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AUTHOR	Malleus, M. Pierre
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ABSTRACT

This paper presents an overview of the educational system and process of elaborating new curricula in France. The education system in France is at a central level, and schooling is compulsory between the ages of 6 and 16. The education system in France has undergone many reform movements during the last 25 years. The changes in society and economic, scientific, and technological progress lead the reform movements in education. (YDS)

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COUNTRY PAPER FROM FRANCE

Prepared by M. Pierre Malleus, Inspector General,
National Ministry of Education, Science and Technology

I. The status of teaching science and technology

a. Legislative framework

Defining and applying educational policy is the responsibility of the Government within a general framework laid down by the legislature which, under the Constitution, merely lays down "general principles" applicable to the teaching system. Within the Government, the Minister of National Education, Research and Technology is responsible for education policy.

By historical tradition, the French education system used to be extremely centralized. When it decided to transfer authority and responsibilities in a number of areas from the State to the territorial communities, in 1982, France embarked on a major decentralization exercise, which radically altered the respective powers of the State administrative authorities and the territorial communities. The State does, though, retain an important role: it is answerable for the smooth functioning of public services and the consistency of teaching.

The 1982 and 1983 Acts on decentralization assigned France's regions and departments a markedly greater role. The regions were given responsibility for building (or extending), making major repairs and operating the '*lycées*' (higher secondary schools); the departments were given the same responsibilities for the '*collèges*' (lower secondary schools) while the communes continued to do the same for primary (infant and junior) schools.

b. The basic principles underlying teaching in France: Compulsory schooling

France has infant schools at which attendance is not obligatory; they take in children from the age of two upwards, free of charge but subject to the availability of spaces. Schooling is free and compulsory between the ages of 6 and 16 - i.e. junior and lower secondary school. On average, pupils finish lower secondary school - which lasts four years if they do not repeat any classes - at the age of 15. In theory, to meet the compulsory schooling requirement, pupils who have not been held back a class must therefore undergo at least a year's full-time education either at a general and technical lycée or at a vocational lycée.

The decree of 30 August 1985, as amended, accorded collèges and lycées autonomy in pedagogical and educational matters over their general administrative arrangements; the upshot was a plan of establishment, developed under a procedure laid down in the Act of 10 July 1989 defining the general thrust of education.

The Act of 10 July 1989 made education the country's top priority, and set the objective of "raising an entire age-group, ten years from now, to at least the level of a '*certificat d'aptitude professionnelle*' (certificate of vocational ability) or '*brevet d'études professionnelles*' (vocational studies diploma), and 80% of it to the baccalaureat level".

The five-year Work, Employment and Vocational Training Act of 20 December 1993 assigned the national education system especial responsibility for helping school-leavers to find jobs, establishing the principle that "before leaving the education system every young person, whatever level of instruction he or she may have reached, must have been offered vocational training".

c. *Financing*

Teaching, educational and counseling staffs are paid by the State. Nowadays, however, the territorial communities are responsible for the assets and operation of school establishments:

- the regions, for higher secondary schools (lycées) and specialist institutions (regional special teaching establishments, EREAs);
- the departments, for lower secondary schools (collèges);
- the communes, for primary schools (infant and junior).

d. *Science and technology at junior school (ages 6-11)*

The "science and technology" teaching on the curriculum is an accompaniment to instruction in the basic skills of reading, writing and arithmetic. It is not offered consistently, and depends on the abilities of the teacher. Junior schoolteachers' initial grounding, which tends to be in literary subjects, is the main obstacle to making an introduction to science and technology at junior school standard practice.

e. *Science and technology at lower secondary school (ages 11-15)*

The purpose of France's collèges is to educate all children emerging from junior school, giving them a common education defined in national curricula. Children are provided with textbooks by the school. The schools have to have some latitude for initiative so that they can offer learning opportunities suited to pupils' diverse needs.

Since the reform introduced in May 1996, education at collèges, which traditionally cover four classes (years), is divided into three cycles:

- Adaptation, covering 6th class only: Schools are left considerable latitude for initiative in giving effect to a teaching plan centered on the basic skills, in particular proficiency in French.

- Central, covering two classes, 5th and 4th: The school sets pupils' schedules within regulatory time-brackets. Optional courses, including one on technology, enrich the learning process.

- Orientation, comprising 3rd class only: Three different ways of arranging the teaching allow pupils to define their future ambitions without choosing a particular direction to follow. A decision on which direction to follow is taken at the end of the year.

f. Relative weight of science and technology

Three subjects fall under the heading of science and technology teaching: the life and Earth sciences, physics and chemistry, and technology.

