## Learning System 6.5

Effective technology for online science and and technical education

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## Learning System 6.5: An effective solution to the technological challenges facing science education

## A new generation of technology

The **Learning 6.5 system** is a combination of <u>network technology</u> and a revolutionary and versatile <u>software suite</u> that not only facilitates the **creation and operation** of a **digital virtual school**, but also **the processing** of any type of **scientific document**, the **design** of all kinds of presentation or science teaching slides, and distance **learning and assessment** involving various applications of mathematical sciences using a computer.

The Learning 6.5 system has the unique advantage of providing end-to-end management of the entire process of computerizing teaching and assessment materials, delivering courses, evaluating student performance and compiling academic results online. This management is as simple in scientific and technical education as in literary education. Each teacher can easily create his own online classes and manage his courses and assessments. He does not need an assistant.

The **Learning 6.5 system** is certainly <u>beyond the expectations</u> of educational institutions and national governments, the only effective solution for distance and online teaching and assessment (courses, assignments and state exams).

### Three major problems solved by the Learning 6.5 system

# 1. The development of lively and dynamic interactive contents in science and technology education

The ScienceWord 6. 5 scientific word processing technology, the Skill 6. 5 assessment technology and the Class 6.5 scientific presentation technology of the Learning 6.5 system facilitate the creation of electronic notebooks for all disciplines, including

- lively learning activities with animated and interactive learning objects that make knowledge fun to learn and easier to understand;
- tests for self-assessment on the computer or tablets online or offline, in class and at home.

These electronic notebooks facilitate self-learning and knowledge review; they are unalterable and can therefore be reused by other learners.

#### 2. Distance and online learning

The Symtone platform of the Learning 6. 5 system provides a flexible virtual environment that incorporates interactive features and makes possible for the first time in history, face-to-face "students-teachers" distance learning, real and effective.

#### 3. Effective remote and online assessment

The Skill 6. 5 assessment technology of Learning 6. 5 System allows for the <u>effective</u> online delivery of <u>state exams</u> (primary school certificate, high school entrance exams, university entrance exams, etc.) and university exams.

This presentation document is produced entirely with the <u>Class 6.5</u> component of the **Learning 6.5 system** software suite.



## I. Brief description of the four components of the Learning 6.5 system software suite



ScienceWord 6.5

Documents and tests
databases



Class 6.5
Lesson and
presentation plan



Skill 6.5
Homework assignments
and online exams



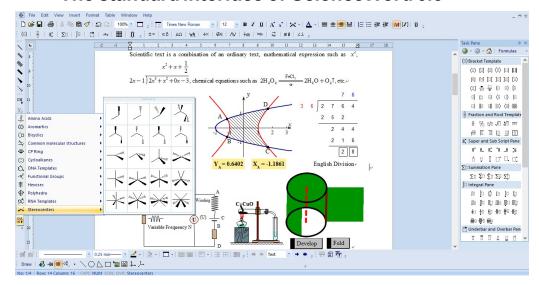
Symtone
Distance and online
training

## ScienceWord 6.5: A convenient tool for typing scientific documents, creating computer-based tests data & teaching

ScienceWord 6.5 is an outstanding software for word processing that greatly facilitates the processing and the publication of scientific documents of all types. It brings to life: the most revolutionary, natural and flexible way ever of writing math formulae; the most natural way in completing geometric and dynamic constructions; a very natural and intelligible way of sketching chemical structures; a very flexible way of graphing functions in linear, 2D and 3D coordinates; ScienceWord also enables to create data base for computer-based tests or exams associated with a variety of attributes useful for learning management.

ScienceWord is indeed the universal format through which the entire scientific community could easily communicate at all levels of education.

#### The standard interface of ScienceWord 6.5



#### ScienceWord 6.5 whiteboard tools



## Class 6.5: An efficient teaching technology

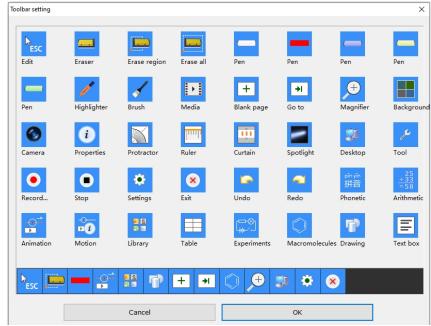
Class 6. 5 is an awesome tool that enables to effortlessly <u>create vivid</u> teaching slides for science education and <u>deliver lectures</u> with the help of a well equipped whiteboard tools. The user at any point of his lecture, can insert a blank page, add scientific contents of all kinds, multimedia or **dynamic learning** objects from a library, etc.

Class is just a master piece of teaching technology that brings to life an effective use of ICT (computer +projector) to deliver scientific courses.

#### The standard interface of Class 6.5

Class - [LEARNING 6.5 for Science & Technology Education] File Edit View Insert Format Table Slide Window Help □ 😅 🖫 🖒 | ⊙ 🕨 🗷 🔚 📳 🐰 🕾 🛍 💅 | Ω 🖂 | 76.4% ▼ 🛅 | ● || ■ 🛫 Times New Roman (ii) | ∰ | x; | Σii | [ii | ♂ | → | | | | | | | | | | | ±= | αβ | ΔΩ | ∀ħ | +× | €< | ΛV | +α | ≒ν | ♂ | ∉∄ | ∠⊥ ── No Title [ a 1 4 4 u n ø % · Algebraic calculus and graphics  $P(x) = A_1x^5 + A_2x^4 + A_3x^3 + A_3x^2 + A_3x + A_6$  is the polynomial of degree at most equal to 5, whose graph passes through the 6 points  $(x_i, y_i)$ , with the values x = 1.... 6, all distinct values.  $x_r = 4.000$ M M = M M = M M =  $|\mathbf{A}||\mathbf{A}|| = |\mathbf{A}||\mathbf{A}||\mathbf{A}|$ \* : : A V • 🗆 🗆 🗆 🛆  $x_r = 5.000$  $y_{s} = 5.00$ £; t z α β Greek Letters(L.C.)  $|\mathbf{H}||\mathbf{H}||=$ M M =  $|\mathbf{H}|\mathbf{H}| =$ α β γ δ ε ε ζ η α θ ικλμνξοπωρ M M =  $|\mathbf{H}||\mathbf{H}||=$ HH = HH= **ξσςτυφφχψω**  $A_5 = -0.07$   $A_a = 1.15$   $A_5 = -6.21$   $A_7 = 13.13$   $A_1 = -9.00$   $A_n = 3.00$ 170 ABГAEZNOIK AMNEOHPETY  $3\sin(x)$ Vector 14516:Length =-1.50Direction =0.00 y = 3sin(x) = -1.50 Vector 14473: From A, to 0 D < 2 < 2 < 0 + 0 + 1 More | → 💥 % 🖰 🚣 🏃 · \ ○ △ 🗆 🕍 🖰 🖴 Width = 0.00, Length = 0.00 n 0.00 Deg CAP NUM SCRL OVR Authorized

#### Class 6.5 whiteboard tools

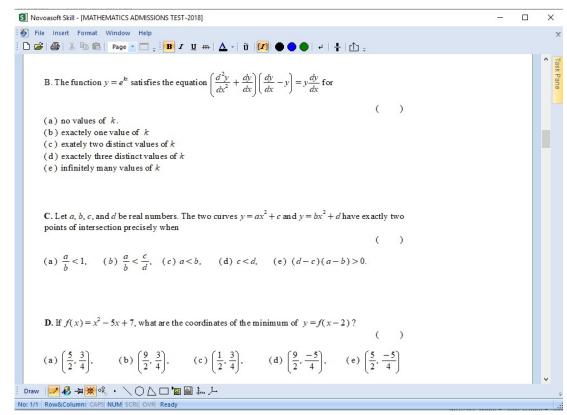


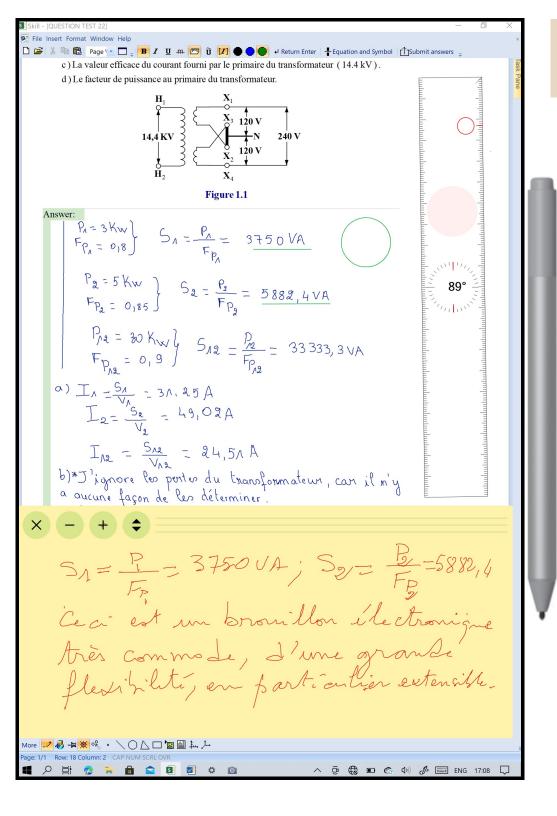
## Skill 6.5: Skill 6.5: An effective computer-based testing technology

Skill 6.5 is a revolutionary program for performing online homework or exams on computer. The programme is equipped with all the scientific features necessary for writing detailed answers of any kind of tests. This includes chemistry, mathematics, biology, physics, etc. However, on a touchscreen computer, the student will just have to use a pen to carry out the test, exactly the same way it does on paper. The programme also provides automatic grading and test result summary report. Students can also use a desktop version of Skill 6. 5 for self-assessment in school computer labs or at home.

Skill 6.5 is indeed the most advanced assessment technology for schools Learning Management System.

#### The standard interface of Skill





## Unique convenience with Skill 6.5 for performing exam on compuer

**Skill 6.5** has an environment where you can easily <u>use the keyboard</u> to write all kinds of mathematical expressions, draw chemical structures, make geometric and dynamic constructions, and draw experimental tools.

On a touch screen, the student or pupil can use <u>a stylus</u> to write manually. In addition, Skill 6.5 has a multi-functional instrument that serves as a ruler, compass and protractor; the user also has the option of using a <u>regular ruler</u> and square.

Skill 6.5 has an <u>electronic drafting sheet</u> that can be positioned below or above the writing area, which is very convenient to use..

With **Skill 6.5**, writing or drawing errors are erased without a trace.

The students to take a test and the teachers for the correction, will not have to disentangle themselves with several tests answer sheets anymore!

## Symtone 6.5: A face to face, synchronous and interactive teaching tool for distance education

Symtone 6. 5 is a real-time remote interactive teaching software that has seamlessly integrated scientific tools, Instant Communication and Video technologies to significantly improve the experience and effectiveness of online education as well as tutoring, with minimal requirement for hardware and internet bandwidth.

