Math Across Cultures: A Resource for Burkinabè Children

Bethany Blackwood
Math across Cultures: A Resource for Burkinabè children

Senior Honors Project
Bethany Blackwood, Math education and French major
This project is dedicated to Diabidi, Youmanli and Agathe,
three Burkinabè young women who taught me so much.
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Project Overview

Project Objective:

As a math education major and a member of the Education group of the Collaboratory for Student Partnerships and Applied Research, I chose to make the Burkinabè math educational system my context of study. After studying the French math educational system and the Burkinabè math education system in Spring 2010, I created a written report for future Education group members to use as a resource. After follow up research and learning in the site team trip in summer 2010 to Mahadaga, I spent Spring 2011 developing tools to aid the teachers and students at the Centre pour l’Avancement des Handicapés (CAH) in Mahadaga, Burkina Faso in the field of math education.

Background:

The Burkinabè teaching staff of the CAH have identified the teaching of mathematics as one of their areas of need; and the Collaboratory education group has been working with them in this area since 2006. Additionally, a teachers’ workshop in January 2009 began a conversation between Messiah Collaboratory members and teachers in Mahadaga about the education system in Burkina Faso. A more detailed understanding – including a comparison to the French educational system, from which the Burkinabè system is based – will benefit the Collaboratory Education group and its relationship with the CAH.

Spring 2010:

In the first portion of this project, I researched the French and Burkinabè math educational systems. I created a written report for each country outlining as much information as possible about the math education system and the national standards and benchmarks.
Summer 2010:

During the site team trip to Burkina Faso in July 2010, I observed the performance of students in Mahadaga in regards to the math activities I created. I documented my work, taking note of areas of proficiency and concepts that need work.

Spring 2011:

After determining concepts that seem particularly challenging for children in Mahadaga, I designed a learning kit for the Collaboratory to implement at the CAH that focuses on those content areas most in need of improvement. I decided to make a learning kit that includes a workbook with supplementary resources that is mathematically and culturally appropriate for the students at the CAH. Each child in the summer 2011 program will receive a workbook, so the teachers at the CAH will be able see the results of our program.
Part 1: Spring 2010 Research
Overview

In spring 2010, I researched the French and Burkinabè education systems to learn about mathematics education. Schools in Burkina Faso are based on the French education system, since Burkina was a French colony from 1896 to 1960. The Center for the Advancement of the Handicapped (CAH) operates a primary school in rural Burkina Faso. The Education Group of the Collaboratory for Strategic Partnerships and Applied Research at Messiah College has been working in partnership with the CAH since 2006.

I hoped to learn more about the education system(s) that govern the school at the CAH to help make the work of the Education Group more fruitful. The Education Group works with primary school-aged students and their teachers, although there is also a possibility of tutoring secondary school-aged students. For the near future (Summer 2010-2012), the Education group is going to implement a summer enrichment program for students at the CAH, so this research aimed to set the stage for the math portion of that program.

I researched the following topics, for France and Burkina Faso:

- Organization of the school system
- Statistics on education
- National standards (i.e. curriculum) for mathematics education in all grades, although focusing mostly on primary grades
- National benchmarks (i.e. math exams) at the end of primary, middle and secondary school

Overall, my research was productive and I was able to gather useful information about math education. However, Burkina Faso does not have much information available online, so I could not
find everything I was looking for. The only “curriculum” or national standards that were available online were just a rough list of topics covered in each grade, and I could not find a copy of the national exam taken at the end of primary school. Thus, in developing math activities for the summer enrichment program, we primarily used the French standards that were more complete.
French Education System

In France, the Ministère d'Education Nationale (Ministry of Education) is in charge of the education system. Their website is found at: www.education.gouv.fr/.

“France has a highly centralized (education) system. The ministry is responsible for developing the curriculum. It also provides guidelines for teaching, although teachers are free to adopt their own methods of instruction. The ministry consults with a number of various advisory committees on the national, regional, and provincial levels.” (www.eric.ed.gov, p. 58) The school (school council/conseil d’école) was granted power in 1990 “to set internal regulations, determine the school's timetable to meet academic benchmarks, select textbooks, and formulate and approve the local components of the curriculum.” (www.eric.ed.gov, p. 39)

“National examinations are developed and administered by the national Direction de l'Evaluation de la Prospective et de la Performance (DEPP) of the Ministry of Education. National diagnostic exams are administered to students aged 8, 11, and 15 at both public and private schools.” (www.eric.ed.gov, p. 40) They test math and French competencies from the curriculum and there are no consequences for the students. (www.eric.ed.gov)
Organization of the Education System in France

Pre-primary education (école maternelle) is three years long. It is designed for children age 3-6, although some 2-year-olds attend as well. Primary education (école élémentaire/primaire) lasts 5 years (CP, CE1, CE2, CM1, CM2) and begins at age 6. By age 12, all students must be in collège, the 4-year cycle of lower secondary school (equivalent to middle school). Lycée (high school) lasts 3 years and culminates in the rigorous baccalaureate exam. (http://eacea.ec.europa.eu)

Compulsory education is from age 6-16 in France, although practically all children are enrolled in pre-primary education and most finish high school (age 18). On average, a student in France is in the system (primary through university) for 16.2 years. (http://eacea.ec.europa.eu)
Figure 2: French education system, www.dijon.iufm.fr
École maternelle (pre-primary school)

Organization/goals:

“Pre-school education contributes to children’s overall development and prepares them for elementary school (primary education). Games play an important part, which does not preclude discipline and effort and helps to explore life settings, action in or on the nearby world, imitating others, inventing new gestures, communicating in all its dimensions, looking at oneself which encourages observation and reflection, discovering the riches of imaginary worlds…It is the responsibility of the team of teachers to ensure that their pupils, throughout their schooling, explore a large variety of situations and cultural worlds along with the use of various tools and instruments. There is room for digital supports in pre-school, alongside toys, games, play areas or books.”

(www.cfem.asso.fr/systen.html)

Pre-school teaching programs, defined by the new 2007 national programs, involve the following five major activity domains:

- **Language at the heart of the learning process**: focus is on oral usage but children begin to understand how the alphabetical code works and how it facilitates reading or writing; in the "big section", pre-school enables children to start learning a new foreign or regional language;

- **Living together** to learn how to experience freedom of action and develop new relationships with schoolmates and adults alike; school life also creates every opportunity to facilitate the development of verbal communication skills;

- **Act and express themselves with their body** to broaden their experience of environments and areas helping children to enhance their self-awareness and develop physical abilities;

- **Discover the world** to try out intellectual work tools in order to understand and describe, quantify, classify or arrange reality;

- **Sensitivity, creation, imagination** to experience the pleasure of creation and establish the foundations of a common culture. (www.cfem.asso.fr/systen.html)
Mathematics

“There is no 'real mathematics', but young children begin to use a mathematical way of thinking. They build their first knowledge about numbers, geometrical shapes and magnitudes and get acquainted with structuring space and time. The activities they are involved with also contribute to developing logical thinking in terms of comparing, classifying, organizing and using symbols.”

(http://www.cfem.asso.fr/syseden.html)

- *Mastering ordinary space* means knowing how to locate oneself and other people or objects in it, organize movements, and knowing how to describe them from different points of view (oneself or others'). This progressive mastering evolves along with the use of an adequate vocabulary.
- *Mastering time* means mastering two ideas: chronology and duration.
- *Work on shapes* is organized through games (jigsaws, paving, assembling, portrait game, etc.) which encourage children to identify common shapes (square, circle, triangle, etc.) as well as some of their characteristics (expressed in terms such as: *straight, curved, pointed, etc.*).
- *Basic magnitudes* (mainly length, mass and capacity) are essentially seen through comparing, classifying and organizing activities.
- *First learning about numbers* at *école maternelle* takes into account the results of numerous research works in psychology and didactics. Children are taught the verbal numerical chain (at least up to 30) and use it to count things. Number becomes a tool for checking quantities, and remembering them, in order to anticipate the result of certain actions on these quantities (augmentation, diminution, sharing, etc.), even if counting is not a goal in itself at this level. Numbers are mainly expressed orally, but children start recognizing and writing figures.

(http://www.cfem.asso.fr/syseden.html)

Some specific benchmarks to be achieved by the end of *école maternelle* are laid out that are related to mathematics – in the categories ‘forms and sizes’ and ‘quantities and numbers’:

**FORMS AND SIZES**

- Differentiate and classify objects according to characteristics of their shape
✓ Recognize, classify and name simple shapes: square, triangle, circle
✓ Reproduce an assembly of objects of simple shapes from a model (ie. puzzle or group of blocks)
✓ Compare, classify and arrange objects according to their size, mass or capacity

QUANTITIES AND NUMBERS
✓ Compare quantities, using numerical or non-numerical techniques
✓ Make a collection of objects equal in quantity to another group of objects (near or far, visible or not), using numerical or non-numerical techniques, orally or with the help of writing
✓ Solve problems dealing with quantities (adding, taking away, sharing, borrowing) using known numbers, without using normal operations
✓ Recognize globally and express very small quantities (1-4), also expressing these quantities in other configurations (fingers on a hand, patterns on a die)
✓ Be able to count orally up to at least 30
✓ Count a quantity using the oral sequence of numbers known
✓ Associate a number with its written numeral, in referring to a number line
(http://www.cndp.fr)

Progression/evaluation

“The teacher or the pedagogical team is responsible for the regular assessment of the children’s knowledge, which is based in pre-school on attentive observation of the children. The Teacher council determines the progression of a pupil in each cycle. In order to keep the parents informed of their child’s situation, a school record book is put together for each child, in which are written the results of precise assessments and indications of their knowledge.” [The Teacher council is made up of all the teachers at school, or all of the teachers for a particular student, in addition to the principal of the school.] (http://eacea.ec.europa.eu, p 39-40)