During the adaptation cycle, only the life and Earth sciences are taught, with 1 1/2 hours' instruction in each per week. They account for 10.7% of a total of 28 hours of teaching.

During the central cycle, science and technology sequences in smaller teams (three groups for two classes) are encouraged. Physics and chemistry, the life and Earth sciences and technology are taught for 1 1/2 to 2 hours per week each. Taking the bottom of the bracket for each subject, this makes for 4 1/2 hours out of a total of 20 hours of teaching in 5th class (i.e. 22.5%), and 4 1/2 hours out of a total of 23 in 4th class (i.e. 19.5%).

For the orientation cycle: in 3rd class, the life and Earth sciences are taught for 1 1/2 hours per week. Technology and physics/chemistry are taught for 2 hours each to 3rd class pupils following option 2: modern languages. Pupils following the technology option have half an hour less physics/chemistry and three hours more technology. Science and technology teaching in collèges amounts to 5 1/2 out of a total of 28 1/2 hours' teaching for pupils following option 2: modern languages (i.e. 19.2%), and 8 out of 27 1/2 hours' teaching for pupils following the technology option (i.e. 29%).

g. Teaching content

Exchanges and consistency between scientific subjects are encouraged. The same holds true of the links with mathematics teaching.

Adaptation cycle:

For historical reasons dating back to 1992, only technology and the life and Earth sciences are taught in 6th class.

Central cycle:

Life and Earth sciences. By the end of the cycle, pupils are expected to have acquired the following general abilities:

- to be able to explain the most accessible signs of the workings of the human organism;

- to be able to identify the biological and geological components of their immediate or broad environment; and

- to grasp the diversity, unity and arrangement of the living world.

Physics/chemistry. Physics/chemistry teaching pursues particular objectives, which can be set forth for both collèges and lycées:

1. It is not merely concerned with training future physicists and chemists.

2. By means of the experimental approach it should inculcate rigor, critical reasoning and intellectual honesty.

3. It should develop both qualitative and quantitative reasoning. The study of matter and its transformation is the domain of qualitative reasoning *par excellence*, since the dominant factors have to be teased out of a complex phenomenon.

4. It must be open towards techniques, which for the most part have their roots in physics and chemistry.

5. It must encourage scientific vocations and, for that reason, be anchored in everyday experience and modern technology.

6. Like other scientific disciplines, physics and chemistry have a bearing on political, economic, social and ethical choices.

7. It must make it plain that physics and chemistry are essential elements of culture by showing that the world is understandable. The extraordinary richness and complexity of nature can be described in a small number of universal laws, which together constitute a consistent representation of the world as it is.

8. It must show that this consistent representation is deeply rooted in experience.

9. It must draw extensively on applications.

10. It must educate citizens and consumers in the proper use of the technology and chemical products they will find themselves using in daily life.

11. It must make optimum use of modern methods. Emphasis is laid on the use of computers for data entry and processing and for simulation.

It includes the study of Discovering our environment and matter, Light and Electric current.

Technology. Emphasis is laid on project execution, bringing into play different options, resources, pupil activities, skills and information technologies.

Orientation cycle

Life and Earth sciences. Teaching here hinges on a return to the concrete and practical activities in the laboratory. The principal notions are to do with genetics, namely Unity and diversity of human beings, Protecting the organism and How the organism functions, cell activity and exchanges with the environment.

Physics/chemistry. The starting point for the teaching is the questions that pupils are apt to ask themselves in their daily setting, namely Materials in everyday life and Our physical surroundings.

Technology. The three main areas of concentration are: Project execution; Computer-assisted tasks (communications, fabrication, automation); and The story of solutions to a technical problem.

h. Science and technology at senior secondary school (ages 15 - 18)[1]

The initial year at senior secondary school (lycée) is a time for firming up decisions: the choices pupils make do not lock them into a particular baccalaureate stream and, their results permitting, they can apply for any penultimate-year (1st) class they like. Once in the penultimate year they are committed to a stream leading towards a baccalaureate in a particular mix of subjects.

Since 1906, science teaching has revolved around practical work done by the pupils themselves. Special-purpose facilities (laboratories, preparation rooms), often very modern scientific equipment and laboratory staffs are available to help. For physical sciences and technology, official equipment guides describe what facilities and equipment are desirable at each level: thus those investing in the school know how much it costs to set up a class, section or institution.