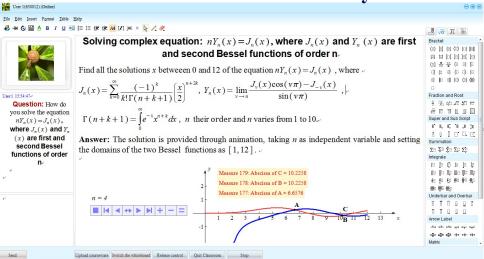
Symtone through Class, opens the 2003 version of PowerPoint and MS Word, for instant remote public presentation over the Internet.

All you need is a computer on which **Symtone** is installed and Internet connection. Then, the remote communication can be done:

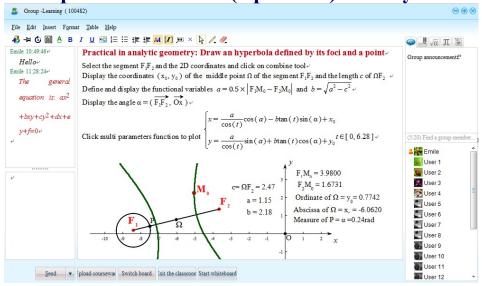
- From computer to computer
- From computer to interactive white board
- From Interactive white board to interactive white board

The result is just perfect when both sides use an interactive whiteboard where it is more convenient for everyone to use handwriting. Thus, creating the lost classroom situation with additional advantage of saving all the communication at once.

**Individual communication with Symtone** 



#### Group communication (up to 500) with Symtone



## **Learning 6.5 System Platform Services**

The **Learning 6.5** platform offers the opportunity to easily create a virtual school, facilitates

- online courses, online homework and exams with automatic grading and summary report of results;
- online training;
- online access to periodicals, publishing journals, libraries and bookstores.

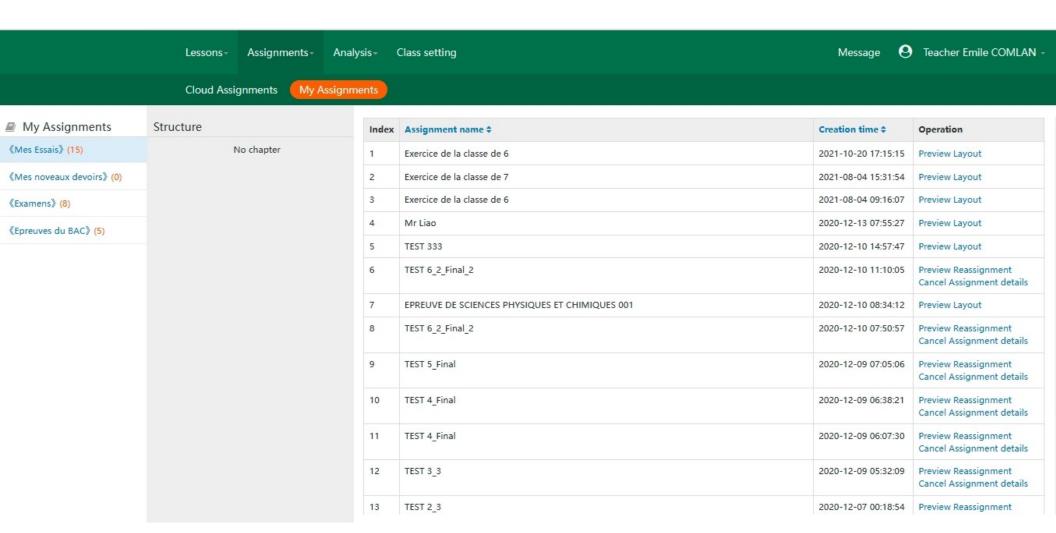
**Note:** A virtual school (or university) is composed of several grades (or faculties); a grade is composed of several classes (or departments). The Learning system uses **ScienceWord**, **Class**, **Skill** and **Marking** and a **website** (https://www.novoatest.com).

## Marking 6.5: A technology for online correction of homework and exams on the computer

Marking 6.5 is a very convenient program for correcting homework on computer. This correction can be done with the mouse or a stylus (in case of a surface that supports the stylus). When the correction takes place with a stylus, everything happens as in the classic case of a paper test where you can circle the writing errors, write comments according to the actual steps of the scoring, reproduce in a very convenient way the traditional scene of the batch change operation. The graded assignments are released to each student in a given class in one click.



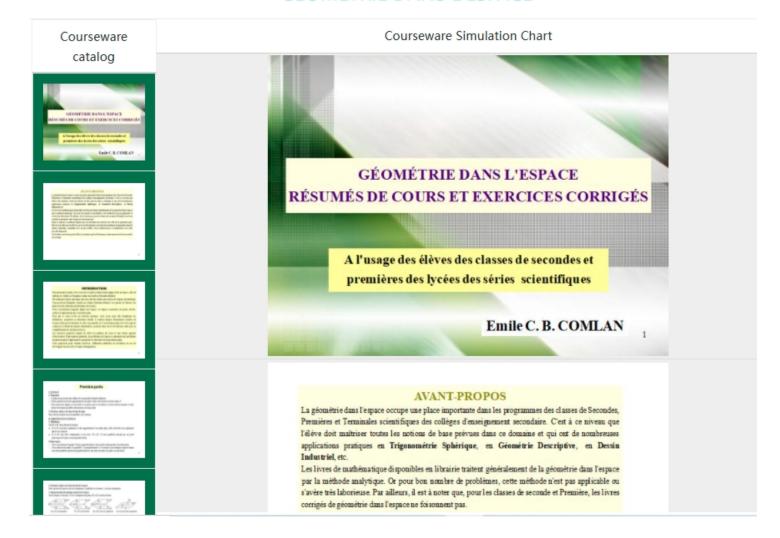
## Layout of assignments on Learning 6.5 System teacher's web page



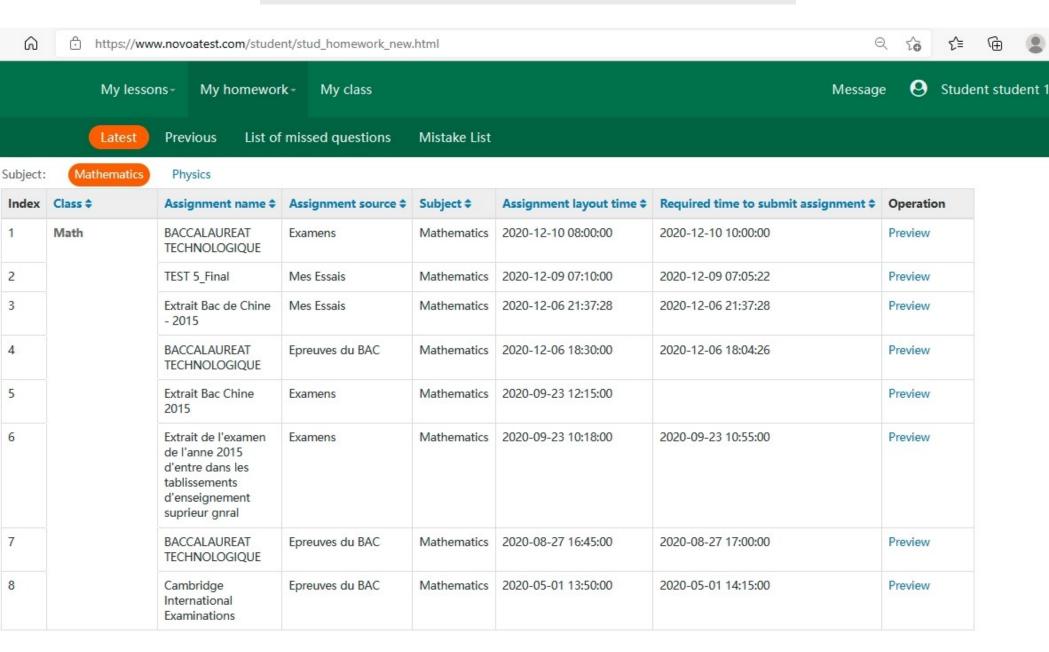
## Preview of a course on a teacher's Learning System 6.5 web page

https://www.novoatest.com/teacher/tech\_lesson\_show.html

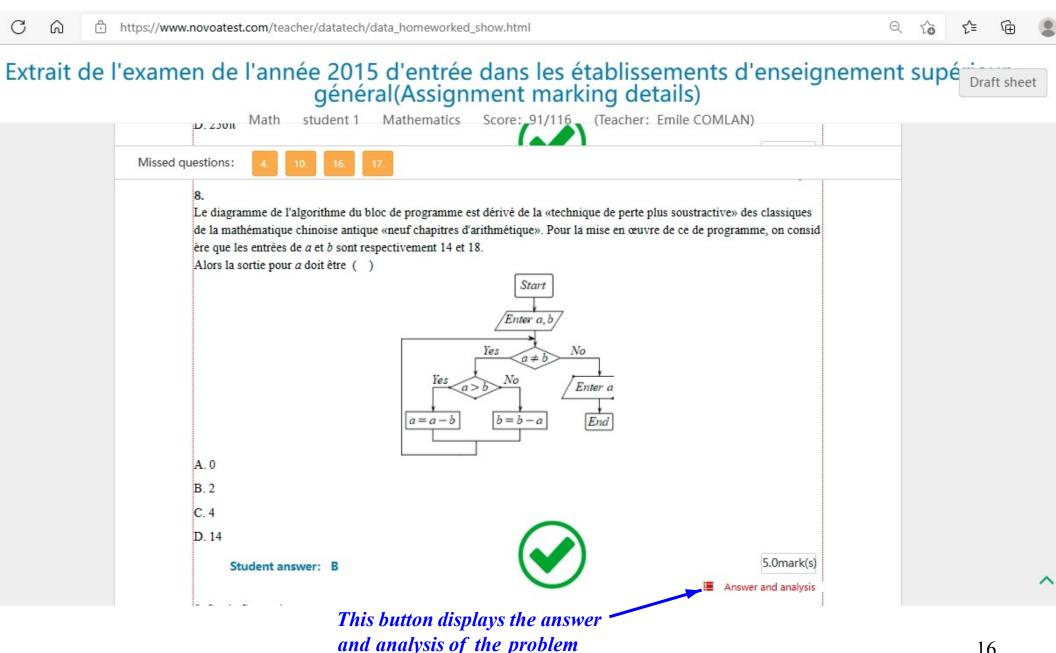
#### GÉOMÉTRIE DANS L'ESPACE



## Learning 6.5 system student web page



### Corrected e-sheet of the Learning 6.5 system

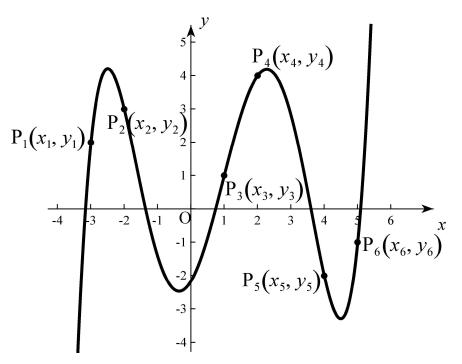


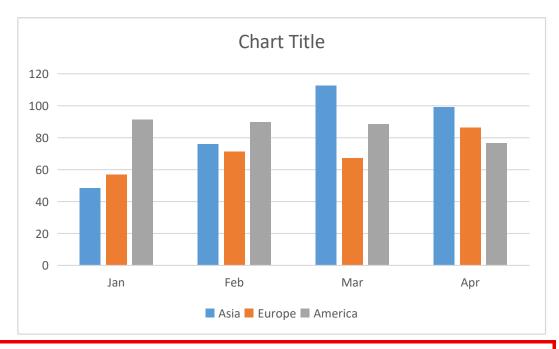


II. The revolutionary concepts of teaching mode and text animation.

### ScienceWord and Class Teaching modes Unparalleled convenience in course delivery

During the delivery of the course, teacher can modify some elements of it. The teacher can even insert new pages or slides for demonstration purposes without disturbing the audience.