Primary school (CP through CM2)
**Organization/Goals**

Primary school in France is divided into cycles. Cycle 1 consists of the first 2 years of *école maternelle* (pre-primary school). Cycle 2, the “basic learning skills” cycle, consists of the third (and final) year of *école maternelle*, and the first two years of primary school (CP and CE1). The third cycle, also known as the “consolidation” or “skills development cycle,” consists of the final 3 years of primary school: CE2, CM1 and CM2. (www.cfem.asso.fr/syseden.html)

“During the ”basic learning skills” cycle, elementary skills are developed (speaking, writing and counting) which form the basis of a successful learning process. The ”skills development” cycle transforms these skills into intellectual tools which enable the pupil to improve his mind and to acquire his first sense of autonomy. Each of the cycles ends with a national assessment which enables teachers, as well as families, to take stock of these skills.” (http://eacea.ec.europa.eu, p. 53)

**Mathematics**

“Math must be practiced 5-6 hours per week, including 15 min of mental arithmetic (cycle 2). The objective of the ”Mathematics” program, by proposing a structured study of the numbers, shapes, magnitudes and measurements, is to mark the pupils’ actual entry into the world of mathematics. The understanding of the numbers, notably in the form of digits (decimal notation) and mental arithmetic in all its forms (memorized results, calculations) constitute priority objectives. Basic mathematical notions, perceived as efficient solutions to problems, are identified and studied with a view to solving new problems.” (http://eacea.ec.europa.eu, p. 54)

The mathematics curriculum is divided into 5 principal domains:
1. The processing and organization of numerical data: pupils learn the meaning of numbers and operations via the resolution of several major problem categories;
2. The knowledge of natural integers (as well as decimals and basic fractions in cycle 3);
3. Arithmetic (including mental math);
4. Magnitude and measurements (length, weight, volume, time, etc.);
5. Geometry

(http://eacea.ec.europa.eu)

**Les compétences évaluées en mathématiques**

Math competencies for national tests in 2nd and 5th grade

<table>
<thead>
<tr>
<th>Évaluation CE1</th>
<th>Évaluation CM2</th>
<th>Les nombres</th>
<th>Numbers</th>
<th>Les calculs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Écrire et nommer les nombres entiers naturels inférieurs à 1000. Write and name whole numbers under 1000.</td>
<td>Écrire et nommer les nombres entiers, décimaux et les fractions. Write and name whole numbers, decimals and fractions.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Écrire ou dire des suites de nombres. Write or say sequences of numbers.</td>
<td>Passer d’une écriture fractionnaire à une écriture à virgule et réciproquement. Change fractions to decimals, and vice versa.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Ordonner, comparer, encadrer, des nombres inférieurs à 1000. Order, compare and circle numbers less than 1000.</td>
<td>Ordonner, comparer, encadrer des nombres. Les placer sur une droite graduée. Order, compare and circle numbers (whole numbers, decimals, simple fractions), and place them on a number line.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Résoudre des problèmes de dénombrement, de comparaison. Solve problems of counting and comparing.</td>
<td>Connaître les résultats des tables de multiplication. Les utiliser pour retrouver les facteurs d’un produit. Understand results of multiplication tables (2-9), and use them to find factors of a product.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connaitre et utiliser des procédures de calcul mental pour calculer des sommes, des différences, des produits. Calculate in line suites d’opérations. Understand and use mental math procedures to calculate sums, differences and products. Calculate multiple operations in a row.</td>
<td>Calculer mentalement le résultat d’une opération ou d’une suite d’opérations ou le terme manquant d’une opération. Calculate mentally the result of an operation or a series of operations, or the missing term of an operation.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Arithmetic

<table>
<thead>
<tr>
<th>Understand and use operating techniques of addition and subtraction, as well as addition and multiplication tables (2-5).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understand a technique of multiplication and use it to multiply by a single digit number.</td>
</tr>
<tr>
<td>Set up and calculate an addition, subtraction or multiplication problem using whole numbers or decimals.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Set up and calculate an addition, subtraction or multiplication problem using whole numbers or decimals.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set up and calculate a division problem of a whole number or decimal by a whole number.</td>
</tr>
</tbody>
</table>

### La géométrie

<table>
<thead>
<tr>
<th>Understand and name principal plane figures, and notice their geometric properties: alignment, right angles, axis of symmetry, equality of lengths.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recognize and verify (using tools) that a shape is a square, rectangle, diamond, special triangle or parallelogram.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Recognize and verify, using tools, that lines are parallel or perpendicular.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recognize and verify, using tools, that lines are parallel or perpendicular.</td>
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</tbody>
</table>

### Geometry

<table>
<thead>
<tr>
<th>Reproduce simple geometric shapes using tools or techniques: a ruler, grid paper or tracing paper. Make graphs using tools: a ruler, a set square or a template of a right angle.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recognize and verify, using tools, that lines are parallel or perpendicular.</td>
</tr>
</tbody>
</table>
| **Situer un objet par rapport à soi ou à un autre objet,**<br>Situate/locate an object with respect to oneself or another object, **donner sa position et décrire son déplacement.**<br>Give its position and describe its displacement. | **Tracer une figure à partir d’un programme de construction, d’un modèle ou d’un schéma codé, en utilisant les instruments.**<br>Draw a figure, using tools, based on a construction guide, a model or coded schema. | **Grandeurs et mesures**
**Size and measurement** |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Résoudre un problème géométrique.</strong>&lt;br&gt;Solve a geometric problem.</td>
<td><strong>Reconnaître, décrire et nommer les figures et solides usuels.</strong>&lt;br&gt;Recognize, describe and name normal shapes and solids.</td>
<td></td>
</tr>
</tbody>
</table>
| **Utiliser les unités usuelles de mesure ; estimer une mesure.**<br>Use normal units of measurement, and estimate measurements. | **Utiliser des instruments de mesure ; effectuer des conversions.**<br>Use measurement tools and make conversions. | **Grandeurs et mesures**
**Size and measurement** |
| **Être précis et soigneux dans les tracés, les mesures et les calculs.**<br>Take measurements, construct graphs/drawings and make calculations precisely and carefully. | **Connaitre et utiliser les formules du périmètre et de l’aire d’un carré, d’un rectangle et d’un triangle.**<br>Know and use formulas of perimeter and area of a square, rectangle and triangle. |  |
| **Résoudre des problèmes de longueur et de masse.**<br>Solve problems of length and mass. | **Utiliser les unités de mesures usuelles.**<br>Use usual units of measurement. | **Size and measurement** |
| **Organiser les données d’un énoncé.**<br>Organize the data of a word problem. | **Résoudre des problèmes dont la résolution implique des conversions.**<br>Solve problems that require conversions. | **Organisation et gestion de données**
**Organization and management of data** |
| **Lire, interpréter et construire quelques représentations simples : tableaux, graphiques.**<br>Read, interpret and build simple representations (tables and graphs). | **Savoir organiser des informations numériques ou géométriques, justifier et apprécier la vraisemblance d’un résultat.**<br>Know how to organize numerical or geometric information, justify and estimate the credibility of a result. |  |
| **Organiser les données d’un énoncé.**<br>Organize the data of a word problem. | **Résoudre un problème mettant en jeu une situation de proportionnalité.**<br>Solve a problem involving proportionality. | **Organisation et gestion de données**
**Organization and management of data** |
Progression/evaluation

“Continual and periodic assessments are organized by the teacher or teachers during each cycle in order to test the pupils’ knowledge. This results in the creation of a "school record book" describing the primary education curriculum of the pupil and recording the skills acquired with a view to college enrolment. This record book is used to keep parents regularly informed of the progress of their children and to organize information exchanges between primary and secondary education teachers, in order to ensure teaching continuity.

“The progression of a child in each cycle is determined on proposal of the teacher by the cycle teacher council, made up of teachers of relevant cycle classes. After having examined the situation of each child, the council of cycle teachers formulates its advice concerning the child’s passage from cycle to cycle and the length of time spent by the child in each cycle: the latter can be prolonged and reduced by a year according to the learning rhythm of the child. The directeur d'école [principal] informs the parents of the proposals made. The parents can then challenge these within a time limit of 15 days, by putting together an appeal to the inspecteur d'académie, manager of the National education departmental services, who will take the final decision.

“There is no exam (or document) marking the end of primary school and determining progression into the next class and the orientation of the lower secondary education. All students have the right to go straight into 6ème, except in the event of the relevant teacher objecting. At the age of 12, all pupils must leave primary school education and must then be registered in a collège, whatever their level may be.” (http://eacea.ec.europa.eu, p. 57)

A copy of the 2009 CE1 national exam, equivalent to 2nd grade, was found at: http://www.pmev.fr. The teacher’s exam, with specifics on how to administer the test, the dictation
questions, as well as specific competencies evaluated for each math question, was found at:

Similarly, the student version of the 2009 national exam administered at the end of CM2, equivalent to 6th grade – the final year of primary school, was found at: http://www.ac-reims.fr, and a teacher’s copy at: http://www.cmi.univ-mrs.fr.