Proportion of science and technology teaching at lycées

The way teaching is organized is under review. The current weekly timetables can only indicate an order of magnitude since details of the new timetables (September 2000) have not yet been published. The figures in brackets refer to periods of tuition for which class size is doubled.

Common-core subjects are taught for:

Life and Earth sciences: 1/2 + (1 1/2) hours
or *Automated systems technology* 0 + (3) hours
Physics and chemistry 2 + (1 1/2) hours.

All in all, depending on pupils' choices, this amount to 5 1/2 or 6 1/2 hours out of a total of 23 1/2 or 24 1/2 hours of teaching, i.e. 23.5% or 26.5%.

Options such as computers and electronics in physical sciences (IESP, 0 + (3) hours), physical science techniques (TSP, 0 + (4) hours) and automated systems technology (TSA, 0 + (3) hours) may flesh out the teaching given, depending on pupils' choices and the subjects offered at each lycée.

Its very up-to-date approach mingling computer studies, physical measurement and electronics, the latitude it leaves teachers and pupils, and the way it enables pupils to

[1] Space constraints limit this topic to the case of general and technological lycées.

consolidate the scientific knowledge they have acquired have made the IESP option a great success with all concerned.

Penultimate year (1st classe)

The details given here cover non-specialist lycées.

Science series (S)
Life and Earth sciences: 1 1/2 + (1 1/2) hours
or *Industrial technology*: 2 + (6) hours
Physics/chemistry: 2 1/2 + (1 1/2) hours

Sciences other than technology account for 7 out of 26 hours of teaching, or 27% of the total. For pupils who take technology, the science and technology schedule amounts to 12 hours, or 44% of the total.

All pupils must choose an option. Of the six on offer, two are scientific:

- Experimental sciences (life and Earth sciences, and physics/chemistry): 0 + (3) hours;
- Industrial technology: 0 + (3) hours.

Economic and social series (ES). Science is available only as an option: 2 1/2 + (1 1/2) hours.

Literary series (L). They include a Common-core in science of 2 1/2 + (1 1/2) hours.

Teaching content (2nd class)[2]

The new curriculum described here will come into effect in September 2000.

Science teaching at lycées is designed first and foremost to make pupils enjoy science by showing them the intellectual steps involved, how ideas evolve, and how specific bodies of knowledge are built up bit by bit. Emphasis is laid on the general-knowledge aspect, but pupils must acquire enough basic scientific culture to be able to aim for one of the predominantly scientific baccalaureate streams. The teaching is designed as a whole, not as an amalgam of different subjects.

The curriculum for the experimental subjects does not rely on the mathematics curriculum either for terminology or for the final assessment of the pupils taking them. The thinking behind this is that science develops through a constant interchange between observation and experiment, on the one hand, and conceptualization and modeling, on the other.

Science is not composed of certainties but of queries and responses that change and adapt over time.

[2] The description here will be confined to the common core, without 2nd class options.

Life and Earth sciences. Courses are devoted to The planet Earth and its environment; The organism and how it functions; and Cells, DNA and living entities.

Physics and chemistry. About 20% of the time is left free for teachers and pupils to pursue a topic of their choosing, namely Chemical or natural?; What constitutes matter?; Transformations of matter; Space exploration; The Universe in motion and time; and The air around us.

Baccalaureat streams (1st and terminal class)

The final certificate of education is the baccalaureat, which can be in technology or general education.

The information given here is limited to numbers of candidates (1998), the weekly schedule of subjects taught and the weight given to each in the examination. French is taught in 1st class, and pupils are assessed in it at the end of that year. The same is true of history and geography for pupils in technological streams. A single baccalaureat has been selected to illustrate the STL and STI streams; there are many others.

Scientific series S: 166,192 candidates

	Coefficient	Weekly schedule
French	4	
Mathematics	7	6
Physics/chemistry	6	3 1/3 + (1 1/2)
Life/Earth sciences	6	1 1/2 + (1 1/2)
or industrial technology	9	2 + (6)
History and geography	3	3
Modern language 1	3	3
Philosophy	3	4
PE and sports	2	2
Special subject		
Mathematics	2	2
Physics/chemistry	2	0 + (2)
Life/Earth sciences	2	0 + (2)

NOTA BENE:

- Life/Earth sciences means biology and geology, including some geophysics.
- The "special subject" is an option the pupils must take, choosing between the three mentioned.
- In some lycées, industrial technology must be taken instead of Life/Earth sciences. A special subject is then not compulsory.