 $P(x) = A_5 x^5 + A_4 x^4 + A_3 x^3 + A_2 x^2 + A_1 x + A_0$  is the polynomial of degree at most 5, whose graph passes through 6 variable points  $P(x_i, y_i)$   $i = 1, \dots, 6$  with values  $x_i = 1, \dots, 6$  all distinct.

$$x_1 = -3.000$$
  $y_1 = 2.000$   $x_4 = 2.000$   $y_4 = 4.00$   $y_5 = -2.000$   $y_6 = -1.00$   $y_6 = -1.00$ 

$$A_5 = 0.04$$
  $A_4 = -0.18$   $A_3 = -0.50$   $A_2 = 2.14$   $A_1 = 1.67$   $A_0 = -2.17$ 

### Switching from teaching mode to slideshow

Any selection, even in a table cell, including text, formulas, drawings and images can be animated in various forms, which makes it easy to create animation sequences.

#### Cell biology

is a

Necrosis is a form of cell damage resulting in premature death of tissue cells.

#### **Primary school vertical calculations**

ScienceWord and Class offer the best way in dealing with usual primary school calculations

such as long division 7 6  $\sqrt{2}$  4 3, etc.

### **Math expressions & chemical structures**

You can easily write complex mathematical

expressions like 
$$\mathbf{K} = \int_{1}^{2} \left( x - \frac{1 - e^{(x-1)} - \frac{1}{x}}{x} \right) dx$$
,

chemical equations like  ${}^{226}_{88}$ Ra  $\rightarrow {}^{4}_{2}$ He  $+ {}^{222}_{86}$ Rn or draw a chemical structure like the one the

complex chemical structures!

caffeine

#### **Editing in Learning 6.5 suite applications offers:**

- The most revolutionary, comprehensive and flexible way ever of writing mathematical formula!
- The most natural way to carry out dynamic geometric constructions using the *concepts of logical drawing*, *smart mode and object properties!*
- A natural way based on human behavior of drawing chemical bonds!
- The most flexible way of plotting graphs of functions!
- A very smart way in manipulating arithmetic <u>vertical notation</u> used in basic schools including formats in *English*, *French*, *Chine*se and many more!



## III. The revolutionary concepts of editing scientific texts and drawing in the software suite



ScienceWord 6.5

Documents and tests
databases



Class 6.5
Lesson and
presentation plan



Skill 6.5
Homework assignments
and online exams



Symtone
Distance and online
training

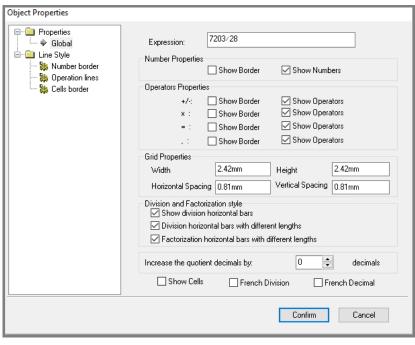
## Unparalleled flexibility of basic schools vertical calculations

The user can easily attempt a usual arithmetic calculation (addition, subtraction, multiplication, division, prime factorization of a composite number, the Greatest Common Divisor and the Least Common Multiple of any two strictly positive integers) with the flexibility of displaying or hiding any part of the result thanks to the dialogue box opposite.

For example, to perform the operation of dividing 7203 by 28, simply write 7203 / 28 in the expression window of the arithmetic operations dialog box opposite. Then we uncheck the option "Show border". Then, we choose the format (French or English division) then we click "OK". While the mouse pointer takes the form plus "+", it is enough to click on the working page to have the result.

The result of the French division is the one in black while the one of the English division is in red.

#### Arithmetic dialog box



Below are other types of alpha-numeric operations that are easy to perform!

### **Editing of mathematical expressions**

#### Mathematical expressions are written like ordinary text!

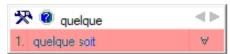
The user can insert formulas and symbols by a very simple method called "Quick Insert Option". As he starts writing the name of the symbol, a menu opens. He will then just have to type the number corresponding to the symbol. No need for a mouse!

$$\forall \alpha \geq 0, \exists \varepsilon \geq 0 \setminus |x - x_0| \leq \varepsilon \Longrightarrow |f(x) - f(x_0)| \leq \alpha$$

Français: Quelque soit alpha supérieur ou égal à 0, il existe epsilon supérieur ou égal à 0 tel que valeur absolue de x moins x indice 0 inférieur ou égal à epsilon implique valeur absolue de f(x) moins f(x indice 0) inférieur ou égal à alpha

Anglais: For all alpha greater or equal to 0, there exists epsilon greater or equal to 0 such that absolute value of x minus x subscript 0 less or equal to epsilon implies absolute value of f(x) minus f(x subscript 0) less or equal to alpha

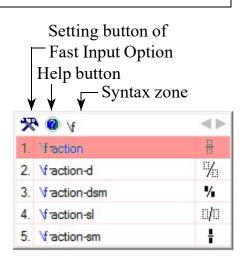






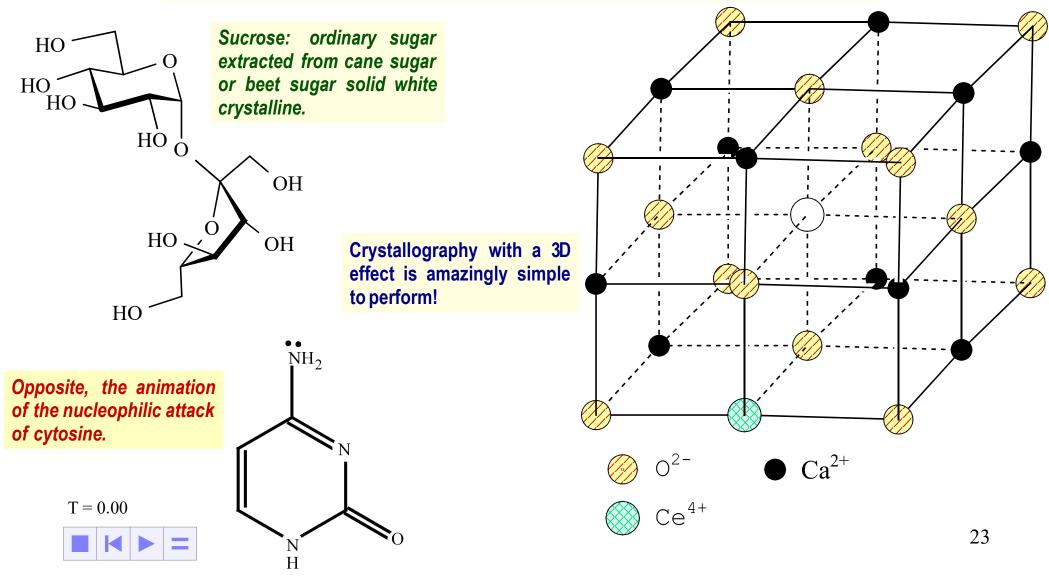
#### Users can customize the size of integrals to fit the content, as shown below.

$$k(x) = \int_{2}^{4} x^{2} dx + \int_{1}^{2} \left[ x - \frac{1 - e^{(x-1)} - \frac{1}{x}}{x} \right] dx + \int_{2\sqrt{3}}^{\sqrt{65}} \left[ x - \frac{e^{x} - \frac{1 - \frac{\ln(x)}{x}}{1 - \sqrt{x}}}{2 + \frac{x}{3 - x^{2} + x}} \right] dx$$



## Chemical structures and equations

The writing, formatting and insertion of the chemical formulas are both naturally and intelligibly simple. The chemical groups, in a type of partial grouping, benefit from the same type of formatting and geometric orientation with variable symmetry.



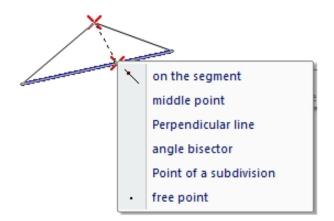
### **Geometric construction tools**

#### Powerful dynamic constructions capabilities

Drawing is done on the basis of plane basic elements, plane geometric transformations, and animation concept based on independent and functional variables. The process uses three principes: The logical drawing, the smart drawing mode and object properties dialog box.

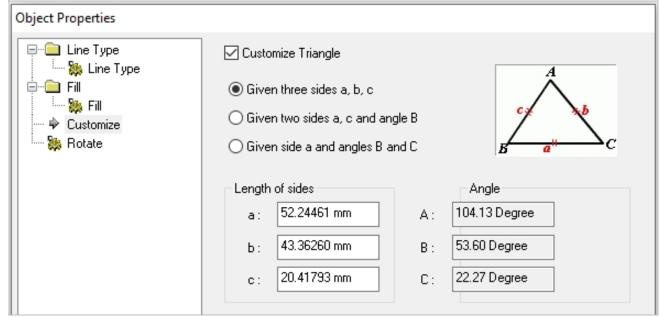
The illustrations show all the three options of drawing related to a triangle and some measures.

#### Few options of smart drawing mode related to a triangle

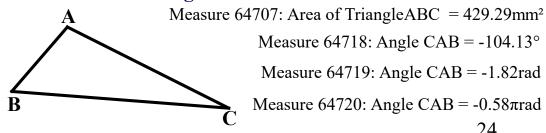


**Triangle logical drawing tools** 

#### **Triangle Object Properties Dialog Box**



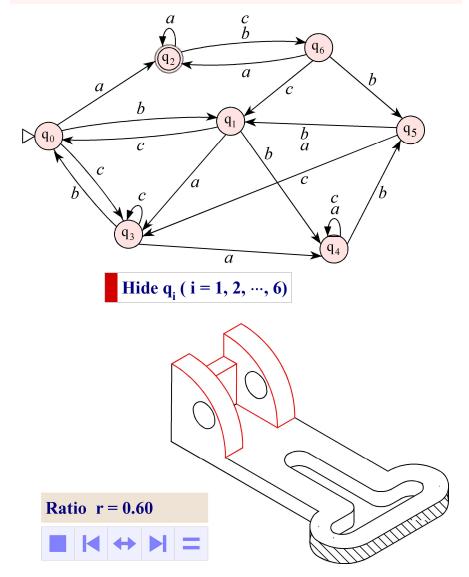
#### Few measures related to a triangle



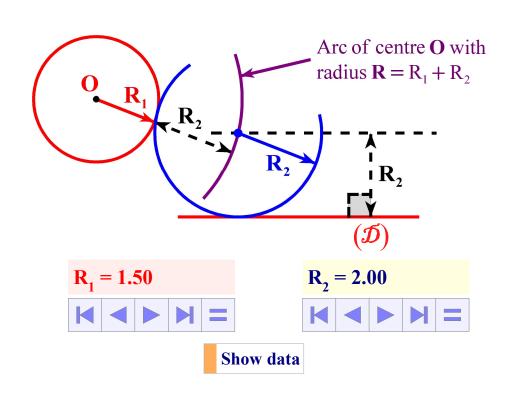
## Examples of graphs and geometric drawings

#### 1. Graphs and automata

The construction uses just the circle, the line segment, the ellipse, the curve and the Bézier vector!