Secondary (collège + lycée)

Organization

Almost all students go to the normal collège (equivalent of middle school), although a small percentage can go to a technical school. In the college, the conseil (group of relevant teachers and the school principal) meets after 2 years to discuss students’ academics, behavior, etc. and give a recommendation, which the parents usually follow, about what type of lycée (academic, technique, or workforce) the student should go to. The culmination of collège is a brevet exam, which gives students a diploma. The brevet is not required, but 90% of students take it, and about 66% of each class earns the brevet diploma. Holding the diploma allows students to enter a more rigorous academic track in high school. (American Federation of Teachers, 1997)

There are two types of lycées (high schools): vocational (or professionnel), and comprehensive (or general, academic). At a lycée professionnel, students prepare for Brevet d’Études Professionnelles (BEP) – which is a general vocational certificate – or a CAP (Certificate d’Aptitude Professionnelle) – more specialized training for a particular trade (students can also do both). This can be followed by taking the bac professionnel. At a comprehensive lycée, students continue doing academics, specializing after one year - in preparation for the baccalaureate exam. The bac general is based on traditional academic curriculum – L for literary, S for scientific, ES for economic and social sciences; and the bac
technologique requires coursework in both core academic subjects and in a technical concentration such as engineering. Students who pass the bac exam at the end of their senior year are able to go onto university. Those who do not pass can repeat the senior year. (American Federation of Teachers, 1997)

Mathematics

In collège, the three domains in mathematics are geometrical work, numerical work and data organization/management. The Commission Française pour l'Enseignement des Mathématiques (CFEM) outlines the following benchmarks during this four year period of education (equivalent to 5th – 9th grade in the US):

**GEOMETRICAL WORK**

- Study of geometrical properties of plane figures in more detail
- Accurate recognition and reproduction of plane figures
- Calculating volume, area and perimeter, including units of measure
- Ability to do build and write proofs (ie. of properties of a parallelogram – symmetry)
- Translation, reflection, rotation
- Vectors as coordinates and sums (composition of translations)
- In-depth study of triangle to acquire new knowledge (sum of the angles, triangle inequality, construction problems, circumcircle, theorem about the middle points of the sides, Thales theorem and Pythagoras theorem, bisectors, tangent, perpendicular bisectors, trigonometry: sine, cosine, tangent)
- (Experimental) study of solids, including surface area and volume of a sphere

**NUMERICAL WORK**

- Arithmetic with decimals, including multiplication and division
- Order of magnitude is important in arithmetic
- Fractions: calculations, reducing, common divisor
• Simple solving of unknowns
• Using negative numbers in calculations and arithmetic
• Powers (including basic calculations with square roots)
• Model situations with equations (first degree, with one or two unknowns)
• Factor basic/simple expressions

DATA ORGANISATION AND MANAGEMENT, FUNCTIONS.
• Proportionality through reasoning (multiplying by a fraction or value ‘k’) – and its effects on area/volume
• Statistics: using tables or graphs, concepts of median and dispersion
• Plotting points and relating proportionality to graphs (problems with scales, uniform movement or average speed, percentage, change of units of measure, particularly with quotient magnitudes)
  (http://www.cfem.asso.fr/syseden.html)

For a French version of these benchmarks, the CFEM website has a translation of the document available in French. Additionally, http://media.education.gouv.fr has a French and English version of knowledge and abilities in mathematics to be acquired before the end of compulsory school (see pages 26-28).

The specific competencies and skills taught in mathematics in lycée (10th – 12th grade) vary depending on the diploma the student is preparing for, so no details are included here. This can be researched later if necessary, depending on Collaboratory/SIM desires in Burkina.

Two resources for secondary mathematics are http://www.math93.com/gestclasse/classes/annales.htm and http://www.2amath.fr/examen-sujet.php, which have previous baccalaureate exams of all three types (S, ES, and L) as well as brevet exams – both the student copy and the solutions.
Education Statistics

According to UNESCO (2007 data), 113% of children are enrolled in pre-primary school (any age divided those of normal age, so two-year-olds enrolled make this statistic >100%), 99% are enrolled in primary, 98% in secondary, and 55% in university. The average length a student is in school, from primary to post-secondary, is 16.2 years. The literacy rate in France (total population) is 99%. (stats.uis.unesco.org)

In 2008, 34.6% of the senior class earned the bac general, 16.6% earned the bac technologique, and 12.6% earned the bac professionnel – making the proportion of baccalaureate holders in that class 68.3%. The success for each bac exam, meaning the percent who took it and passed, were as follows: 88% for the bac general, 80.7% for the bac technologique, and 77.2% for the bac professionnel. (http://media.education.gouv.fr)

According to a national French education survey in 2005-2007, on average 10% received no diploma (middle or high school, “aucun diplôme”), 9% passed middle school but not high school (“brevet”), 23% left after receiving their baccalaureat and 42% received a diploma from superior education (diplôme du…). Figure 3 illustrates these findings.

Les diplômes des sortants [moyenne 2005-2007]

Figure 3: Highest diploma held by students on average, 2005-2007; media.education.gouv.fr
References:


American Federation of Teachers and National Center for Improving Science Education. (1997). *What Students are Expected to Know about Mathematics*. Bethesda, MD: AFT.


http://www.dijon.iufm.fr/static/internat/quebec02/orgafr.htm
Burkinabé Education System: An Overview and Details on Mathematics

The education system in Burkina Faso, West Africa, is modeled after the French education system, as Burkina Faso was a French colony until independence in 1960. Few, if any, curriculum or procedural changes were made until the mid 1980’s, and the system in place today still looks very similar to the French system. Teaching is done entirely in French; however this poses a challenge because children are not exposed to French until they arrive at school at age 6-7.

The Burkinabè education system is governed by several ministries. The Ministère de l’action sociale et de la solidarité nationale (MASSN) is responsible for pre-primary education – although this is only available in large cities. The Ministère de l’enseignement de base et de l’alphabétisation de masse (MEBA) is in charge of primary education, literacy, and non-formal education, and the Ministère des enseignements secondaire, supérieur et de la recherche scientifique (MESSRS) is in charge of secondary education, higher education and scientific research. All of the ministries have websites, although they are not necessarily well maintained. (http://www.ibe.unesco.org)


Organization of the Education System

In Burkina Faso, there is not pre-primary education like there is in France. Primary education in Burkina Faso is six years long, whereas in France it is just five years. An extra year of cours primaire (CP) is added, so primary school is three mini-cycles of two years each, in: cours primaire (CP), cours élémentaire (CE) and cours moyen (CM). At the end of the six years, all students take the Certificat d’Etudes Primaires exam (CEP), which gives them access to collège (lower secondary/middle school). (www.ibe.unesco.org)
Collège (equivalent to middle school) is the first cycle of secondary education and lasts four years. Collège culminates in the Brevet d’Etudes du Premier Cycle (BEPC) exam. From there, students can go to lycée for three years of academics in preparation for the baccalaureate exam (same as in France), and onto university if they pass the bac. Otherwise, there is a more technical track for professional training that occurs in Collèges d’Enseignement Technique (CET) – rather than the normal collèges and lycées. The short technical cycle is lasts for 3-4 years after the CEP, where students can receive the Certificat d’Aptitude Professionnelle (CAP). The middle technical cycle, two years of training after passing the BEPC, leads to the Brevet d’Etudes Professionnelles (BEP). The long technical cycle is three years of training after the BEPC and allows students to take the baccalaureate technique exam.

(www.ibe.unesco.org)

Compulsory education is technically age 6-16, like in France, but many issues prevent this from being achieved (illness, overcrowding, location, money for books, tradition of not educating all children-especially girls, etc.). The percentage of children in school is already low for primary school, and even lower for secondary education, as education does not have the value or use that it does in developed western countries. (D. Johnson, personal conversation, January 21, 2010) See the following section about education statistics for details on the percent of children who are schooled and pass primary school.

Currently there are no national examinations (standardized tests) other than tests for a certificate/diploma at the end of primary, lower secondary and upper secondary education. Especially in the highly crowded public schools, children may be promoted despite poor grades and insufficient academic levels for the subsequent grade level. (D. Johnson, personal conversation, January 21, 2010)
Structure of School System in Burkina Faso

The following chart, found on the website of secondary schools in Burkina Faso, outlines the way students may progress through the Burkinabè education system.

(Source: Adapted from IBE, 2001, UNESCO)

Figure 4: Structure of education system in Burkina Faso, www.dgifpe.gov.bf
Mathematics in Burkinabè Education

The ministries for primary and secondary education in Burkina Faso both have curricula overviews by subject, including benchmarks for each academic year. However, the page for mathematics for secondary school is currently under construction (http://www.dgifpe.gov.bf/fichiers/maths.htm). Hopefully more information will be available soon. Consequently, only the primary school mathematics topics will be covered here. (*The original French version will be kept alongside my English translation, for Collaboratory purposes.*)

1. COURS PREPARATOIRES (CP1/ CP2) – equivalent to 1st-2nd grade

   a. **Le calcul (Arithmetic):** deux séances de 30mn par jour ; l’unique séance du samedi étant consacrée aux révisions. Two class sessions of 30 minutes per day; the single session on Saturday is consecrated to reviewing.

   i. **Au CP1,** le programme comprend deux volets : In CP1, the curriculum is comprised of two components:

      1. Le langage mathématique qui couvre les 4 semaines du début d’année. Ce langage fait acquérir à l’enfant les notions telles que : j’enlève, l’ajoute, il reste zéro, etc. The first 4 weeks of the year cover mathematical language. Children learn notions such as: subtract, add, remain 0, etc.

      2. L’étude des nombres qui vont de 0 à 20. Cette étude se consacre à la présentation, au nom et à l’analyse de chaque nombre. Le reste de l’année scolaire est dévolu à ce deuxième volet. The study of numbers from 0-20. This study is dedicated to the presentation, name and analysis of each number. The rest of the school year is used for this component.

   ii. **Au CP2,** outre la révision des nombres de 0 à 20 durant les trois premières semaines, le programme du CP2 prévoit dans les dix – neuf semaines suivantes l’étude de nombres jusqu’à 100. En sus de l’écriture, du nom et de la présentation d’un nombre, il est prévu après l’étude de cinquante premiers nombres la notion d’addition avec retenue ; la notion de soustraction avec retenue intervient après le nombre soixante ; celle de multiplication avec retenue après le nombre 69 et la division exacte et la division avec reste après. A partir de la 22e semaine, l’on étudie l’usage des pièces, la lecture de l’heure juste et le calendrier. In CP2, other
than reviewing the numbers 0-20 during the first three weeks, the curriculum spends the next 19 weeks on the study of numbers up to 100. In addition to writing and the name and presentation of the number, after the first 50 numbers the concept of addition will be introduced. Subtraction will be taught after the number 60, multiplication after 69, and division (whole numbers, no remainders) after that. After the 22nd week, students will study coins, telling time and the calendar.