Laboratory science and technology series (STL)

Laboratory and industrial chemistry: 1,858 candidates

	Coefficient	Weekly schedule
Physics/chemistry	7	7
Chemical engineering	3	0 + (3 1/2)
Practical work	5	0 + (7)
Laboratory techniques	7	0 + (4)
French	3	
History and geography	1	
PE and sports	2	2
Modern language 1	2	2
Mathematics	4	2 + (2)
Philosophy	2	1 + (1)

Electro-technical engineering series (STI): 17, 144 candidates

	Coefficient	Weekly schedule
Building study	6	1 1/2 + (3)
Study of industrial systems	9	2 + (10)
Applied physics	7	3 + (3)
French	3	
History and geography	1	
PE and sport	2	2
Modern language 1	2	2
Mathematics	4	2 + (2)
Philosophy	2	1 + (1)

II. Curriculum reform

a. Advisory bodies involved

The National Curriculum Board (CNP). Created by the 1989 Act defining the general thrust of education, made up of members chosen by the Minister for their competence, it offers opinions and makes suggestions (to the Ministers concerned) on the "overall design of teaching, the main objectives to be pursued, how well curricula and subject fields match these objectives and how well they lend themselves to the development of knowledge".

The Higher Council on Education (CSE), whose members represent the teaching staff in public education, the users - parents, pupils and students, - the territorial communities, and associations and groups supporting individual schools and the broader aims of education. It offers opinions on anything to do with education (aims and operation, rules governing curricula, examinations, school attendance etc.).

b. Increasingly rapid reform

The Education System in France has undergone many reforms for these last twenty five years.

The reasons for the reforms

It is a permanent process of adaptation to:

- Economic progress which creates needs for a more qualified manpower. It became necessary to extend compulsory school attendance to the age of 16 in 1976. The average time which a child beginning nursery school can expect to spend in education has reached exactly 19 years in 1995-96 compared with 16.7 years in 1982-83.

- Changes in society. In 80 years time, France have evolved from a mainly rural country to a highly industrialised one with dramatic breakthrough in telecommunication, rapid transportation by train or by air. French society had to adapt quickly and not without difficulties or negative fallouts. The growing but limited violence in schools mainly in some poor neighbourhoods, the growing number of one-parent families has lead to strong differences in learning abilities amongst pupils. This have been taken into account in the recent reform of the « collège ».

- Scientific and technological progress. Knowledge has grown at a rapid (sometimes exponential) pace. The renewal is not only in the content but also in the way scientists and engineers see their own activity. The methods on the production line have dramatically changed. Curricula in science and technology are particularly concerned. Some teaching tools are obsolete and must be replaced (traditional measurements are replaced by computer aided data acquisition). The dilemma is what content must be discarded in the new curricula ?

In France, curricula and structures are decided at a central level. Although teachers take part in the process of elaborating new curricula, it has been always necessary to explain the reform and help teachers. From the experience of the last 25 years, we can list the desirable actions to be taken in France.

1. As far as possible, experiment the new curriculum in different schools all over the territory at least one year before the extension.

2. Be sure the number and quality of available teachers fits the needs. If not provide for teachers training.

3. Produce sufficient detailed documentation with comments, examples of practical work sessions.

4. Rely on a body of regional inspectors (at least one per subject) who meet with teachers in the schools and explain the aims of the reform, show examples of assessment, experiments, examples of courses. The inspector is assisted by a team of carefully chosen teachers.

5. Provide for expenses like new equipment, special chemical products.

6. Anticipate the evaluation of the reform.

b. General procedure

The procedure for changing curricula has undergone a succession of alterations. The current procedure stems directly from the history of the past 25 years, punctuated by the legislation mentioned above. A curriculum reform exercise normally includes the following:

- Formulation of a draft curriculum, on the basis of specifications drawn up by the Minister, by a subject-specific working group (GTD) chaired by a university professor or a National Education Inspector and comprising teachers selected by the chairperson(s). The draft is forwarded to the working groups working on other subjects at the same level.

- A one-year trial at a number of schools around the country.

- Production of a definitive draft curriculum, which becomes official after it has been before the coordination and advisory bodies (the National Board and Higher Council) and been published in the Official Journal.

- Production of an accompanying document setting out the intentions and limits of the curriculum, describing the trials, giving a bibliography and academic reference for teachers, and explaining how it fits together with other subjects.