2. Construction of an arc of radius  $R_2$  tangent to a given circle of radius  $R_1$  and a straight line  $(\mathcal{D})$ 



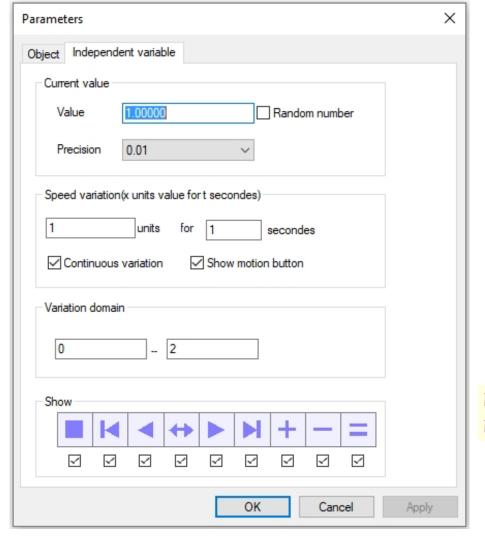
### 3. Engineering drawing

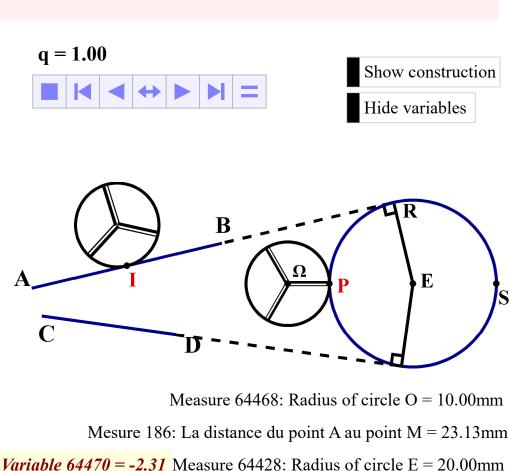
Opposite the construction of a machine part of variable dimensions.

## **Example of dynamic constructions**

An independent variable **q** is used to animate two wheels on a straight line and a circle. While this variable can mean anything, such as a length, a surface, a unit of force, etc., here it expresses the abscissa of point I in linear coordinates (A, B) and the value of the polar angle of **P** on the circle of center E.

#### Motion propeties of the independent variable q





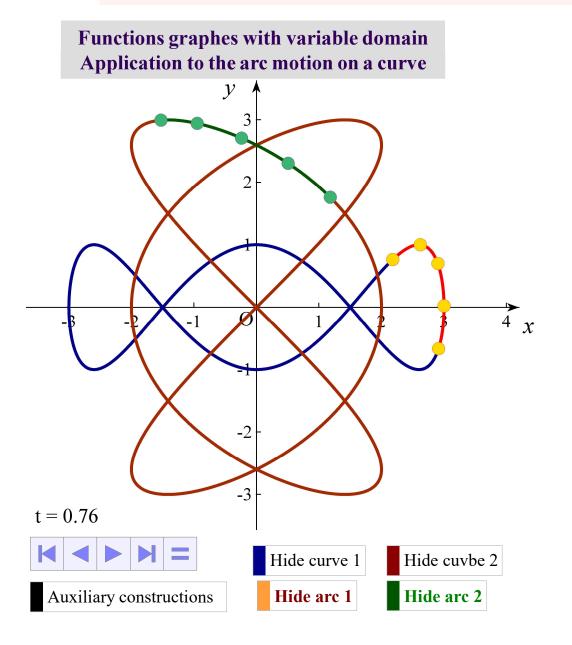
Variable 64470 = -2.31 Measure 64428: Radius of circle E = 20.00mm

*Variable 64516 = 6.28* Measure 64512: Radius of circle  $\Omega = 10.00$ mm

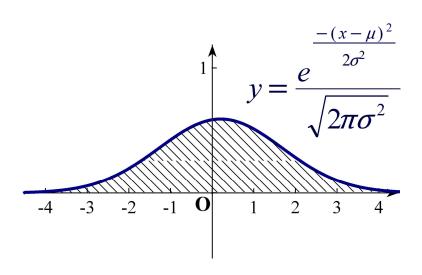
Measure 64510: Length of the arc of the circle SP = 62.83mm

## **Analytic geometry - common functions graphs**

The graphical representation includes line coordinate, 2D and 3D graphs. Here are just few examples of functions graphs in 2D coordinates.



## Probability density function of the normal distribution



Moyenne  $\mu = 0.20$ 

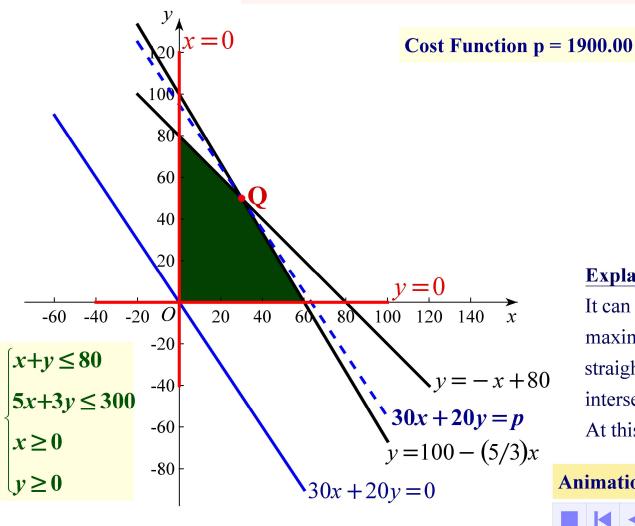


Ecart type  $\sigma = 0.67$ 



## Practical application of dynamic constructions Illustration of solving an optimization problem

The animation steps S<sub>i</sub> are related to time intervals t<sub>i</sub> where the sum  $\sum t_i$  is the maximum value of the independent variable T.



#### **Explanation**

It can be seen from the figure that the (x, y) that maximizes 30x + 20y is the intersection of two straight lines x + y = 80 and 5x + 3y = 300 of intersection point (30, 50).

At this point,  $p = 30 \times 30 + 20 \times 50 = 1900$ .

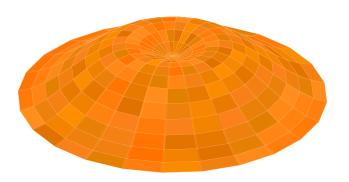
Animation Period T = 11.00

Hide Explanation



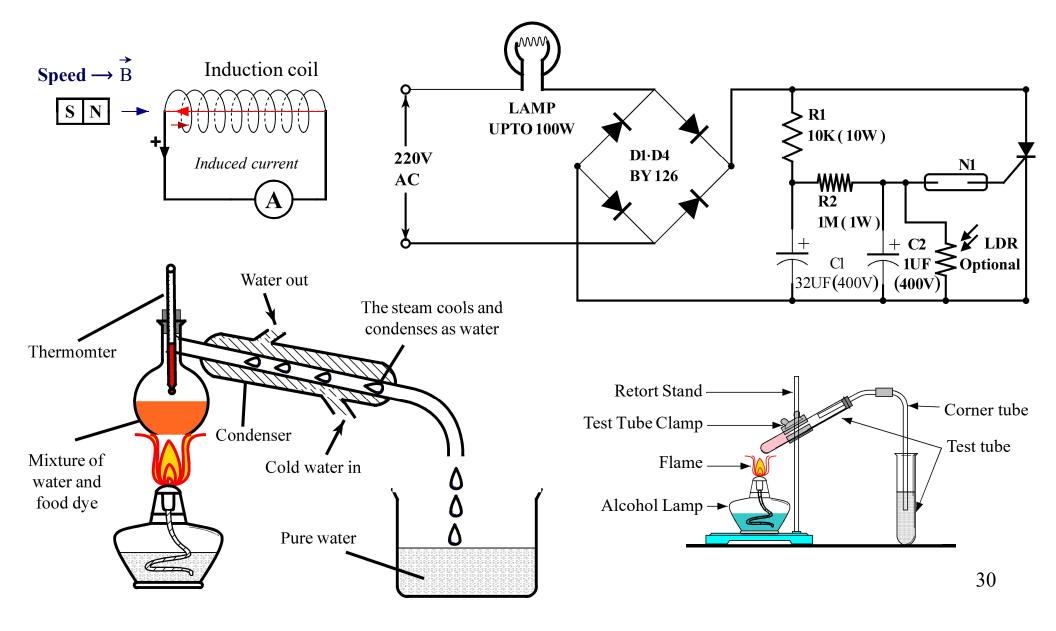
## Application of 3D analytic geometry

The graph of the polar wave which function is given as follows  $F(t,r) = \left[r\cos(t), r\sin(t), r^2 \frac{\cos(r)}{1+r^2}\right] \text{ is shown left, is shown below}$ 



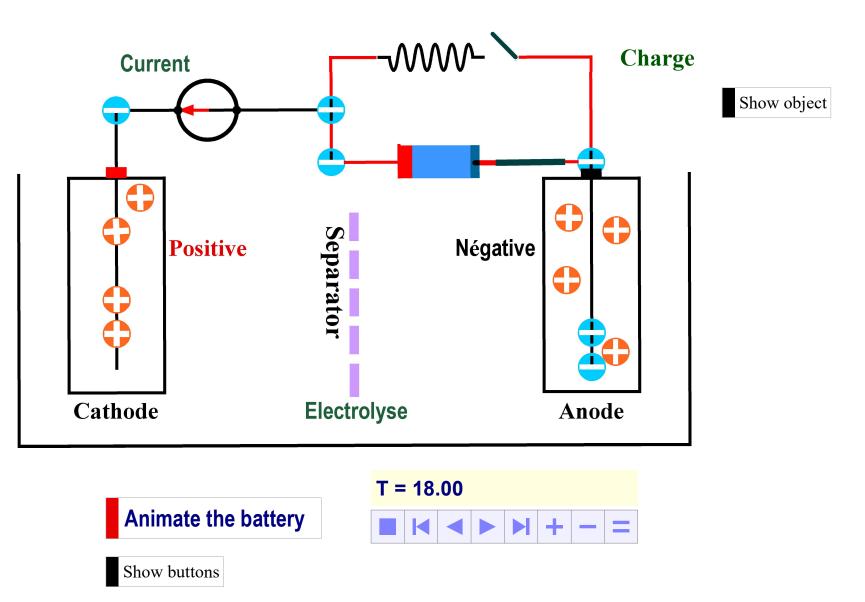
## **Experimental Set-ups**

The user can easily draw complex experimental set-ups from a wide range of laboratory tools in physics, chemistry, etc.