2. COURS ELEMENTAIRE (CE1 / CE2) – equivalent to 3rd-4th grade
   a. Le calcul mental Mental math: Quatre séances de 10 mn chacune sont réservées à cette discipline par semaine. Le programme couvre: l’écriture des nombres allant de 1 à 4 chiffres, les différentes opérations avec ces nombres, multiplier un nombre 10, 100 ou 1000… Four sessions of 10 minutes each are reserved to this discipline weekly. The curriculum covers: writing numbers (up to 4 digits), the different operations with these numbers, and multiplying by 10, 100 or 1000.
   b. L’Arithmétique Arithmetic: Deux séances de 45 mn chacune sont consacrées à cette discipline au CE1 au CE2, chacune des deux séances dure 60 mn. Two sessions of 45 minutes each are spent on arithmetic in CE1 and two sessions of 60 minutes in CE2.
      i. Au CE1 Le programme prévoit, outre la révision de programme du CP2, l’introduction de notions tels le quart, le tiers, les termes d’échange, la table de Pythagore jusqu’à 10 et l’analyse des nombres jusqu’à 100. In CE1, the curriculum involves reviewing what was learned in CP2, and introduces the notions of the quarter and third, terms of exchange, the multiplication table (up to 10), and analysis of numbers up to 100.
      ii. Au CE2 Le programme est un renforcement de celui du CE1 avec l’étude des nombres jusqu’à 10 000 et l’introduction des notions de gains et salaires et la preuve de la multiplication et de division. In CE2, the curriculum reinforces that of CE1, as well as studying numbers up to 10 000, introducing the ideas of profits and salaries, and more in-depth use of multiplication and division.
   c. Le système métrique The metric system: Une séance de 45 mn par semaine est réservée à l’enseignement de la discipline au CE1 et au CE2. On étudie les pièces de
monnaie, les mesures de longueur, de capacités, de poids et de surface. One class period of 45 minutes per week is reserved for this discipline in CE1 and CE2. It is used to study coins and measures of length, capacity, weight and area.

d. La géométrie Geometry: Une séance de 45 mn par semaine. One session of 45 minutes per week.

   i. **Au CE1**, le programme prévoit l’étude des lignes, des droites, du carré et du rectangle, le calcul d’un un coté a partir du demi -périmètre, les notions de surface, de circonférence, de cercle. In CE1, the curriculum includes the study of curves, lines, squares, and rectangles; the calculation of a side (given a half-perimeter); the notions of area and circumference of a circle.

   ii. **Au CE2**, le programme prévoit l’usage de la règle, de la ficelle, du compas, l’étude du carré, du rectangle de l’angle droit, et des perpendiculaires, le calcul de la superficie à partir quadrillages. In CE2, students learn to use a ruler, string, compass; study squares, rectangles and right angles and perpendiculars; and calculate area using a grid.

3. COURS MOYEN (CM1 / CM2) – equivalent to 5th-6th grade

   a. **Le calcul mental Mental math:** Il est prévu quatre séances de 15 mn chacune. Le programme, commun aux deux choses, prévoit outre l’écriture des grands nombres, les quatre types d’opérations pour les entiers et décimaux. There should be 4 sessions of 15 minutes each. For both years (CM1 and CM2), the curriculum involves writing large numbers and doing all 4 operations using whole numbers and decimals.

   b. **L’arithmétique Arithmetic:** 2 séances de 60 mn chacune. Two sessions of 60 minutes each.

   i. **Au CM1** Le programme prévoit les quatre opérations des nombres entiers et décimaux, les échanges, la règle de trois, les fractions, les partages inégaux, les pourcentages, les factures, les nombres complexes, les échelles. In CM1, the curriculum includes all 4 operations on whole numbers and decimals; exchanges; the rule of 3; fractions; unequal sharing; percentages; bills; complex numbers and scales.
ii. **Au CM2** C’est le renforcement du programme du CM1, avec en sus, les notions de moyennes et des intervalles. **In CM2**, the curriculum reinforces the topics of CM1, with the addition of medians and intervals.

c. **Le système métrique** *The metric system*: L’horaire est d’une séance de 60 mn par semaine. **The schedule is one session of 60 minutes per week.**

i. **Au CM1** Le programme est consacré à l’étude des mesures de longueur, des capacités, de poids, de surface, agraires et de volume. **In CM1**, the curriculum is dedicated to studying measurements of length, capacity, weight, area, land, and volume.

ii. **Au CM2** C’est le renforcement du programme du CM1 et l’introduction de notions comme le *stère*, les échelles, les plans et cartes et les rangements. **In CM2**, the curriculum reinforces the curriculum from CM1 and also introduces topics like standard specific measurements (‘stère’ = 1m³), scales, maps and arrangements.

d. **La géométrie** *Geometry*: Une séance de 60 mn est consacrée à cette discipline par semaine. **One session of 60 minutes is spent on this discipline weekly.**

i. **Au CM1** Le programme prévoit des lignes, des droites, du carré, du rectangle, du triangle, du trapèze, du losange, du cercle et du cube. **In CM1**, the curriculum includes the study of curves, lines, squares, rectangles, triangles, trapezoids, diamonds, circles and cubes.

ii. **Au CM2** C’est le renforcement du programme du CM1 avec l’introduction de notions comme le parallélépipède rectangle, du cylindre droit, du prisme et des surfaces diminuées. **In CM2**, the curriculum reinforces the curriculum of CM1 and also introduces notions like the rectangular parallelepiped, the right cylinder, prisms and diminished surfaces.

(https://www.meba.gov.bf)
SECONDARY

General goals for mathematics in secondary education were explained in a detailed survey/explanation of education in Burkina Faso, according to the SMICT 2004 study. See the following list of objectives:

Les objectifs de l'enseignement secondaire en mathematics:  
(General) Objectives of secondary mathematics:

D’une manière générale, l’enseignement des mathématiques dans l’enseignement secondaire vise à:

In a general manner, teaching mathematics in secondary education aims to:

- développer l’esprit critique, de l’élève; develop the critical spirit (reasoning) of the student;
- fournir à l’élève des outils, un bagage de connaissances pratiques, de techniques, etc. lui permettant de résoudre des problèmes, de s’intégrer dans la vie active; provide students with tools, a collection of practical, technical, etc. knowledge that allows them to solve problems and be involved in active life;
- fournir à l’élève une base solide pour les études approfondies qu’il est susceptible de mener ultérieurement supply students with a solid base for thorough studies in other disciplines/areas

Au premier cycle, c’est à dire de la 7ème à la 10ème année d’études qui va de la 6ème à la 3ème, l’enseignement des mathématiques dans ces classes vise à: In the first cycle, that is the 7th through 10th year of study, in grades 6ième to 3ième (US equivalent of 5th – 9th grade), math classes aim to:

- consolider les acquis de l’enseignement primaire, c’est à dire les 6 premières années d’études; consolidate the knowledge learned in primary school, the first 6 years of education;
- fournir à l’élève un bagage de connaissances pratiques, de techniques usuelles, de méthodes opératoires lui permettant de résoudre des problèmes simples qui se posent à lui dans la vie courante où à l’occasion d’autres enseignements; provide students with practical tools, common techniques, operations methods to enable them to solve simple problems in daily life or in other academic disciplines
- contribuer à la formation intellectuelle de l’élève contribute to the students’ intellectual development
permettre à l’élève de mettre ses aptitudes à l’épreuve et lui fournir une base solide pour les études approfondies qu’il est susceptible de mener ultérieurement allow students to put their aptitudes to the test, and supply them with a solid base for other studies that they is likely to pursue

Au second cycle, c’est à dire de la 11 ème à la 13 ème année d’études, qui va de la 2nde à la Tle, l’enseignement des mathématiques en séries littéraires (2nde A, 1ère A, Tle A) vise à: During the second cycle, that is the 11\textsuperscript{th} through 13\textsuperscript{th} years of study, named 2\textsuperscript{nd} through terminale (10\textsuperscript{th} – 12\textsuperscript{th} grade in the US), mathematics classes in the literary track aim to:

- fournir à l’élève un bagage de connaissances qu’il pourra réinvestir dans d’autres disciplines, d’autres domaines; supply students with knowledge that they will be able to use in other disciplines and domains;
- entraîner l’élève à la pratique d’une demarche scientifique et promouvoir l’acquisition de méthodes ; train students about the scientific method and to promote the acquisition of methods;
- développer les capacités d’organisation et de communication ; develop the abilities to organize and communicate;
- fournir des outils nécessaires à la poursuite d’études dans les domaines littéraires et des sciences humaines. supply necessary tools for pursuing studies in literature and humanities.