- Training of the propagating staff - regional education inspectors and teacher-trainers.

- Training given at schools by the regional education inspectors and teacher-trainers.

- Evaluating curriculum implementation and its effects on pupils is the responsibility of the corps of national education inspectors.

- The Department of Curriculum Design and Development (DPD) conducts an overall evaluation of the education system, using sophisticated, up-to-date tools, and undertakes statistical surveys for the Minister.

Depending on the circumstances, the Minister may also order national consultations by post or at specially called meetings, and may commission reports from the corps of national education inspectors or notable outside figures.

d. A special case

Technology teaching is a noteworthy exception, because the procedure followed is very different. The draft curriculum for a special subject in a technology baccalaureat is drawn up by the corps of national education inspectors with teachers in that particular subject. The curriculum is first submitted to a Professional Advisory Committee, comprising representatives of the Minister, industrialists in the field concerned who make known their requirements, representatives of the industrial and teachers' unions and experts in industrial safety. Once agreement is reached, the draft goes before the same coordinating and advisory bodies as other curricula.

e. Main orientations of the reforms led/underway

Away from excessive mathematics

In the sixties, the teaching and learning of physics and chemistry had not really changed for thirty years. These sciences were considered as applied mathematics and examinations like baccalaureat were build with this spirit. No links were made between science and technology, science and industry.

In fact, a strong tradition in France was to value mainly abstract studies and mathematics. Teaching a scientific subject only in the form of lessons followed by mathematical-type exercises tended to make pupils believe that science was finalised, perfect, removed from the reality and not to be questioned.

The development of a new scientific elite in France spurred on a new way of considering science and its teaching. Some examples of this new turn of mind :

- It is better to show how a physical situation leads to an equation than to resolve this equation. Knowing the influence of parameters when they tend to zero or infinity, recognising an homogeneity in a formula are more valued.

- It is better to involve the pupils in a problem solving situation than *to teach science as though it were truths strung together like pearls on a thread.*

It should be recognised that, mathematics are far more easier to assess than science. So they were the favourite tool of selection in our system of education. The assessment of new types of abilities did not take place before 1986. Even now, we must be watchful not to fall back in the old habits.

The introduction of practical work

Although practical work have been specified as early as 1902 in syllabi, it was considered by many teachers as the negligible part of the teaching and learning process. Nowadays, comparisons with many foreign countries seems to show France as being at the leading edge of what is called « experimental teaching » of physics and chemistry.

It took nearly a quarter of century to change the minds by:

- Giving to the teachers examples of new and interesting experiments;

- Convincing older teachers that pupils should not be taught science the way they were themselves taught;

- Leading schools to build laboratories and buy equipment; and

- Lobbying by national or regional decision makers to convince them that practical work was worth the money.

Now the aim is achieved at the secondary level even if practical work is costly - half size classes, scientific equipment are needed.

The development of links to everyday life and environment

Science must not remain away from applications and technology. Documents, visit to industrial sites should link science at school with manufacturing of goods and products, particularly in chemistry.

Nowadays, pupils are taught the respect for the environment and involve themselves in collecting chemical wastes from the school laboratory activity. The environment is explicitly mentioned in the syllabus.

Besides, education to citizenship has become a major concern.

Project « la main à la pâte » (hands on science)

With the support of the French academy of sciences the initiative of the French Physics Nobel prize winner Georges Charpak has developed for two years a new pedagogical process at the elementary school we may call « hands on science ». The pupils observe an object or a phenomenon and experiment on it. All along the investigation, the pupils reason, argue, and discuss ideas and results. The activities are organised in sessions and rely on a curriculum but leave a large autonomy to the pupil. The objective is the gradual assimilation of scientific concepts and technological know-how.

The idea is to spread a reform of teaching methods for 5 to 12 year-olds. "Hands On" was developed from 1995 and gradually grew and gained in prestige. At the beginning of 1999, the operation itself had been extended to 4% of French schools and its reputation was visibly much more extensive than that.

The enquiry which has been carried out has brought to light the very positive effects of the "Hands On" methodology, not only in the acquisition of scientific knowledge but also, even more obviously, in all means of expression in the mother tongue, in a general broadening of the mind and, perhaps, in the acquisition of social skills. The results obtained by this method are particularly evident in difficult sociological contexts.

It has also been noted that the "Hands On" methodology leads to very positive transfers of skills. As they become used to a logical sequence - observation, possible formulation of a hypothesis, experiments, conclusion - children have proved capable of re-using this acquisition in areas other than experimental science.