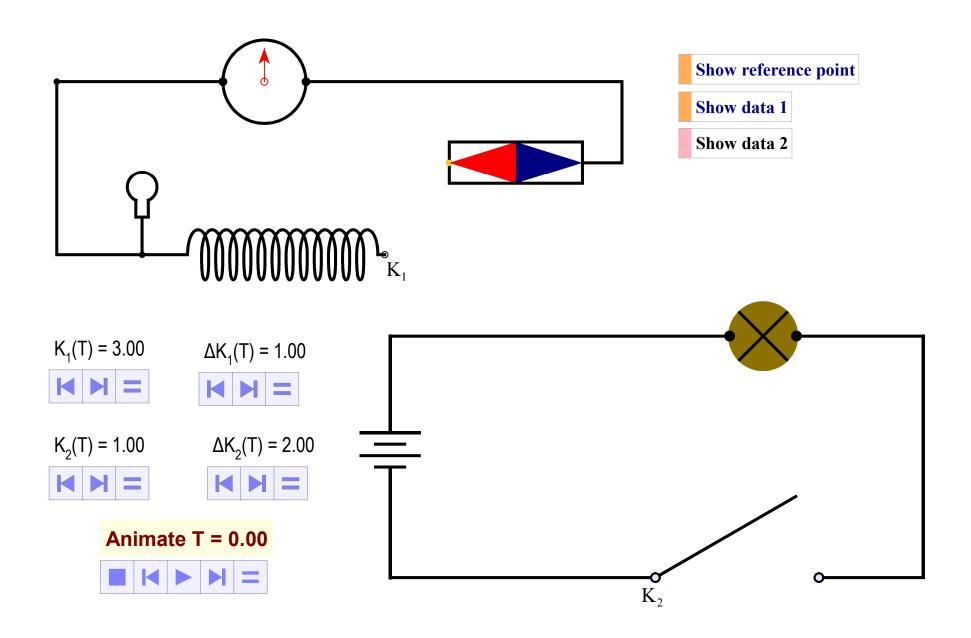


## Animation of the battery cycle

Recharge and discharge cycle of a rechargeable battery

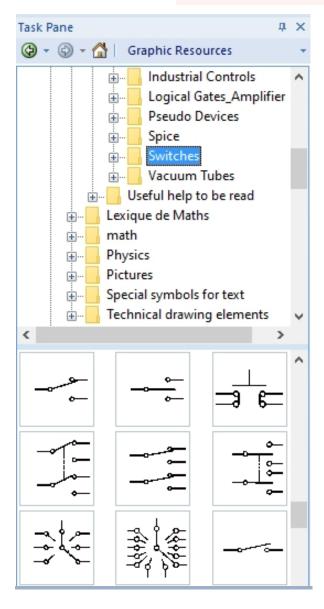


## Animation of an electrical circuit



## **Graphic library - Graphic resources**

The user can easily create a library and save graphic resources of all kinds. The dynamic course element below on annuity calculation is an example of a graphic resource in the library.



#### **Example of the calculation of the annuity**

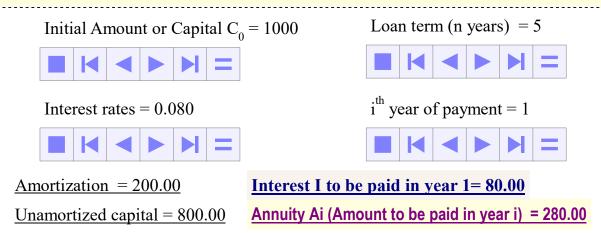
An individual borrows an amount  $C_0$  of \$1000 at an annual interest rate t of 8% to be amortized over a period n of 5 years.

If this individual chooses to repay the loan at a constant annual amortization, the amount of the annual payments for the duration of these 5 years will be given by the following variables.

You can change the variables: Amount, Loan duration, Interest rate, i-th year of payment.

For example, in the first year (i=1), the individual will have to pay the following annuity::

$$A_1 = \frac{1000}{5} + 1000 \times 0.08 - \left(\frac{1000 \times 0.08}{5}\right) \times (0) = 280$$
\$



**Learning 6.5** package facilitates the creation of dynamic learning objects that can be used repeatedly without being altered.

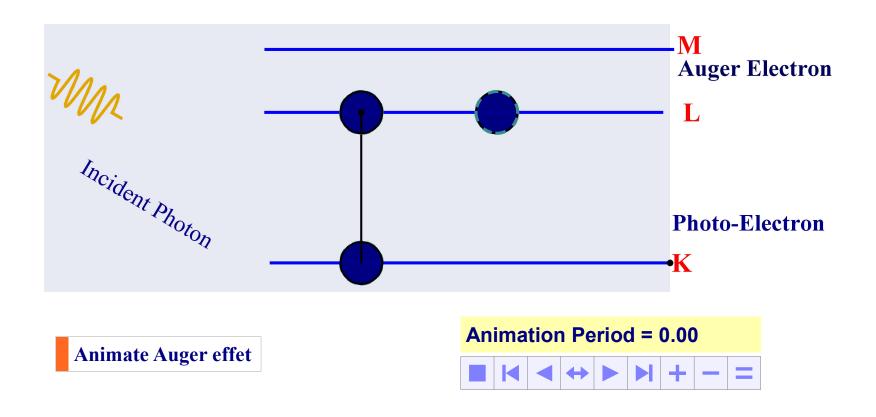


IV. Examples of reusable learning objects for scientific and technical education

## **Example 1 of learning object in Higher Education**

#### **Auger effect**

Not every photoelectric absorption leads to the emission of X-rays. In some circumstances, another electron is ejected giving rise to a radiationless transition. This process is known as the Auger effect

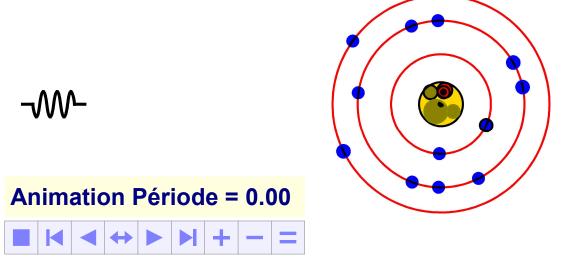


## **Example 2 of learning object in Higher Education**

Photo ejection of k electrons by energetic radiation and photo electric absorption

### Photo ejection

X-rays are produced when inner bound electrons are ejected from the atom leaving a vacancy. Replacement of the vacancy by electrons from higher orbits leads to the emission of characteristic X-rays.



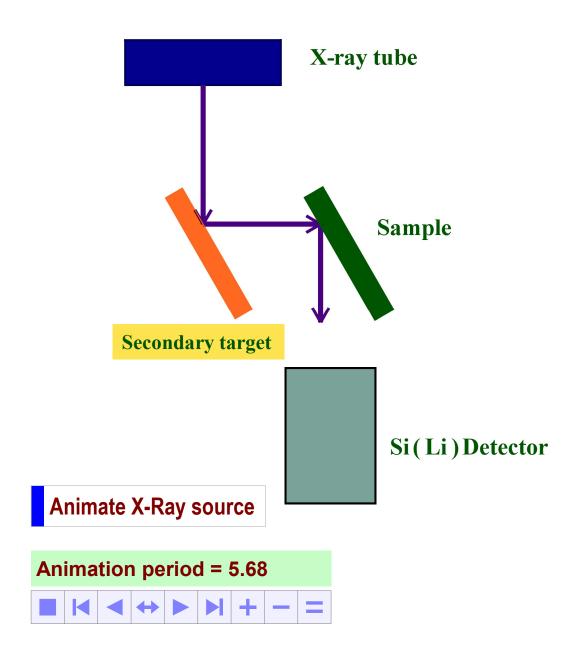
## **Example 3 of learning object in Higher Education**

### Illustration of X-Ray tube source Direct and secondary excitation modes

X-ray tube excitation source for X-ray spectrometry analysis

<u>Direct excitation</u>: X-rays are directly from the anode target of the X-ray tube to the sample

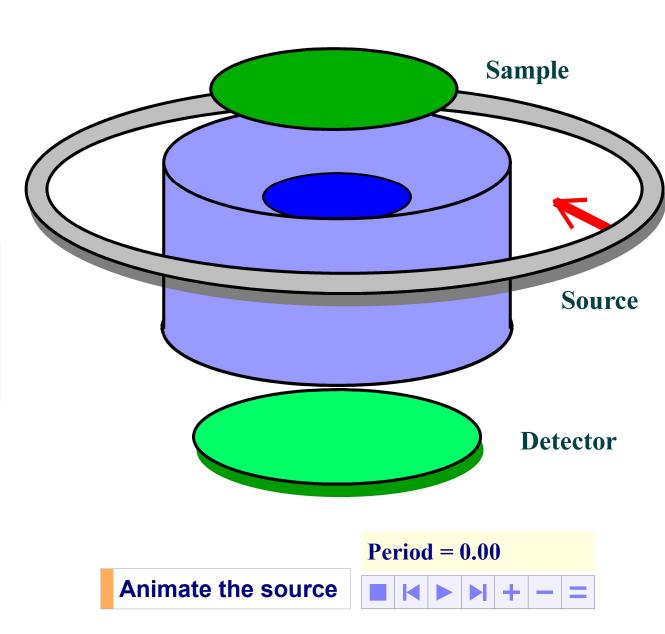
Indirect excitation: X-rays are from a changeable secondary target to the sample



# **Example 4 of learning object in Higher Education**

### Source of excitation

Illustration of a radioisotope X-ray excitation source in the geometry of a sample-detector source of an X-ray spectrometer.



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### **Example 5 of learning object in Higher Education**

### Activity: Help students to understand the principle of a nucleophic reaction

The <u>reaction</u> (1) is that of a nucleophical attack carried out easily using chemical bonds; a dynamic representation of this attack is (2).