L’enseignement des mathématiques en séries scientifiques de l’enseignement général (2nde C ; 1ère C ; 1ère D ; Tle C ; T le D) vise à : Mathematics teaching in the science tracks of general secondary education aim to:

- approfondir les connaissances et à les structurer; To go thoroughly into knowledge and structure it;
- entraîner l’élève à la pratique d’une demarche scientifique qui lie expérimentation, analyse et raisonnement ; train students about the scientific method that is linked to experimentation, analysis and reasoning
- développer les capacités d’organisation et de communication de l’élève ; develop the abilities to organize and communicate;
- exploiter les interactions entre les mathématiques et les autres disciplines. To make use of the interactions between mathematics and other academic disciplines
L’enseignement des mathématiques en séries scientifiques de l’enseignement technique (2nde AB3; 2nde H, 1ère E, 1ère F ; 1ère G2 ; 1ère H ; Tle E ; Tle F ; Tle G2 ; Tle H) vise à : Mathematics in science tracks of technical high school aims to:

- consolider les acquis du premier cycle ; consolidate what was learned in the first cycle (middle school);
- fournir à l’élève des outils pour suivre avec l’enseignement scientifique, technologique et l’enseignement des techniques économiques ; to supply students with tools to follow scientific and technological education and techniques of economics;
- développer les capacités d’organisation et de communication ; to develop the ability to organize and communicate;
- promouvoir l’acquisition de méthodes et de techniques. to aide with learning methods and techniques.

http://www.dgifpe.gov.bf

Resources for math problems/exams:

Not many study or test prep websites exist specifically for math in Burkina Faso. I could not find any copies of specifically Burkinabè baccalaureate exams or the CEP exam (taken at the end of primary school) – just the BEPC exams. (This will be followed through in Burkina Faso in summer 2010.)

The website www.sam.tice-burkina.bf had copies of the math sections on 14 recent Burkinabè BEPC exams. Also, the website maths.educamer.org has multiple BEPC and baccalaureate exams from West Africa but none specifically from Burkina Faso.
Education Statistics

The percentage of children in Burkina Faso enrolled in primary school varies somewhat depending on the source, but the net is between 45-54%, as of 2007. According to UNESCO, 49% of girls and 59% of boys attend primary school. About 75% of those who enter primary school will finish – about 30% of girls of primary school age finish primary school and 38% of boys. No more than 70% pass the CEP exam at the end of primary school. (http://stats.uis.unesco.org)

Only 11% of girls and 15% of boys attend secondary school, as measured by UNESCO for 2007. A net 3% of boys and girls are in pre-primary school and 3% make it all the way to university (only 1.5% of girls). (http://stats.uis.unesco.org) The baccalaureate exam had a success rate of only 33% in 2005, although this was higher than previous years. (http://fr.excelafrica.com)

Education in Burkina Faso is taking place in a country with a 21.8% overall literacy rate and a primary student to teacher ratio of 47:1. On average, girls stay in school for 4 years and boys for 5 years, placing Burkina Faso as the lowest or second lowest of all countries in terms of length of achieved education. (http://www.nationmaster.com)
References:


Part 2: Summer Enrichment Program
Overview

In the summer of 2010, I participated on the Collaboratory site team that went to Burkina Faso and implemented a summer enrichment program for students at the CAH.

The goal of the Burkina Summer Enrichment Program (BSEP) was to strengthen math and literacy skills among the students and to include local teachers or potential teachers-to-be in our work. The Education group planned on implementing a summer enrichment program for three years (2010, 2011 and 2012) and during that time train teachers to run a similar program on their own.

The Education group had planned literacy, math and geography activities and brought many educational supplies (books, games, worksheets, slates, chalk, memory cards, etc.) to use during our program. The math activities were based on topics mentioned in the national standards found in the Burkinabè and French math ‘curricula’ that I researched earlier in the spring. Most activities were based on the French standards since they were more detailed. We created around two dozen activities that covered a wide range of math topics found in the standards for various years in elementary school, since we did not know the age of the students we would be working with.
Implementation of the BSEP

The initial year of the BSEP (summer 2010) required adapting our plans, since we were not able to have a full four-week program with one set of students. We ended up having 17 eager students and 2 young Burkinabè men to help us run the program. The students ranged from 1st to 7th grade (CP1 to 6ième), and 5 students were visually impaired. Unfortunately, no teachers were able to consistently observe or participate in our program, since it was their period of grading and then their summer vacation began. However, it was valuable to have our 2 assistants to help with translating and explaining the cultural or educational background of the students.

The children enjoyed the activities, especially the games and physically active or hands-on activities. We learned that many activities that are easy and fun for American children do not work well in Burkina Faso, such as Hangman and jigsaw puzzles. These activities are so foreign for Burkinabè children that they struggled to complete them. They were not able to connect words or numbers to images. In Hangman, they could not determine a missing letter of a common word. Also, having such a wide age-range and so many differences in ability among the students meant we had to split the children into groups and modify activities for each. We had
the most success using rotating centers, where children were grouped by age, so we could change the activity or difficulty of the activity for each age group.

It was difficult to fully assess the mathematical abilities of the students since every student was unique. Overall, I noticed students could perform rote calculations and most were able to memorize the multiplication table or simple formulas needed in math class. However, they struggled with word problems or activities where we asked them to apply their knowledge or think creatively. More specifically, they do not seem to have developed abstract thinking skills. All their education is done in a rote way that does not require any higher level thinking skills that are used in America. This probably accounts for the difficulty we heard students have on the CEP exam at the end of primary school or passing secondary school, for those who make it that far.

During the BSEP, I worked the most with the upper elementary-aged children, two of whom did not pass the exam at the end of primary school and will be repeating 6th grade. Thus, I decided the focus for my honors project would be on developing materials for this age range.
Mon Cahier des Mathématiques

Nom : ______________________
Prénom : ____________________
Année : _____________________
Overview

The second part of my project, developing a learning kit specifically designed for CM1 and CM2 students (5th – 6th grade) at the Center for the Advancement of the Handicapped (CAH) in Mahadaga, Burkina Faso, came about due to research on math education as well as my personal experiences and observations from working with children from the CAH in Summer 2010.

The topics I chose to focus on were topics that I found in the math curriculum for CM1 and CM2 that students at the CAH struggled with during our summer enrichment program.

1. Fractions, decimals and percents
2. Perimeter and area
3. Identifying geometric shapes and solids

My workbook targeted the three concepts above, as well as adding components of literacy and abstract thinking to the exercises and activities. For example, I added reflection questions to address the reading, writing and higher-level thinking weaknesses of Burkinabè students. The weak foundation these students have in literacy and the absence of books and images in Burkina Faso plays a role in weakening their mathematical ability.

The following pages outline the goals in math curricula for my topics (based on the French and Burkinabè systems) for these grade levels, research-supported teaching methodology, and modifications necessary to implement this in Burkina.
Research – Fractions, decimals, percents

Mathematical Standards:

The following are the French national math standards from CM1 and CM2 for fractions and decimals. (No math standards from Burkina Faso were found.)

FRACTIONS

1. Know and recognize simple fractions, such as: one-half, thirds, quarters, tenths and hundredths
2. Use these fractions for sharing and measuring
3. Write the whole numbers a fraction falls between
4. Represent a fraction as the sum of an integer and a fraction less than one
5. Add two decimal fractions (fractions with a denominator of 10, 100, 1000 etc.) or two simple fractions with the same denominator

DECIMALS

1. Perform calculations (using the 4 operations) with decimals
2. Know how to place decimals on a number line and compare/order decimals
3. Know the place values of decimals (tenths, hundredths, thousandths) and how to round to a given place value

(www.education.gouv.fr)

The workbook does not cover any of the specific competencies listed, other than #1 under fractions and some of #3 under decimals. This is for a few reasons. First, from what we have heard
from teachers or employees, the students at the CAH most likely do not know anything about fractions. Therefore, the part in this workbook about fractions is an introductory approach. Second, the children in Burkina Faso seemed to be able to use decimals to perform calculations (competency under decimals #1), so I am not focusing on that. Third, the goal of this part of the workbook is to show the connection between fractions, decimals and percents. Thus, the activities are focused more on a visual representation of fractions and transferring the understanding of tenths (and later hundredths) to decimals, and from hundredths to percents. As such, the children should hopefully develop an understanding of what decimals and percents are that they might not have known even if they were able to perform calculations using decimals or percents.

**Teaching Methodology:**

Elementary school teachers, both in France and the US, typically start teaching fractions and then move on to decimals. When teaching fractions, which is possibly the first time students use numbers that are not whole numbers, teachers should emphasize that whole numbers are not sufficient for calculating, describing or measuring everything. There are various ways to teach fractions, including area models, length models or bands, and parts of a set. (Van de Walle) Regardless, teachers should introduce the fact that fractions are part of a whole and that these parts are the result of dividing the whole/unit into parts of equal area. Eventually students should be able to link fractions to the division operation. (Van de Walle) Fractions also lead to the study of decimals, as the French lesson plan suggests, through the study of fractions whose denominators are 10 or 100. (Équipe des Conseillers)

The progression for teaching fractions and decimals generally follows the following format:

1. Recognize and understand fractions
2. Develop fractions of various denominators, including 10 and 100
3. Use fractions with a denominator of 10 or 100 to develop concept of decimals
4. Compare and perform calculations with decimals
5. Link fractions and decimals: write and read fractions and decimals in various forms
6. Introduce percentages – via fractions with denominator 100 or hundredths (decimals)

(Équipe des Conseillers)

Modification:

Given the research I have conducted and what I experienced, the following points are modifications I took into account for the students at the CAH when creating the activities in the workbook:

- Their ability to perform calculations with decimals is satisfactory, but their understanding of the connection between fractions and decimals is probably nonexistent.
- The school at the CAH in Mahadaga apparently does not cover fractions, so a basic approach to fractions will be taken.
- From the summer enrichment program in summer 2010, I noticed that 3 girls who were in CM2 were possibly familiar with the vocabulary ‘half’ and ‘double’ but were not really able to calculate half or the double of a given number, showing their lack of understanding of fractions or relevant vocabulary.