In fact, science teaching in schools had declined because people believed that the time spent in teaching was subtracted from that spent on fundamental skills (speaking, reading, writing, and counting). "Hands On" has provided an opportunity to bypass this contradiction by offering a method of teaching science, which leads to the acquisition of fundamental mother tongue and mathematical skills.

Possible drawbacks. The teachers may lack the scientific training needed to infer a correct conclusion and confront it to the scientific knowledge.

The « supervised personal projects » (TPE)

One important innovation is the introduction of supervised personal projects, which aim at giving teaching a direction by helping pupils to understand the ultimate purpose of what they are learning. They will be intended to develop the ability to work in groups, to extract relevant information from a documentation, to build an original project and to present the results. They will be applied to the pupils next September.

All pupils will thus be given opportunities to learn by different means, through motivating and rewarding activities (such as setting up a little weather station). The personal project should find an achievement in concrete production : scientific experience, document with text, sound, images. The content of the projects must be connected to the curriculum and chosen in accordance with a list of themes published each year.

The projects will call on the schools' capacities for initiative and the resources of the teaching staff. They will profitably be based on experimental disciplines.

Possible drawbacks. They are being experimented this year for the first time in four schools per region (*'académie'*). Many teachers and headmasters fear the shortage of rooms, books, documents and the lack of experience in this new activity.

An enduring problem

In the first two years of the 'collège', three scientific or technological subjects are taught : biology-geology, physics-chemistry, technology. Physics and chemistry are taught only the second year. This means too many teachers for pupils who had only one at the elementary school and difficulties to give each teacher a service in their subject. An integrated and coherent teaching and learning of science has to be built.

*f. **Future perspectives***

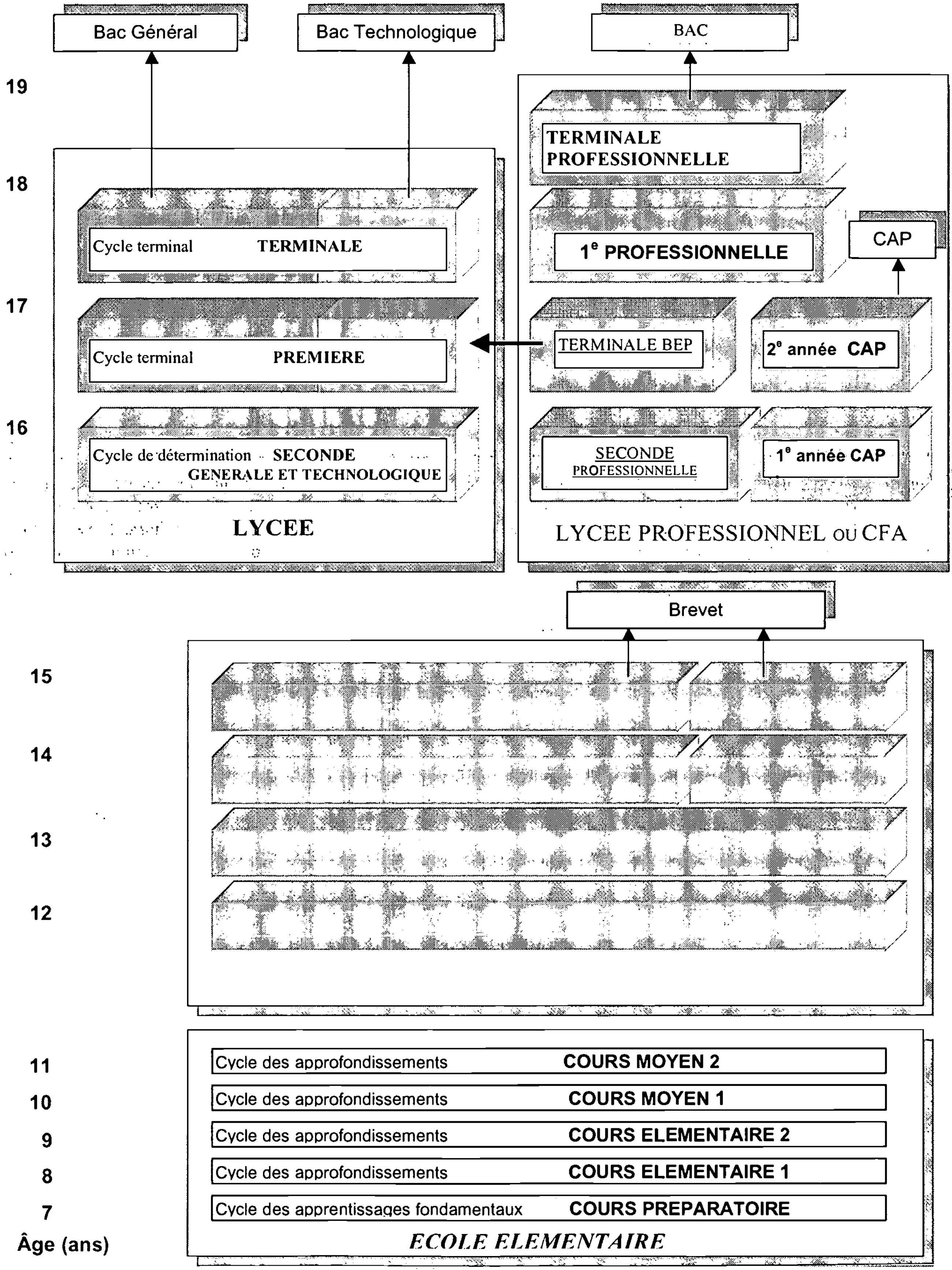
A new curriculum is under way ; its main idea is less is more. It insists more on skills than knowledge. Two original features will emerge soon : one is related to the teaching and learning of science at the elementary school, the other is intended to develop new pupils abilities.