(1) 
$$R - \overline{N}H_2 + R - C$$

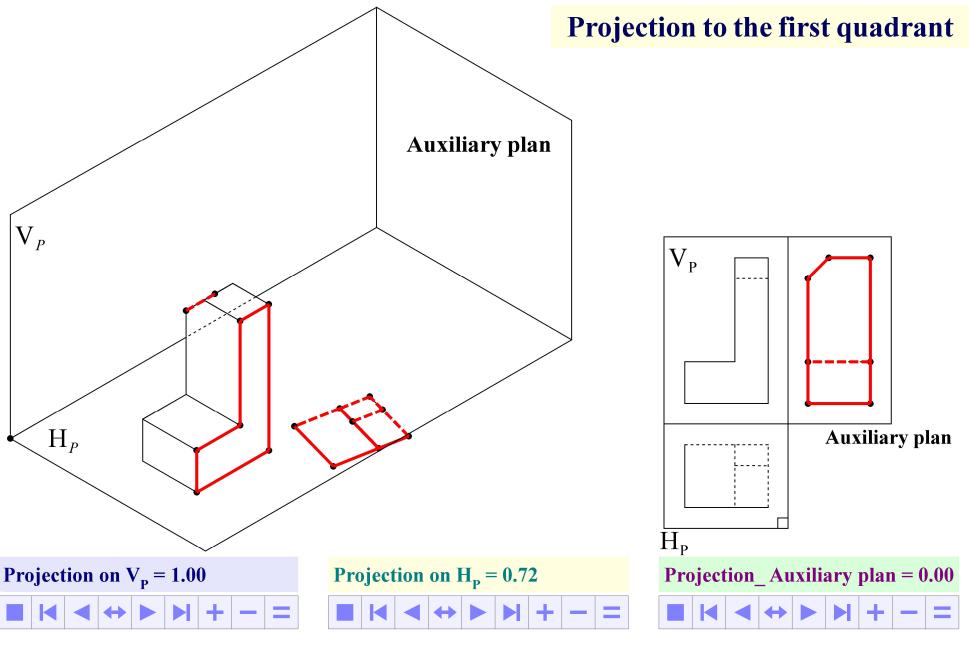
Cl

$$R - \overline{N}H_2 - C - Cl$$

R

(2) 
$$R - H_2N$$
:
$$T = 0.00$$

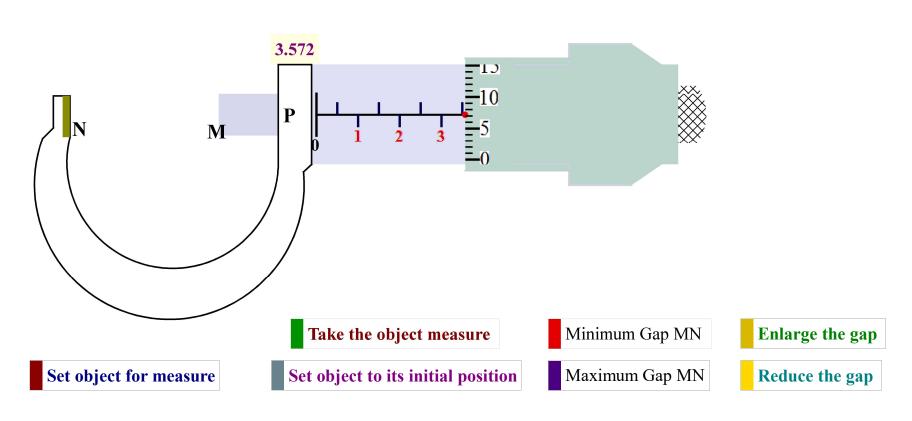
# Example 1 of learning object in technical education



# Example 2 of learning object in technical education

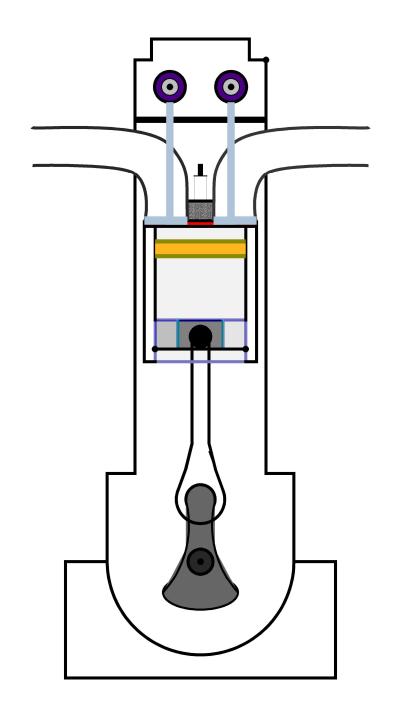
Operating a vernier caliper

Measurement conditions are not set properly!



# Example 3 of learning object in technical education

Functioning principle of a four-stroke engine



Animate the engine

### **Example 4 of learning object in technical education**

Engaging the student in the design of gear systems: The gear system coincides with its initial position for the first time when: the wheel of 40 teeth makes 9 turns, the 18-tooth wheel makes 20 turns and the 12-tooth wheel does 30 turns, i.e. when T = 60.

In particular, the wheels of 12 teeth and 18 teeth are again for the first time in their original position when: T = 6,  $N_1 = 3$  laps; and  $N_2 = 2$ .laps. The 12-tooth and 40-tooth wheels coincide again for the first time in their original position when: T = 20;  $N_1 = 10$  laps and  $N_3 = 3$  laps, where T is the rotation angle in  $\pi$  rd of the small wheel.

#### Animate the period T = 0.0



Rotation of traingle  $O_1O_2O_3 = 42.00$ 



 $\angle O_2 O_1 O_3 \text{ (en } \pi \text{ rd)} = 3$ 

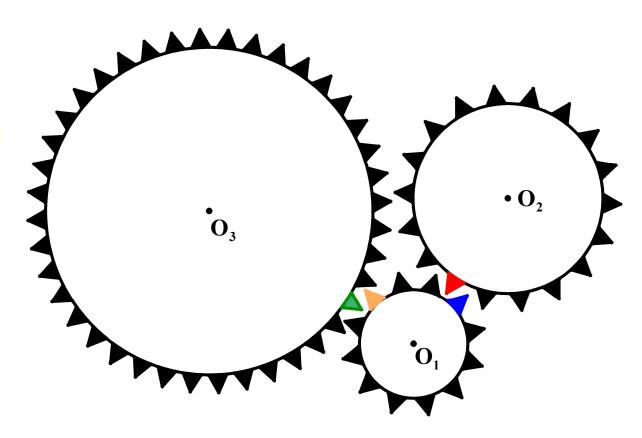


 $N_1 = 0.00$ laps

 $N_2 = 0.00 laps$ 

 $N_3 = 0.00 laps$ 

Show object

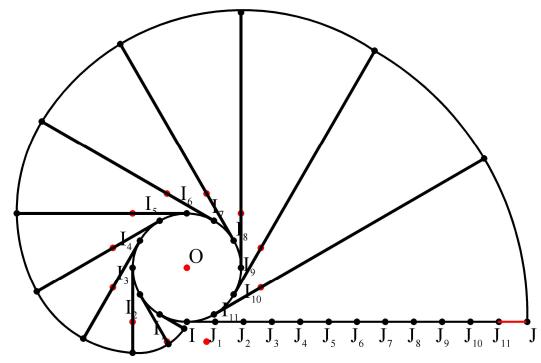


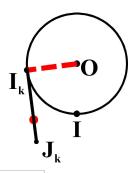
# Example 5 of learning object in technical education

### Practical construction of the involute of the circle by the locus method.

 $IJ_k = II_k = R\theta$  rd, where R is the radius of the circle and  $\theta$  is the angle  $\angle IOI_k$ . To generate the 12 tangents, of the involute, we select in order the independent variable, then the current tangent. Then, we click on "Generate the trajectory" tool.

# Technique for constructing an involute of the circle using a series of arcs





Show l'objet

**Animate the construction** 

 $\theta = 1.44$ 



### Example 1 of learning object in secondary school

The animation below is related to the approximate default and excess values of the fraction  $\frac{A}{B}$  where A is a variable integer between -1000000 to 1000000 and B is a strictly positive integer variable between 1 and 1000000. The domains of the values of A and B can be modified from the parameters of the animation.

Value rounded to the nearest hundred thousandth = 10.94667

Value by excess to the nearest hundredth of A/B = 10.95

Default value to the nearest hundredth of A/B = 10.94

$$A = 821$$



$$\mathbf{B} = 75$$



Show / Hide Approximate values to the nearest unit of A/B

Show / Hide Values approximated to the nearest tenth of A/B

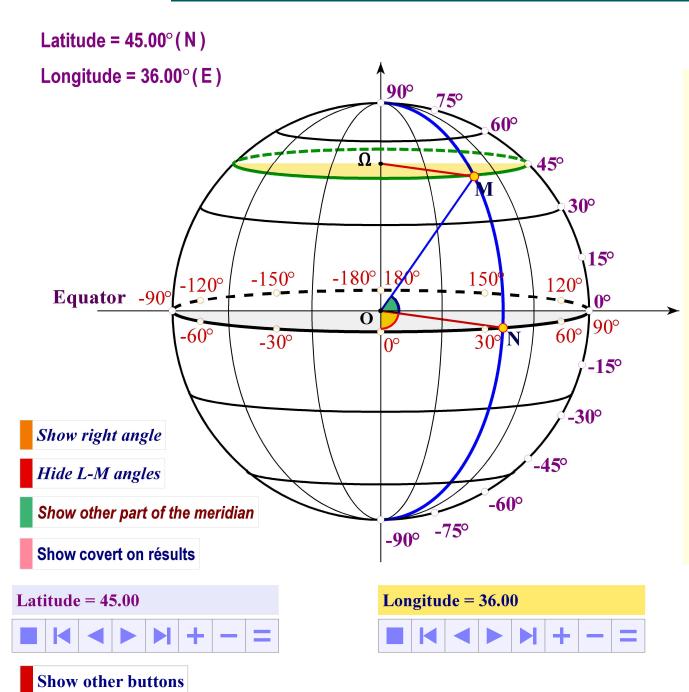
Show / Hide Default value to the nearest hundredth of A/B

Display/Voiler Default value to the nearest thousandth of A/B

Show/Voice Default value to the nearest ten thousandth of A/B

Hide rounded value

### Example 2 of learning object in secondary school



#### Geographical coordinates of a point M

Latitude is an angle that is measured between the equator and the parallel of a place. This angle varies between -90° and +90°. In practice, we use only positive angles with North (**N**) and South (**S**) considerations.

The longitude is an angle that is measured between the meridian of Greenwich and the meridian of a place. The angle varies between -180° and +180°. In practice, only positive angles are used with East (E) and West (W) considerations.

Point **P** is a point on the variable meridian at the equator.

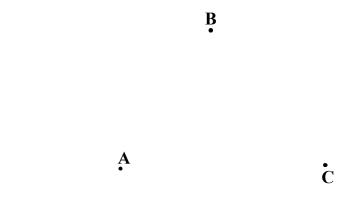
Hide note

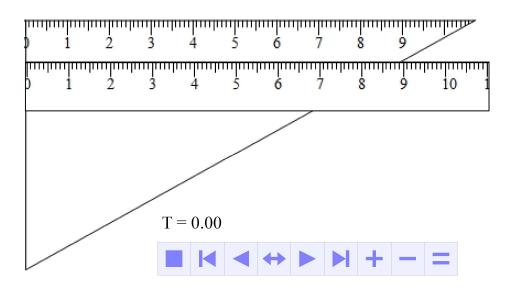
### Example 3 of learning object in secondary school

This activity allows the student to visualize the construction of the midpoint E of [AB] and that of [AC]. It also shows the parallelism of lines (EF) and (BC).

The three points A, B and C can be rearranged with the mouse or with the arrow keys on the keyboard.

The visualization of the construction for various arrangements provides the student with a good understanding of the manipulation of the ruler and the square in the construction of parallelograms.

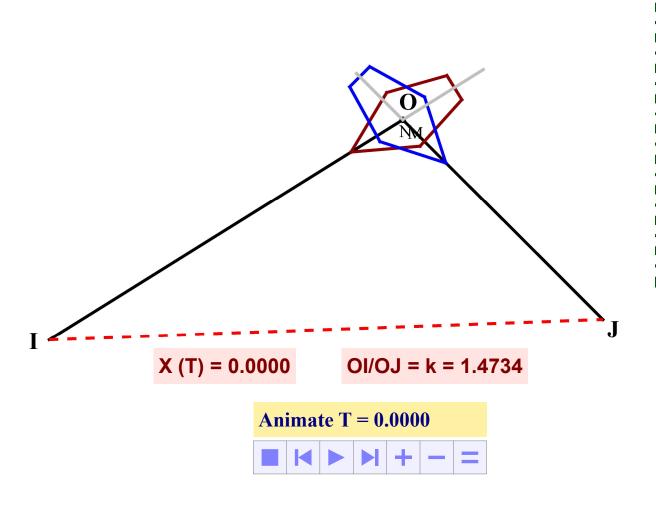




### Example 4 of learning object in secondary school

Activity: Line coordinate - Abscissa, Distance, Speed, Period, Reciprocal of Thales' theorem.