In this section of the project, I seek to propose activities that would be of an appropriate level for children in CM1 or CM2 in Burkina that would help develop their understanding of fractions, decimals and percentages. I hope to make possible a mathematical connection between these three related concepts, knowing this might require more abstract thinking than they traditionally use in math classes. I believe the implementation of these activities will help prepare students for their final exam as well as give them tools necessary for math and life in the future.
Activities:

- **Intro to Fractions**:
  1. Folding and coloring equal parts of paper (including vocab: half, third, quarter, tenth)
  2. Linking pictures and fractions (writing and coloring) – 2 pgs
  3. ACTIVITY: measuring cups and fractions
  4. Matching activity (review shapes and fractions)

- **Decimals**:
  5. Fraction/decimal connection - tenths
  6. Fraction/decimal connection - hundredths
  7. Fraction-decimal-words-picture connection
  8. Writing numbers (transforming fractions to decimals and vice versa)

- **Percents**:
  9. Intro to percentages (coloring out of 100) – 2 pgs
  10. Representation of percentages (concrete activity)
  11. Percent-fraction-decimal
  12. Percents at school (word problem)

- **Game**: Memory (cards involving fractions and decimals – vocabulary and pictures to match)
Research – Perimeter and Area

Math standards:

The following are the French national math standards from CM1 and CM2 for perimeter and area. (No math standards from Burkina Faso were found.)

AREA
1. Compare surfaces according to their area
2. Learn normal units of area and conversions between units (cm$^2$, m$^2$, km$^2$)
3. Know the formulas for the area of a square, rectangle and triangle
4. Measure or estimate the area of a surface using a scale or graph paper

PERIMETER
1. Calculate (using the formulas) the perimeter of a square, rectangle and triangle
2. Calculate the perimeter of a polygon
   (posted by Eysseric)

The competencies that are covered in this part of my workbook are #1, 3 and 4 under area and #2 under perimeter. They will be calculating the perimeter and area of various shapes and surfaces using graph paper and later using the formulas for area of a square, rectangle and triangle. I will also be having them try to estimate which shape has a bigger area, as well as constructing shapes of a given area or perimeter – to show that a fixed perimeter does not imply one set area, and vice versa. (See the list of activities on the following page.)
Teaching Methodology:

Area and perimeter are related concepts that students often confuse, so it is necessary for students to have a strong background in each. Once students have mastered both concepts, activities that show how one fixed area can be represented by different shapes (with different perimeters), or that there can be shapes with the same perimeter that have different sizes (different areas) are valuable. The concept of perimeter is not difficult and does not require any formulas, so I focused on area – and only included 2 short activities about perimeter to make sure students were reminded of the concept before dealing with area.

Progression for teaching area:
To show the similarity between French and American math education resources, here is the progression from a French source, followed by an American source.

From a French teacher training document:
- Discovery of area by covering a surface
- Comparing sizes of surfaces (mentally), including by cutting/rearranging
- Using graph paper to understand and calculate the area of surfaces
- Formula for area of rectangles
- Calculating area and perimeter (and understanding the difference) – rectangles
- Different units of measurement and conversions between them (i.e. m\(^2\) and km\(^2\))
  (Eysseric)

From an American elementary math education teacher-training book:
- Understand meaning of area before measuring (376)
• “Area is measured by covering” – measure area before giving them formulas (379)

• Covering a shape with squares in rows that can be counted using multiplication

• Development of formulas for area of rectangle/square (measure # of squares needed along each side without filling them all in)

• Generalize formula for rectangle to other parallelograms

• Modify formula for parallelogram to formula for triangle (fold parallelogram in half – or show that a triangle is half a parallelogram)

(Van de Walle)

Modification:

Given the research I have conducted and what I experienced, the following points are modifications I took into account for the students at the CAH when creating the activities in the workbook:

• Less emphasis will be placed on being able to understand the formulas for area, since this would be too abstract and they are good at memorizing and using formulas. However there will be activities that show the meaning of area and perimeter.

• We will stick to squares, rectangles and triangles since those are the only shapes mentioned in the French curriculum (although one African CM math book had several other shapes). Since the Burkinabè information did not mention area and perimeter, I deferred to the French curriculum.

• The focus is almost exclusively on area, since this is more complicated to calculate and understand than perimeter. I will try to establish a clear difference between area and
perimeter and have them explore these two concepts to deepen their visualization, geometric reasoning and abstract math skills.

- Various activities will try to stretch their understanding of the concepts of area and perimeter, by asking questions that require thinking and making guesses, rather than just calculating the area and perimeter.

- There are a few activities that involve drawing, or constructing shapes, because that is a familiar and enjoyable activity for all Burkinabè children. However, I added a new aspect and asked them questions about the drawing or asked for them to draw specific-sized shapes to require thinking and understanding the concept of area.

**Activities:**

**Perimeter:**
1. Perimeter: calculate by measuring and adding sides of shapes
2. **ACTIVITY:** string = fixed perimeter for various shapes

**Area:**
1. **ACTIVITY:** understand area by a concrete representation (covering surfaces)
2. Perimeter vs. Area: comparing and visual understanding of size
3. Area: visualizing/counting squares
4. Area: squares and rectangles
5. Area: triangles
6. **ACTIVITY:** fixed perimeter, different area
7. Consolidation: drawing activity using these shapes and calculating the area
8. Consolidation: drawing shapes of a given area
9. Consolidation: a few word problems
Conclusion and Analysis

My goal was to create a math resource that the Collaboratory Education group could use in the summer 2011 that is appropriate in mathematics content, as well as culturally appropriate. I created a workbook with 35 activities and supplementary materials that was based on research on the French and Burkinabè math standards and personal experience in Burkina Faso working with students at the CAH.

The mathematics content in the workbook addresses the weaknesses I identified – fractions, decimals, percents, perimeter, area and geometric shapes and solids. The workbook corresponds to the French math curriculum, with an added emphasis on the relationship between fractions, decimals and percents. The workbook was divided into three parts:

1. Fractions, decimals and percents
2. Area and perimeter
3. General thinking skills

The third part has a wide range of activities, several each focusing on spatial sense, identifying geometric shapes and solids, and algebraic thinking. Since identifying shapes and solids is not a large category, I included it as a smaller topic with the other activities at the end of the workbook. Also, the workbook already had nearly enough activities, given the length of the program in Burkina Faso.

Some of the other activities in the third part, the geometric construction and coloring activities, are designed to be a fun activity for the students as well as an activity that is familiar to them yet can also enhance their spatial sense. Finally, the numerical puzzles in this section were added as one way to try to promote algebraic thinking. Algebraic thinking is somewhat the opposite of rote memorization, so I thought it would be a good challenge for students who are not used to thinking in that way. There was not enough time or space to devote to more algebraic thinking activities,
although this could be a potential way to improve the resource for future work with the students at the CAH.

The workbook also approached the students’ lack of abstract thinking and literacy skills in a general way. The two main parts of the workbook had a summary at the end where the students need to write (tie in literacy), numerous activities where the students need to be creative and create something that is not specifically stated (promotes true thinking not just rote calculations), and several activities with questions for reflection that promote abstract thought and made students explain their answer through writing.

This project will need to be modified based on feedback from the Summer 2011 site team that implements it during the summer enrichment program. Even after all my research and time in Burkina Faso, the scope, depth and specific activities of the project could be improved. Having more information about the Burkinabè math curriculum in CM1 and CM2, the level of the students participating in the program or other demands from the teachers at the CAH, would provide a stronger foundation for a math resource that benefits the students at the CAH as it is designed to do.
References:


Mon Cahier des Mathématiques

Nom : ____________________________________________
Prénom : _________________________________________
Année : ___________________________________________
Liste des activités :

**PARTIE 1 : Les fractions, les nombres décimaux et les pourcentages**

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<td>Surface : Le carré et le rectangle</td>
<td>27</td>
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<td>20</td>
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<td>21</td>
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<tr>
<td>22</td>
<td>Dessiner et calculer la surface</td>
<td>30</td>
</tr>
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<td>23</td>
<td>Construction d’une figure</td>
<td>32</td>
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<tr>
<td>24</td>
<td>Surface : Des problèmes</td>
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</table>

**PARTIE 3 : Autres activités**

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</thead>
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<td>Construction 1</td>
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<td>26</td>
<td>Construction 2</td>
<td>39</td>
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<td>No.</td>
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<td>35</td>
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<td>50</td>
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</tbody>
</table>
PARTIE 1 :

Les fractions, les nombres décimaux et les pourcentages
(1) Les fractions : Plier et découvrir

Fais les pliages indiqués avec ton papier. Puis, dessine comment tu as plié ton papier.

1. 2 parties égales

2. 4 parties égales

Une moitié =
Un des 2 parties égales

Un quart =
Un des 4 parties égales

3. 3 parties égales

4. 10 parties égales

Un tiers =
Un des 3 parties égales

Un dixième =
Un des 10 parties égales

Les fractions sont les nombres qui décrivent les parties d’un entier. Les parties ont toujours la même taille.

Écris les nouveaux mots de vocabulaire : __________________________

__________________________________________________________

__________________________________________________________
(2) Les fractions : Colorier et découvrir – Partie 1

Colorie une moitié de cette forme :

![Image of a diamond divided into two parts]

**Je divise la forme en ___ parties.**

**Je colorie ___ partie(s).**

Colorie un tiers de cette forme :

![Image of a square divided into three parts]

Colorie deux tiers de cette forme :

![Image of a square divided into four parts]

Comment écrire des fractions ?

Une moitié = \( \frac{1}{2} \)

Le numéro en haut est le nombre de parties coloriées.

Un quart = \( \frac{1}{4} \)

Le numéro en bas est le nombre de parties en total.

Écris la fraction qui correspond à la partie coloriée :

![Image of a pie chart with colored sections]
(3) Les fractions : Colorier et découvrir – Partie 2

Indique sous chaque carrée la fraction qui correspond à la partie coloriée.

Colorie la partie qui correspond à la fraction écrit sous chaque carrée.
(4) Activité : Mesurer et découvrir les fractions

Aux Etats-Unis, il y a des « tasses » pour mesurer les quantités pour la cuisine. Les tasses ont des tailles différentes :

Quelle tasse est la plus grande ? _____
Quelle tasse est la plus petite ? ______
Écris les tasses en ordre décroissant (plus grande au plus petite) :
____________________________

Complète le tableau. Écris le nom de l’objet que tu vas remplir. Puis, utilise une tasse pour remplir l’objet. Écris combien de tasses sont nécessaires.

