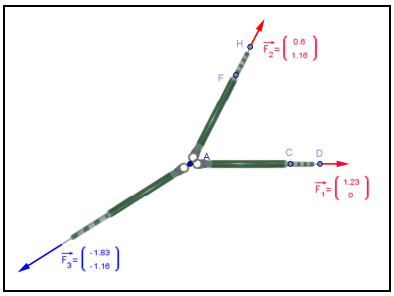


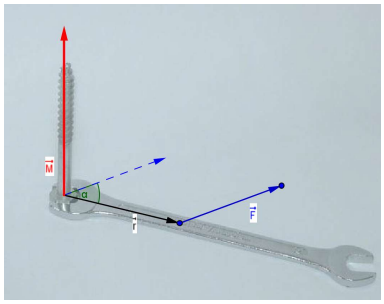


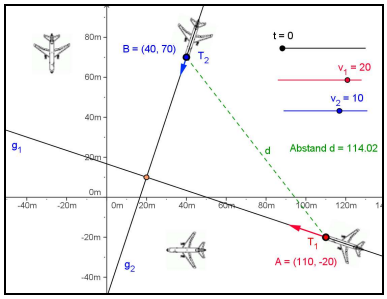
http://home.eduhi.at/teacher/alindner/diverses/Parameterkurven/zykloide_fahrrad.html
http://home.eduhi.at/teacher/alindner/diverses/Bsp_OS/Spirograph.html

Vectors

Example: Mathematics and physics
I) Visualizing the sum of 2 forces and the addition of vectors.
II) Visualizing a normal vector and the torque.
III)Applet using cliparts to show the intersection of 2 lines







http://home.eduhi.at/teacher/alindner/Dyn_Geometrie/vektor1/sites/Federwaage.htm
http://home.eduhi.at/teacher/alindner/diverses/Bsp_OS/04_drehmoment.html
http://home.eduhi.at/teacher/alindner/Dyn_Geometrie/vektor2/sites/Rollfeld2.htm