In line coordinate (O, I) and (O, J) respectively, the centers N and M of objects in uniform motion, have an abscissa of the same variable X(T). The independent variable T is the time that has elapsed from their starting point O to their current position. The student should be able to make the link between abscissa, distance, speed and the relationship between the lines (MN) and (IJ)..



Note that X(T) is periodic of period 3 and that M and N are for the first time in J and I when T=1.

$$|X(T)| = \frac{ON}{OI} = \frac{OM}{OJ};$$

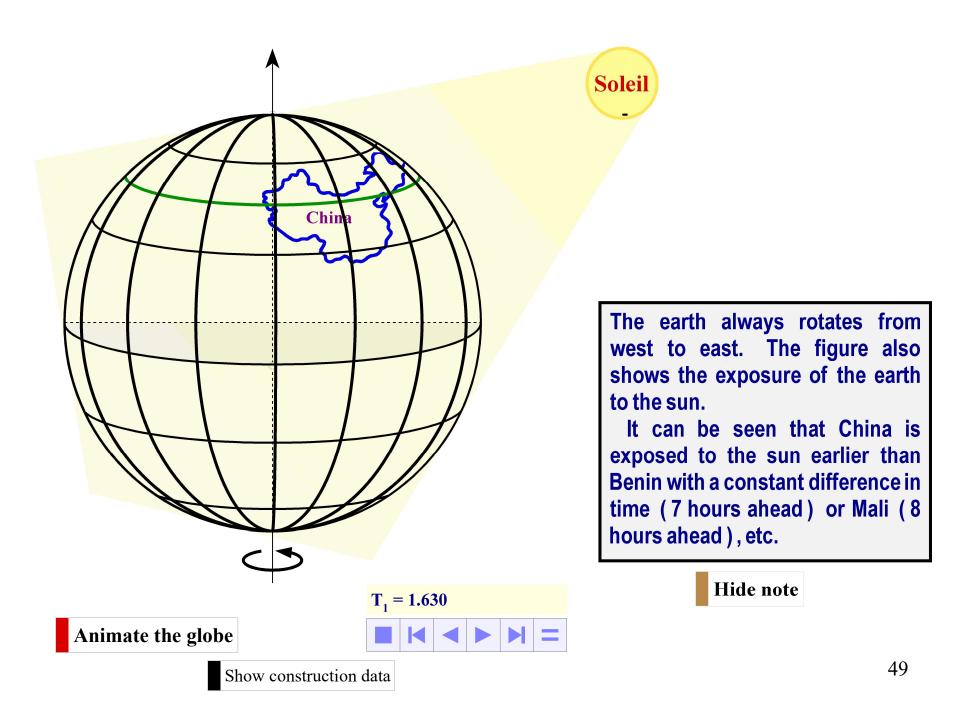
On en déduit que:  $V_N = \frac{OI}{OI} V_M$ .

 $d_M = T \times OJ$ ;  $d_N = T \times OI$  ( $d_M$  and  $d_N$  are the distances travelled by M and N).

The reader could change the positions of the O, I and J points.

Show data

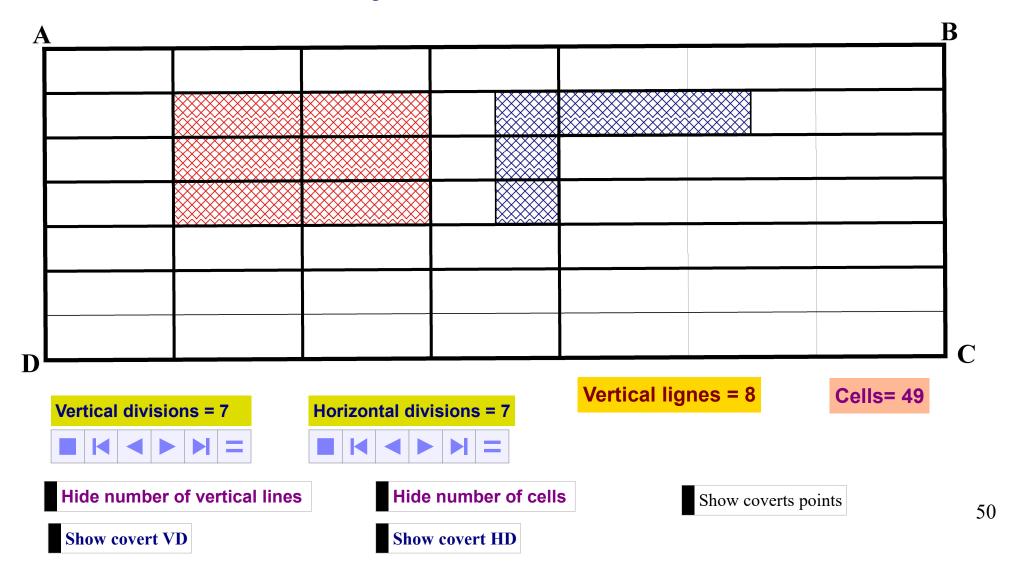
# Example 5 of learning object in secondary school



## Example 1 of learning object in primary school

### **Activity: Addition - Multiplication - Division - Fraction**

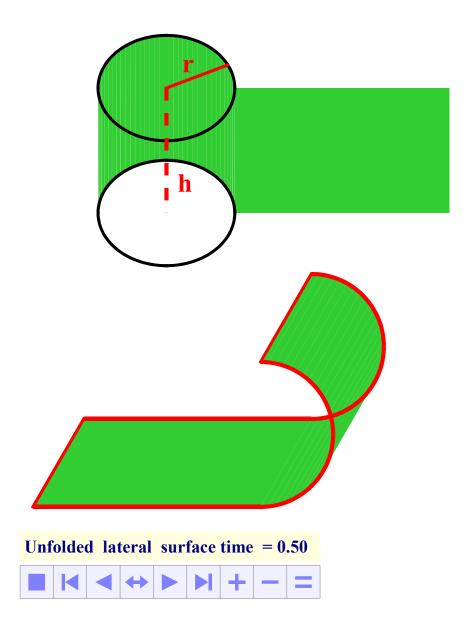
Engage students to find a link between addition and multiplication. Get students to distinguish between division and fraction - Practical application of the calculation of the hatched area of the rectangle.



# Example 2 of learning object in primary school

Activity: Engage students in the formulation of the side area of a cylinder

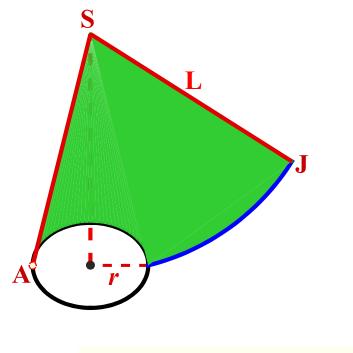
Lateral surface area = circumference of circles at either end  $\times$  height of the cylinder

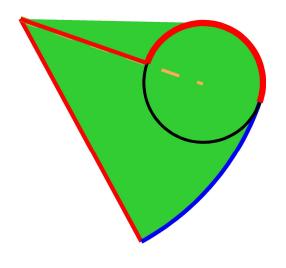


# Example 3 of learning object in primary school

Activity: Engage the student in the formulation of the lateral surface area of the cone

Base perimeter =  $2\pi r$ ; Lateral area =  $L \times 2\pi r$ 





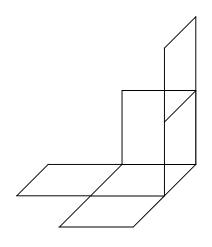
Fraction of unrolled area: q = 0.50



Hide objects

# Example 4 of learning object in primary school

### Animation of the 11 sets of the cube

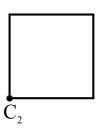




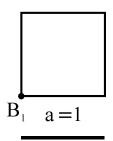


## Example 5 of learning object in primary school

# Activity: Engage students in the construction of the square of area 2









Original squares side size= 2.00

Algebraic interpretation: Find a measure b such that,  $b^2 = 2$ .

Here are two equal squares of side a=1, with an area (S) of 1. Then each of them is cut into half diagonally and as result, four isosceles right triangles with area of 1/2 are produced. Finally, one larger square with an area of 2 is formed by re-arranging the four triangles.

The measure b is as  $\sqrt{2}$ .

The ability to animate geometric constructions and mathematical models, to directly apply scientific concepts to real life activities, to explore and deepen in order to find solutions to scientific questions using the **Learning 6.5** package has considerably broadened the scope of its applications, making it a powerful pedagogical tool that not only extends the teacher's teaching activities, but also prepares students for future tasks related to scientific research.



# V. Examples of Teaching Activities for Science and Technology Education

# Type 1 of teaching activity in secondary school

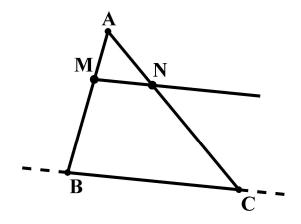
Activity: This activity is a practical application of the number line in the verification of intercept theorem. Students will be asked to relate the x-coordinate of a point M in (A, B) coordinate to the ratio  $\frac{AM}{AB}$ .

### **Activity: Verification of intercept theorem**

- 1. Draw three distinct points A, B and C that are not aligned.
- 2. Draw the segment AB with A as the starting point.
- 3. Draw the segment AC with A as the starting point.
- 4. Select the segment AB, then click in the drawing toolbar on "\" tool and draw a point M on the line (AB).
- 5. Display the abscissa x of the point M in (A, B) coordinate.
- 6. Draw the point of intersection N of the parallel to (BC) passing through M and the line (AC).
- 7. Display the abscissa y of N in (A, C) coordinate.
- 8. Move M point with the help of mouse and note that x = y.
- 9. What is the value of y when M coincide with the point B.

10. Note that 
$$|x| = \frac{AM}{AB}$$
,  $|y| = \frac{AN}{AC}$  and then  $\frac{AM}{AB} = \frac{AN}{AC}$ .

### **Activity result**



Measure 97102: Abscissa of M on the axis = 0.3389

Measure 97136: Abscissa of N on the axis = 0.3389

### Displace the point M to the point B

$$y_B = 1; \frac{AM}{AB} = \frac{AN}{AC}.$$

# Type 2 of teaching activity in secondary school

**Acivity:** The activity is designed to help students understand the fundamental relation of trigonometry and the graph of the sine function; they are given practical experience in locating a point on the circle and in the plane, in projecting a point on a line, and in the proper use of angle measurements in degrees and radians.