<table>
<thead>
<tr>
<th>Taille de Tasse :</th>
<th>Objet 1 =</th>
<th>Objet 2 =</th>
<th>Objet 3 =</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/4</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Combien de tasses $\frac{1}{2}$ sont nécessaires pour remplir l’objet 1 ? ____
Combien de tasses de taille 1 sont nécessaires pour remplir l’objet 3 ? __
Combien de tasses $\frac{1}{3}$ sont nécessaires pour remplir l’objet 2 ? _____
Combien de tasses $\frac{1}{4}$ sont nécessaires pour remplir l’objet 1 ? ______
**Vrai ou faux ?**

1. 2 tasses $\frac{1}{2}$ font la même quantité qu’une tasse 1. (Est-ce que 2 tasses $\frac{1}{2}$ remplissent une tasse 1 ?) ________

2. 3 tasses $\frac{1}{3}$ font la même quantité qu’une tasse 1. (Est-ce que 3 tasses $\frac{1}{3}$ remplissent une tasse 1 ?) ________

3. 5 tasses $\frac{1}{4}$ font la même quantité qu’une tasse 1. (Est-ce que 5 tasses $\frac{1}{4}$ remplissent une tasse 1 ?) ________

**Le Vocabulaire**

Te souviens-tu du vocabulaire pour les fractions ? Écris le nom de chaque tasse selon sa taille (utilise les mots de vocabulaire dans la boîte).

<table>
<thead>
<tr>
<th>un entier</th>
<th>un tiers</th>
<th>un quart</th>
<th>une moitié</th>
</tr>
</thead>
</table>

1 (unité)  $\frac{1}{2}$  $\frac{1}{3}$  $\frac{1}{4}$
(5) Révision : Les fractions

Relie la fraction avec l’image qui correspond.
(6) La fraction décimale : Une introduction

Quelle partie de la bande est colorée ? Écris la fraction et en mots (le nombre de dixièmes).

Modèle :  

\[
\begin{array}{ccc}
\hline
\text{Dizaine} & \text{Unité} & \text{Dixième} \\
\hline
10 & 1 & \frac{1}{10} \\
\hline
\end{array}
\]

\[
\frac{5}{10} = 5 \text{ dixièmes}
\]

(la bande est divisée en 10 parties égales et 5 sont colorées)

Les fractions sont aussi écrites comme des nombres décimaux (des nombres avec une virgule). Les fractions décimales sont les fractions qui sont facilement transformées en écriture décimale.

Modèle : \( \frac{5}{10} = 0,5 \)
parce que c’est 5 dixièmes

Écris les fractions en écriture décimale et colorie les cases.

\[
\begin{array}{ccc}
3 \frac{7}{10} = \frac{37}{10} & \frac{2}{10} = \frac{2}{10} \\
7 \frac{8}{10} = \frac{78}{10} \\
\end{array}
\]
(7) La fraction décimale : Les centièmes

<table>
<thead>
<tr>
<th>Dizaine</th>
<th>Unité</th>
<th>,</th>
<th>Dixième</th>
<th>Centième</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>1</td>
<td>,</td>
<td>1/10</td>
<td>1/100</td>
</tr>
</tbody>
</table>

Les centièmes sont les deux nombres après la virgule. (0,7)

Les dixièmes sont le premier nombre juste après la virgule. (0,7)

Les centièmes sont les deux nombres après la virgule. (0,64)

Les centièmes sont les fractions avec 100 en bas (ex. \(\frac{22}{100}\) ou \(\frac{4}{100}\)).

Écris les nombres comme une fraction, un nombre décimal, et aussi en mots.

Modèle : \(\frac{9}{100} = 0,09\) (9 centièmes)

Modèle : \(0,42 = \frac{42}{100}\) (42 centièmes) ou \(\frac{4}{10} + \frac{2}{100}\) (4 dixièmes et 2 centièmes)

1. \(\frac{4}{100} = 0,\ldots = \ldots\) centièmes
2. \(0,07 = \ldots = \ldots\) centièmes
3. \(\frac{58}{100} = 0,\ldots = \ldots\) centièmes = \ldots dixièmes et \ldots centièmes
4. \(0,96 = \ldots = \ldots\) centièmes = \ldots dixièmes et \ldots centièmes
(8) Révision : Les fractions décimales

Utilise la bande de dixièmes et le quadrillage de centièmes pour cet exercice.

Complète le tableau.

<table>
<thead>
<tr>
<th>Nombre de dixièmes ou centièmes</th>
<th>Fraction</th>
<th>Nombre décimal</th>
<th>Colorie</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>8/10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>12 centièmes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>0,6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Écris le nombre décimal et la fraction qui correspond à l’image.

1. Décimal : _______________

   Fraction : _______________

2. Décimal : _______________

   Fraction : _______________

3. Décimal : _______________

   Fraction : _______________
(9) L’écriture des nombres : Fraction et décimale

Écris les nombres suivants en forme décimale dans le tableau.

Modèle : \(14 + \frac{2}{10}\) (ou \(10 + 4 + \frac{2}{10}\)) = 14,2 (vois le tableau)

1. \(500 + 30 + 8 + \frac{6}{10} + \frac{3}{100}\) (ou \(538 + \frac{6}{10} + \frac{3}{100}\))
2. \(82 + \frac{9}{100}\)
3. \(104 + \frac{5}{10} + \frac{3}{100}\)

<table>
<thead>
<tr>
<th>Centaine</th>
<th>Dizaine</th>
<th>Unité</th>
<th>,</th>
<th>Dizième</th>
<th>Centième</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>10</td>
<td>1</td>
<td>,</td>
<td>(\frac{1}{10})</td>
<td>(\frac{1}{100})</td>
</tr>
<tr>
<td>Modèle</td>
<td>1</td>
<td>4</td>
<td>,</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Écris les nombres suivants comme une somme des fractions.

Modèle : \(5,42 = 5 + \frac{4}{10} + \frac{2}{100}\) (ou \(5 + \frac{42}{100}\))

1. \(12,8 = \quad \)
3. \(0,74 = \quad \)
2. \(4,06 = \quad \)
4. \(1,50 = \quad \)
(10) Les pourcentages : Une introduction

Les pourcentages sont les nombres suivis par %. Ces nombres sont toujours une partie du 100 (une fraction avec 100 en bas).

$$\text{Exemple} : 84\% = \frac{84}{100}$$

Il y a 100 cases dans ce quadrillage. Colorie 14\% des cases. (Je colorie _____ cases.)
(11) Les pourcentages : Une représentation

Colorie le nombre de cases qui représente les pourcentages suivants.

1. 6%
   (Je colorie ___ cases.)

2. 18%
   (Je colorie ___ cases.)
(12) Les pourcentages, les fractions et les nombres décimaux

Te souviens-tu comment écrire les nombres décimaux à partir des fractions avec 100 en bas ?

Modèle : \( \frac{32}{100} = 0,32 \) et \( \frac{7}{100} = 0,07 \)

**Complète le tableau.**

Modèle : 57\% = \( \frac{57}{100} = 0,57 \)

<table>
<thead>
<tr>
<th>Pourcentage</th>
<th>Fraction</th>
<th>Nombre Décimal</th>
</tr>
</thead>
<tbody>
<tr>
<td>91%</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>( \frac{60}{100} )</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0,25</td>
<td></td>
</tr>
<tr>
<td>9%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Quel pourcentage représente une quantité plus grande : 9\% ou 60\% ?

__________

Quel nombre décimal est plus grand : 0,23 ou 0,07 ?

__________
(13) Les pourcentages à l’école : Un problème

Imagine que la classe CP2 a 100 élèves. Il y a 41 filles.

Il y a combien de garçons ? _________________________

Quelle est la fraction de filles dans la classe ? __________

Quelle est la fraction de garçons ? __________

Ecris la fraction de filles comme un nombre décimal __________
et un pourcentage __________

Ecris la fraction de garçons comme un nombre décimal __________
et un pourcentage __________

Est-ce que le nombre décimal des filles ou des garçons est plus grand ? ________________________________

Si le pourcentage des garçons dans la classe de CE1 est 64%, et il y a 100 élèves dans cette classe, il y a combien de garçons dans la classe ? ________________
Sommaire : Les fractions, les nombres décimaux, et les pourcentages

<table>
<thead>
<tr>
<th>une fraction</th>
<th>un centième</th>
<th>un quart</th>
<th>un pourcentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>une moitié</td>
<td>un dixième</td>
<td>un tiers</td>
<td>un nombre décimal</td>
</tr>
</tbody>
</table>

Écris une définition pour 3 mots de vocabulaire dans cette partie. Tu peux choisir les mots de vocabulaire ou tu peux utiliser des exemples dans la boîte.

1. ______________________________________________
   ______________________________________________
   ______________________________________________

2. ______________________________________________
   ______________________________________________
   ______________________________________________

3. ______________________________________________
   ______________________________________________
   ______________________________________________
PARTIE 2 :

Le périmètre et la surface
(14) Calculer le périmètre

Le périmètre d’une forme est la mesure de distance autour de la forme.

Pour calculer le périmètre, il faut trouver la somme de toutes les côtés de la forme.
(Quelle opération ? L’addition.)

Le périmètre est :
\[ 5 + 9 + 5 + 9 = 28 \text{m} \]

Utilise une règle pour mesurer les côtés. Puis, calcule le périmètre.