Conclusion

Teaching in science and technology takes place at all levels of schooling, but to widely differing degrees. Obviously, it is intended that everyone should have such teaching up to the age of 16. Account is taken in the teaching of the need to educate future citizens.

There is constant stress on scientific questioning and increasing progression from the particular to the abstract. Practical work by pupils themselves is an expensive requirement, but one the teaching system strives to satisfy at all levels. Information and communications technologies have become essential in modern science teaching.

Changes in curriculum are evidence that the education system is constantly adapting to developments in science and society. The setting in which such changes, initiated by the Minister on the basis of a continuous assessment of the education system, are introduced is one of extensive collaboration among the various constituencies involved.



Bac Général
Bac Technologique
BAC
19
18
17
16
TERMINALE PROFESSIONNELLE
Cycle terminal TERMINALE
1e PROFESSIONNELLE
CAP
Cycle terminal PREMIERE
TERMINALE BEP
2e année CAP
Cycle de détermination SECONDE GENERALE ET TECHNOLOGIQUE
SECONDE PROFESSIONNELLE
1e année CAP
LYCEE
LYCEE PROFESSIONNEL ou CFA
Brevet
15
14
13
12
11
10
9
8
7
Âge (ans)
Cycle des approfondissements COURS MOYEN 2
Cycle des approfondissements COURS MOYEN 1
Cycle des approfondissements COURS ELEMENTAIRE 2
Cycle des approfondissements COURS ELEMENTAIRE 1
Cycle des apprentissages fondamentaux COURS PREPARATOIRE
ECOLE ELEMENTAIRE

APPENDIX II. WHO IS DOING WHAT IN SCIENTIFIC AND TECHNOLOGICAL CURRICULUM DEVELOPMENT IN FRANCE?

	CENTRAL LEVEL	REGIONAL/ PROVINCIAL LEVEL	SCHOOL LEVEL
AIMS & OBJECTIVES	The government and parliament (law) The minister of Education	==============================	==============================
CURRICULUM PLAN	The ministry of Education after taking technical advice from GTD , IGEN , and general advice from the Counsels (CNP, CSN) and other possible organisations or personalities	==============================	==============================
METHODS AND APPROACHES TO TEACHING	The ministry of Education after taking technical advice from GTD , IGEN	==============================	According to the school project, schools can adapt teaching methods to the diversity and the needs of their pupils : help, remediation…
MATERIALS	Documentation for teachers is issued by the GTD and circulated by the ministry School textbooks are published by private publishers on their own	*Collège* school textbooks are paid by the *Région* Laboratories and/or equipment are paid by • The town for elementary schools • The *département* for *collèges* • The *Région* for *lycées*	The *lycées technologiques* and *lycées professionnels* may get directly some tax paid by the companies from secondary or tertiary sector and buy equipment or books
EVALUATION AND EXAMINATION	The system in general is evaluated by the DPD (statistical approach) , the IGEN (pedagogical approach) The IGEN chooses and check the examination papers of the baccalaureates	The system in general is evaluated by the *recteur d'académie* (under the authority of the minister) The exam papers are made under the responsability of the *recteur d'académie* The IPR are in charge of one subject	Under the authority of the headmaster the teachers assess the pupils and inform their parents. Some tests can be the same for a whole level or abide by a national procedure.