### **Activity: Fundamental relation of trigonometry**

$$\sin^2(\theta) + \cos^2(\theta) = 1$$
 and graph of  $\sin(x)$ 

- 1. Draw a circle  $\mathcal{T}$  of centre  $\Omega$ , a variable point M on  $\mathcal{T}$ ; then insert the animation button of M.
- 2. Display the polar angle  $\theta$  of the point M.
- 3. Draw the segments that join  $\Omega$  to the points I and J of respective polar angles  $0^{\circ}$  and  $90^{\circ}$ .
- 4. Display point  $M(x_1, y_1)$  coordnates in  $(\Omega, I, J)$  system, then the sum  $x_1^2 + y_1^2$ , and animate M.
- 5. Now let's write:  $x_1 = \cos(\theta)$  and  $y_1 = \sin(\theta)$ . What is the value of the sum  $\sin^2(\theta) + \cos^2(\theta)$  when  $\theta$  varie?
- 6. Draw  $P(\theta rd, \sin(\theta))$  in  $(\Omega, I, J)$  coordinates system.
- 7. Show the trace of the point P, and animate it.

The path of P is the graph of  $y = \sin(x)$ , with  $x \in [0, 2\pi]$ .

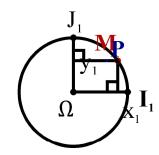
### **Activity Result**

$$x_1 = 0.8171$$

$$y_1 = 0.5765$$

$$x_1^2 + y_1^2 = 1.000$$

$$\angle M = 0.61$$
rad



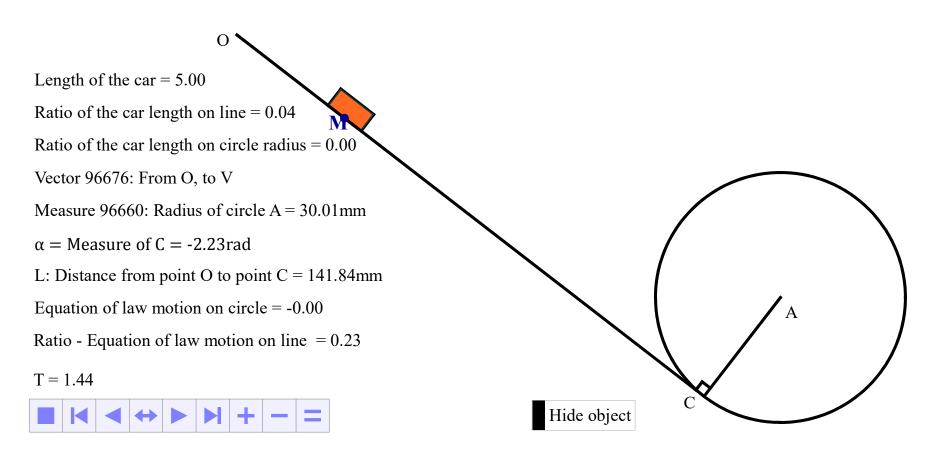
**Animate the point M** 

### Type 3 of teaching activity in secondary school

### Activity: Help students to translate linear and angular uniformly variate motions into practice

$$x(t) = \frac{1}{2}\gamma t^2 + V_0 t + x_0$$
 and  $V(t) = \gamma t + V_0$ ;  $\theta(t) = \frac{1}{2}at^2 + \dot{\theta}_0(t) + \theta_0$  and  $\dot{\theta}(t) = at + \dot{\theta}_0$ .

An object starts its motion from the point O with an initial speed of  $V_0$ = 0 and runs the segment OC in a uniformly variate motion in 3 seconds; then from point C, it also runs an arc of a circle of radius AC through a uniformly variate motion in 3 seconds and finally stops.



### Type 4 of teaching activity in secondary school

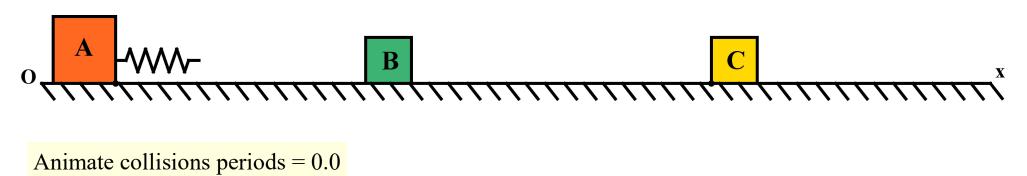
Activity: The object A runs from the start with a constant speed  $V_0$  and when the spring hits the object **B**, the two objects move together with the speed  $\frac{3}{5}V_0$  while the spring is compressed and sticked to the object **B**. Then when the spring retakes fully its initial form, the object **B** leaves the spring with a speed of  $\frac{6}{5}V_0$  and moves to hit the object **C**. Then the objects **B** and **C** stick together and move at the same speed  $\frac{3}{5}V_0$  as the object **A**.

The **objective** of this activity is to help students interpret the different sequences of a movement and to master the use of variables for experimenting with the result.

Students are led to deepen their knowledge of the use of addition in set theory.

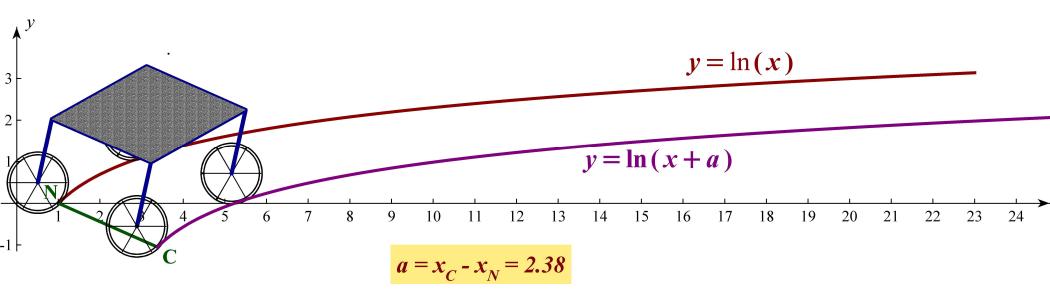
They have the opportunity to discover the application of systems of equations to the constraints of a problem.

Finally, they have the opportunity to deepen the notion of time as a concept related to a predefined norm.

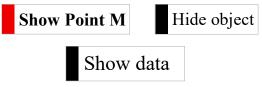


# Type 5 of teaching activity in secondary school

**Activity:** Students are asked to construct a road in practical application of the relationship between the functions f(x) and f(x+a). They are also led to make practical use of the derivative number in the definition of the direction of a vector and to locate a point which circulates on a circle also in movement.



**Wheel radius** = 0.70 **■ | → | → | → | =** 



The software suite of the **Learning 6. 5** system facilitates the creation of dynamic learning objects that can be used repeatedly without being altered.



V. Potential users of Learning 6.5 system

# Practical use of Learning 6.5 in Teaching and Learning

#### The use of learning 6.5 by teachers

Learning 6.5 is a set of powerful working tools for teachers. It facilitates the design and production of electronic teaching materials (courses and evaluation tests) as well as course delivering and students assessment. In particular, it makes it easier the creation of dynamic learning objects that facilitate the description of complex scientific concepts.

Teachers and lecturers can use

- (i.) **ScienceWord** for publications, to create electronic file of teaching or lecture notes for science education and to generate data base for students assessment on computer;
- (ii.) **Class** to create vivid and interactive presentations or lectures slides for science education;
- (iii.) Skill to assess students;
- (iv.) **Symtone** for teaching over internet and distance collaborative works;

### The use of learning 6.5 by students

Learning 6.5 is a powerful learning tool that students can use to explore and understand mathematical concepts as well as their applications in other fields such as physics, bio-chemistry, engineering, etc. In particular, students can use Learning 6.5 to build and investigate scientific models, geometric figures. In general, they can use it to perform practical activities of scientific concepts that induce inquiry-based learning and active exploration of solutions to problems, creativity, analytical and critical thinking.

Specifically, students will use

- (i.) **ScienceWord** to type scientific reports, dissertations and scientific presentations, etc;
- (ii.) Class for presentations and learning activités;
- (iii.) **Skill** for self-training in computers labs or at home.
- (iv.) Symtone for online course and training

# Use of Learning 6.5 by technical and professional structures in public and private administrations

### The use of learning 6.5 by technical and professional structures

**Learning 6.5** is a very <u>effective set of tools</u> for the preparation of technical reports, the design of regular and scientific presentations, and the evaluation of executives in public and private administrations.

Specifically, the public and private administration sectors will be able to use

- (1) **ScienceWord** for writing technical reports including formulas, technical drawings with the possibility of adding animated illustrations, etc;
- (2) **Class** to easily create slides of interactive and lively presentations of all kinds.
- (3) **Skill** for executive assessment and recruitment tests;
- (4) **Symtone** for remote collaborative work.

The software suite of the **Learning 6. 5** system facilitates the creation of dynamic learning objects that can be used repeatedly without being altered.



# VII. Some important results

### In Benin

In Benin, not only the ministry of education has recommended the use of **Learning 6.5** by all schools, but has organized the training of teachers and inspectors of education.

### Training of 94 teachers in September 2005





Official release of ScienceWord to Secondary and High schools in Benin



### In Ghana

Adoption of software package by Ghana Education Service (G.E.S), to be use in all secondary and technical schools. Training on the software package of all the thirteen (13) institutes of Ghana Council for scientific and industrial research (C.S..I..R), Ghana universities math and science departments lecturers, Ghana training schools, science and math teachers of Ghana secondary schools and all Ghana technical schools, etc.



Training of Heads of departments of the faculty of sciences of Ghana University



Training of Heads of departments of the faculty of sciences of Cape-Coast University

### In Mali

Under the auspices of the *Ministry* of Education, a good number of inspectors of science education have been trained on **Learning 6.5**. The Centre de Formation pour le Développement (C. F. D.) has trained more than 600 teachers in the use of **Learning 6.5**.

Other institutions such as the Ecole Normale Supérieure (EnSup), the Ecole Nationale des Ingénieurs (E. N.J.), and the Institut Polytechnique Rural de Formation et de Recherche Appliquée (IP/IFRA) have also trained lecturers in the use of Learning 6.5.



Training of Lecturers and Heads of Departments of the Faculty of Sciences of the University of Sciences, Techniques and Technologies of Bamako

# In Germany

Presentation in December 2013 of **Learning 6.0** package at Online Educa Berlin, the annual leading international cross-sector event on technology supported learning



### **Importance of Training**

The Learning 6.5 system demystifies and popularizes the creation of lively and dynamic scientific course materials. *Its integration* of *scientific word processing technology*, *scientific presentation technology*, *multimedia and Internet technology* significantly enhances online learning experiences and outcomes.

The relevance of the use of an ICT programme depends on the capabilities or skills of the users. Training of Teachers is important as it promotes professional development and integrates information technology into classroom teaching.

The cornerstone of Beijing Elearning Technology (**B.E.T**) is to help build sound **Human Resources Capabilities**. Hence, we are committed to promoting the editing of electronic teaching materials of all scientific subjects and the use of ICT in teaching scientific contents and assessment. **B.E.T** organizes the training on the use of **Learning 6.5 system** with the help of its consultants.

**B.E.T** provides a bank of **teaching resources**, **assessment and learning activities**. Schools can use the <u>Learning 6.5 suite</u> to create their own resources and add them to this bank. The new enriched bank is undoubtedly invaluable and promotes self-learning that meets the specific needs of students.