1.  
2.  

\[ \text{périmètre} = \underline{\hspace{2cm}} \quad \text{périmètre} = \underline{\hspace{2cm}} \]

3. Le périmètre du rectangle est ____________________
(15) Périmètre : Une activité de mesure

   Quel est son périmètre ? _________

2. Construis un carré avec la ficelle. Dessine le carré ici.
   Quel est son périmètre ? ______________
   Quel est son périmètre ? ______________

Est-ce que le périmètre de chaque forme est égal ? Pourquoi ?

_______________________________________

_______________________________________

_______________________________________

_______________________________________

_______________________________________
(16) Surface : Une activité pour découvrir

Choisis un objet qui est un rectangle ou un carré. Est-ce que ton objet est grand ou petit ou moyenne ?

Mets des cailloux sur ton objet pour couvrir l’objet. Combien de cailloux sont nécessaires pour couvrir l’objet ?

Répète l’activité avec autres objets. Complète le tableau :

<table>
<thead>
<tr>
<th>Nom de l’objet</th>
<th>Grand ou petit ?</th>
<th>Combien de cailloux ?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Après avoir couvert 4 objets, réponds aux questions suivantes :

Quel objet est le plus grand ?

Quel objet est le plus petit ?

Comment sais-tu quel est plus grand ou petit ?
(17) Surface et périmètre : Une comparaison

**La surface** est l’espace dans une forme ou un objet.

![Image of a square with labeled surface]

**Le périmètre** est la distance autour d’une forme ou un objet.

![Image of a rectangle with labeled perimeter]

**Colorie la SURFACE du triangle. Trace le PERIMETRE de toutes les formes avec 4 côtés.**

![Images of various shapes with labeled perimeter]

**Encercle la forme avec la surface la plus petite. Colorie la forme avec la surface la plus grande.**

![Images of various shapes with labeled areas]
(18) Surface : Compter et Découvrir

Si une unité = □

Surface de A = 25 unités$^2$
Surface de B = 27 unités$^2$

(Compte le nombre de cases dans chaque figure pour trouver la surface.)

Calcule la surface de chaque figure, avec l’aide du quadrillage.

<table>
<thead>
<tr>
<th>Figure</th>
<th>Surface (unités$^2$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td></td>
</tr>
</tbody>
</table>

Écris les figures en ordre croissant : _____, _____, _____, _____, _____

Trace sur le quadrillage des figures correspondant à ces surfaces :

| A = 16 unités$^2$ | B = 10 unités$^2$ | C = 9 unités$^2$ |
(19) Surface : Le carré et le rectangle

**Formules** :
- la surface d’un carré = ________________
- la surface d’un rectangle = ________________

Écris le mesure de chaque côté des figures suivantes. Puis, calcule la surface et le périmètre et complète le tableau.

**Formules** :
- la surface d’un carré = ________________
- la surface d’un rectangle = ________________

<table>
<thead>
<tr>
<th>Périmètre (cm)</th>
<th>Surface (cm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td></td>
</tr>
</tbody>
</table>

Quelle figure est la plus grande ?
________________________

Pourquoi ? ____________________________________________

____________________________________________________
(20) Surface : Le triangle

La surface d’un rectangle est _______ fois ________.

Dans le rectangle ABCD, il y a deux triangles : ABD et BCD. Colorie triangle ABD. Puisque les deux triangles couvrent le rectangle, la surface d’un triangle est la moitié du rectangle.

Formule :
La surface d’un triangle = h

Calcule la surface des triangles.

Avant de calculer… complète les phrases :
   Je crois que le triangle ____ est le plus petit.
   Je crois que le triangle ____ est le plus grand.

Avais-tu raison? Quel triangle est le plus petit? ____ Le plus grand? ____
(21) Activité : Des surfaces différentes

Prends une ficelle et construis un rectangle. Essaie de faire un rectangle le plus grand que possible.

1. Dessine le rectangle ici. Quelle est sa surface ? __________

2. Fais un autre rectangle et dessine-le. Quelle est sa surface ? ______

3. Penses-tu que c’est possible de faire un rectangle plus grand que les deux rectangles que tu as fait ? Explique.
  
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
(22) Dessiner et calculer la surface

Tu peux dessiner ! Dessine une personne ou une maison en utilisant les formes : carré, rectangle ou triangle. Après que tu dessines, tu vas calculer la surface de ton dessin.
**Calculer la surface:**

D’abord, écris une lettre (A, B, C…) dans chaque forme dans ton dessin.

**Les rectangles** : *Indique la lettre de chaque rectangle et calcule sa surface.*

**Les carrés** : *Indique la lettre de chaque carré et calcule sa surface.*

**Les triangles** : *Indique la lettre de chaque triangle et calcule sa surface.*

**La surface totale** : *Ajoute la surface de chaque forme.*

La surface totale de mon dessin est ____________.
(23) Construction d’une figure

Formules :  
la surface d’un carré = ________________________
la surface d’un rectangle = ________________________
la surface d’un triangle = ________________________

1. Construis une figure avec une surface de 16 cm$^2$. Dessine-le ici.

2. Construis une autre figure avec une surface de 16 cm$^2$.

3. Les figures ont-elles le même périmètre ? ______________
(24) Surface et périmètre : Des problèmes – Partie 1

1. Un terrain de football a une surface de 4635 m² et une largeur de 45 mètres. Quelle est sa longueur ? ________

2. Une salle de classe a une longueur de 30 mètres. Sa largeur est la moitié de sa longueur.
   a. Quelle est sa longueur ? ________
   b. Quelle est sa surface ? ________
   c. Quel est son périmètre ? ________
Surface et Périmètre : Des problèmes – Partie 2

3. Un champ rectangulaire mesure 80m de long pour 35m de large. On décide de le partager en plusieurs jardins de 140m².
   a. Quelle est la surface du champ rectangulaire ? ____________
   b. Combien de jardins de 140m² peut-on faire ? ______________

4. Youmanli a une maison carrée avec des côtés de 8m. Martine a une maison rectangulaire 12m de long pour 5m de large. Qui a une maison plus grande ? ______________
Sommaire : Le périmètre et la surface

1. Écris 3 formules que tu as utilisées dans cette partie du cahier.

_____________________________________

_____________________________________

_____________________________________

2. Écris deux nouvelles choses que tu as apprises sur le périmètre et la surface. (Ou tu peux expliquer la différence entre le périmètre et la surface.)

___________________________________________________

___________________________________________________

___________________________________________________

___________________________________________________

___________________________________________________

___________________________________________________
PARTIE 3 :

Autres Activités
## (25) Construction 1

Suis le programme de construction et reproduis cette figure :

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1.</strong> Trace un carré de 16 cm de côté.</td>
<td><strong>2.</strong> Partage le carré en 4 en traçant ses 2 médianes.</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>3.</strong> Repartage en 4 les 4 carrés en traçant les 4 médianes.</td>
<td><strong>4.</strong> Trace toutes les diagonales dans un sens.</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>5.</strong> Trace les diagonales dans l’autre sens.</td>
<td><strong>6.</strong> Colorie.</td>
</tr>
</tbody>
</table>
(26) Construction 2

Reproduis les figures suivantes.
(27) Construction 3

Reproduis les figures suivantes.
Écris le mot pour chaque image. Tu peux trouver tous les mots de vocabulaire dans la boîte.

<table>
<thead>
<tr>
<th>le carré</th>
<th>le cercle</th>
<th>le losange</th>
<th>le parallélogramme</th>
</tr>
</thead>
<tbody>
<tr>
<td>le rectangle</td>
<td>le trapèze</td>
<td>le losange</td>
<td>le triangle</td>
</tr>
</tbody>
</table>

---

---
(29) Solides géométriques : Vocabulaire

Écris le mot pour chaque image. Tu peux trouver tous les mots de vocabulaire dans la boîte.

<table>
<thead>
<tr>
<th>le cube</th>
<th>le cylindre</th>
<th>le pavé</th>
<th>le pyramide</th>
</tr>
</thead>
</table>

[Diagram of a cube, a pyramid, a cuboid, and a cylinder]
(30) Révision : Formes et solides géométriques

Écris le mot (une forme ou solide géométrique) dans les cases qui décris la figure ou la phrase. Puis, écris les lettres qui sont dans les cases numérotées en bas de la page, dans les cases correspondantes.
(31) Jeu de nombres


- 1, 3, 5, 7, 9, ? → ?=11

- 32, 16, 8, 4, 2, ? → ?=

- 70, 61, 52, 43, ?, ? → ?=

- 3, 6, 12, 24, ? → ?=
Jeu de nombres – Partie 2

C’est à toi ! Crée tes propres lignes avec une opération inconnue. Puis, donne tes lignes à un(e) ami(e) pour compléter.
(32) Jeu de Pyramide

Complète la pyramide. L’opération est addition, alors ajoute deux cercles et mets leur somme dans le cercle en haut.

Modèle :
Pour ce jeu, tu vas essayer à trouver le numéro qui va dans chaque flèche. Utilise les indices pour trouver les numéros manquants. L’opération est toujours l’addition. (Les indices sont dans les boîtes colorées: la somme de 3 flèches ensemble = 9 et 2 flèches à côté = 4).

Finis le jeu toi-même.
Jeu de flèches – Partie 2

C’est le même jeu, mais les indices sont différentes. Complète toutes les flèches.
(34) Des images mathématiques

Trouve le numéro manquant dans le dessin. Regarde le total et l’opération (+ signifie l’addition, x signifie la multiplication).

Total (+) = 28
7 ?
5 13

? = ____

Total (x) = 60
2 5
3 1

? = ____
(35) Coloriage : Des formes géométriques

Colorie les images et réponds à la question.

Quelles formes géométriques vois-tu dans ces images ?

1. _______________

2. _______________

3. _______________
Colorie cette image.

Décris ce que tu vois dans l’image.
C’est une image de quoi ?

________________________________

________________________________

________________________________

________________________________

________________________________

________________________________

________________________________

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