APPENDIX III.

CONTENT		REQUIRED SKILLS
3.3	Action of an electrical and/or magnetic field on a beam of particles in various devices: oscilloscope, television set, particle accelerator, electron microscope.	Know that the force imparted to a charge particle q subject to ddp u is $W = qu$
3.3.1	Action of a uniform electrical field on a charged particle.	Deduce the time and trajectory equations by applying basic dynamic relations in the presence of gravity and a uniform electrical field.
3.3.2	Action of a magnetic field on a charged particle: Lorentz force: $\underline{F} = q(\underline{v} \wedge \underline{B})$, special case of the uniform field.	Know the characteristics of the velocity and acceleration vectors of a particle in uniform circular motion.

Back-up activities

Discussion of historical documents.
Verification of the basic laws of dynamics using chronological sequences of photographs.
Analysis of movement using sensors.
Computer processing of results, modelling (e.g. free fall and fall in air).
The motions of the planets.
Experimental demonstration of lines of electrical and magnetic force. Detection of a magnetic field using a magnetised needle, measurement of its intensity with the help of a Hall-effect probe

Uniform field between Helmholz coils.
Action of the field *E* and a field *B* on a beam of electrons.
Discussion of documents on the Earth's magnetic field and its effects on cosmic particles.
Computer simulation of particle motion in fields.
Discussion of documents on the Sun's magnetic field.

Discussion of documents on particle accelerators.
Prepared, guided visits to a particle accelerator, an observatory, a laboratory with an electron microscope.

Show that in an approximation of circular trajectories, the motions of a satellite and planet are uniform. Deduce expressions for their velocity and period.

Know the expression for the force experienced by a particle in motion in a magnetic field. Demonstrate that the motion of a particle in a magnetic field perpendicular to its initial velocity is planar, uniform and circular.

Explain why a uniform magnetic field, unlike an electrical field, cannot affect the kinetic energy of a particle.

Know the expression for the work done by a weight.

APPENDIX IV. 'S' SERIES BACCALAUREAT - PHYSICS/CHEMISTRY TEST

The skills to be tested throughout this test include:

- the knowledge and practical skills defined in the "skills required" column of the terminal year S curriculum;

- abilities relative to the content and scientific approach defined below.

Models and parameters

Know how to:

- identify the parameters playing a role in a physical or chemical phenomenon;

- forecast how a situation will change if one of the parameters is modified;

- use models or laws to establish, by demonstration, the properties inherent in a given situation.

Text analysis

Know how to:

- identify in a document the realm of science within which the physical or chemical phenomena described belong;

- use scientific vocabulary to define or clarify particular terms in the document, or correct them where necessary;

- analyze an illustration in scientific terms;

- explain what role a hypothesis plays in an argument;

- recognize the scientific character of an argument or description.

Analysis of a set of data (graph or table of values)

Know how to:

- recognize, when reading a graph, the quantities whose values are shown along the axes and read off their values with due regard for the scales;

- extract relevant information from a table of values;

- recognize qualitatively whether one quantity is increasing or decreasing as a function of another in a given field;

- determine a new value from a graph: e.g. physical speed or speed of a chemical reaction.

Application of critical reasoning to a result

- be able to tell whether a data entry is or is not consistent;
- know the orders of magnitude specified in the curriculum, and use them to make a rapid evaluation of the order of magnitude of a value of the parameter under study;
- assess the relevance of a result from limit cases;
- determine the number of significant figures from the precision of the data.

Use of mathematical tools

- master the mathematical tools needed in physics and chemistry which are compatible with the common-core mathematics curriculum for the 'S' stream in the terminal year.

Experimental skills

Know how to:

- use the equipment covered in the curriculum;
- explain why particular equipment needs to be used in pursuit of a given experimental aim;
- follow the basic safety rules governing the use of the equipment and supplies covered in the curriculum;
- of the 20 points awarded in the physics/chemistry text, at least 15 are awarded for questions verifying candidates' application, in basic modes of use, of the knowledge, practical skills and abilities defined under "skills to be tested";
- a maximum of 5 points may draw on knowledge and practical skills covered by the curriculum and information given in the statement of the text question, leading to a result that is not necessarily part of the skills and knowledge required.

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