TASK 5.- MEASURING AND SAVING WATER

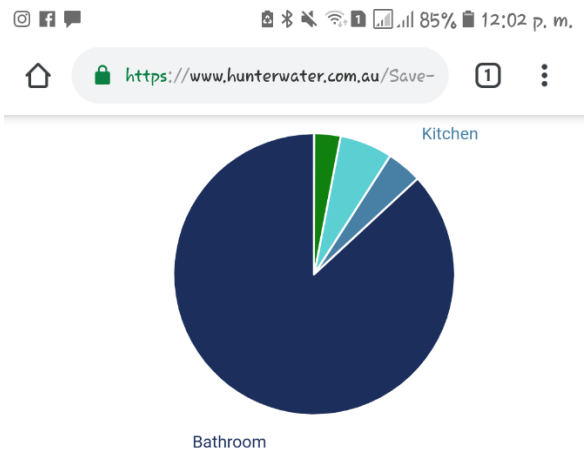
We worked on this task with students from 3rd ESO (14 to 15 years old) in the subject Mathematics oriented for academic studies.

A) Measure the amount of water you use at home with the "calculator" you will find in this link: https://www.hunterwater.com.au/Save-Water/Water-Usage-Calculator.aspx

With the help of our Language assistant, the students from 3rd ESO-A spent two sessions using this application on their mobile phones, and commenting their results among them. As it comes from a website in Australia, some of the situations previously established did not sound familiar to them, so it required further explanation to them.

B) Save your results and email them to your teacher.

Their final results are displayed in a table with six different categories as well as its corresponding pie-chart:



	Your Usage (%)	Your Usage (kL)	Typical Customer Usage (kL)
Bathroom	86%	398	88
Kitchen	4%	20	12
Laundry	6%	29	30
Lawn / Garden	0%	0	32
Pool	0%	0	0
Car / Boat	3%	16	12
Total	100%	462	174

18 students sent me their results, and then I sent them back to a couple of them who decided to elaborate a summary of the data in this table:

	Bathroom (%)	Kitchen (%)	Laundry (%)	Lawn / Garden (%)	Pool (%)	Car / Boat (%)	Total (KL) per year
Kevin	58	12	2	22	6	0	276
Inna	81	9	5	2	0	3	306
Víctor	86	1	3	4	2	4	438
Maya	76	2	0	22	0	0	347
Yamil	88	3	3	0	0	6	279
Rosi	73	4	19	0	0	4	208
Laura	78	1	9	0	4	8	402
Bea	62	6	8	1	19	4	364
Álvaro	63	12	11	9	0	5	302
Patricia	88	2	7	3	0	0	189
Agus	59	6	14	4	0	17	359
Alex	85	1	6	5	0	3	869
Sebas	93	1	4	1	0	1	1141
Juanjo	90	2	4	0	0	4	441
Esperanza	89	2	1	1	0	7	906
Jonás	91	0	4	0	0	5	646
Pablo	78	12	10	0	0	0	147
Alexander	87	4	6	0	0	3	462

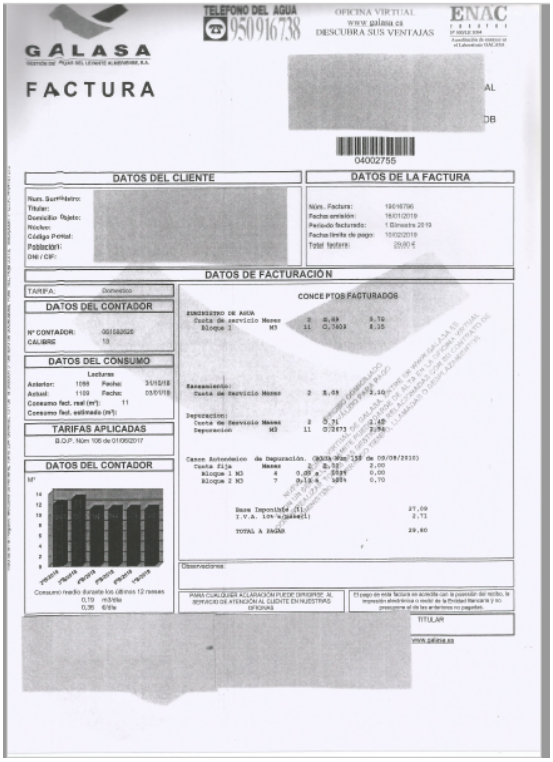
Besides that, they indicated the most relevant results they found:

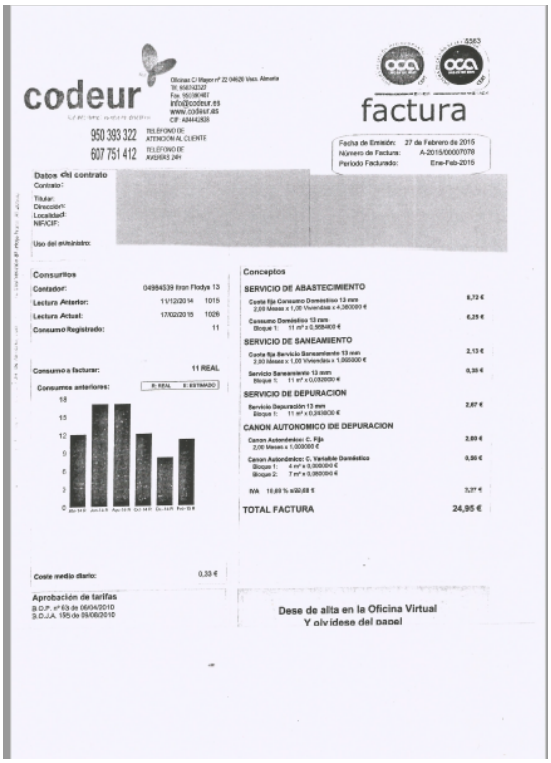
- Minority use: Pool (1.82%)
- Majority use: Bathroom (83.82%)
- Family with greatest use: Sebastián (1141 KL)

Once reached this point, some of the students' results must be clarified or even questioned in a certain way. Although the website provides an average consumption figure of 174, these results do not correspond to the reality of our country and our region, where climatic, culture and hygienical factors have traditionally led our people to perform personal grooming more frequently than in other countries, thus causing more water consumption. Therefore it is assumed an average consumption of between 250 and 350 litres per inhabitant per day in our area. This would mean an average annual consumption of more than 500 KL per year, considering 4 inhabitants per home. Consequently, the final figures of 869, 906 or 1141 of some students may be derived from misunderstandings in some of the questions, which have caused these anomalous results.

C) Interpreting a water bill:

The students had to work in pairs or groups of three. They were given one water bill from CODEUR (The water company that provides the service in Vera, where most of students come from) and other from GALASA (the company that supplies in Garrucha, Cuevas del Almanzora, Los Gallardos and Mojácar, where some of the students live).





They had to find and write down similarities and differences between them. This is what they found:

SIMILARITIES	DIFFERENCES
Both companies: - Consider the water consumption in a month as a variable. - Invoice for periods of two months - Have three different concepts to be invoiced: abastecimiento (drinkable water), saneamiento (sewerage) and depuración (treatment - purifying system). - They include some fixed concepts to be invoiced no matter there was a water consumption or not: Cuota fija (fixed fee) and Canon autonómico (regional fee). - They have a step system or billing block system in the Canon Autonómico. According to it, you don´t have to pay anything for the first 4 m^3. Besides that, it turns out that both bills had exactly the same water consumption, 11 m3	- The fixed water supply fee is 4,89 €/month in GALASA and 4,36 €/month in CODEUR - The fixed water supply fee is 0,7409 €/m^3 in GALASA and 0,5684 €/m^3 in CODEUR - The fixed sewerage service fee is 1,05 €/month in GALASA and 1,065 €/month in CODEUR - CODEUR considers a variable term to be billed in the sewerage water, 0,243 €/m^3 , whereas GALASA does not consider it. - According to treatment or purifying water, when exceeding 4 m^3 the established fee is 0,10 €/m^3 in GALASA and 0,08 €/m^3 in CODEUR Even though the water consumption was the same, 11 m3, the final amount to pay was 24,95€ in CODEUR and 29,80€ in GALASA

Later, as we were dealing with the Unit *Polynomials* in class, students were asked to identify the variable in a formula that can be established to calculate how much a family must pay in each of those bills. Once done that, they had to write down the formula or algebraic expression that allows us to work out how much we have to pay according to the water consumption made.

Considering a two-month billing period, the results were:

CODEUR:

Variable: x = Consumo a facturar m^3 (Consumption to be invoiced, in cubic meters)

Algebraic expression:

$$C((x) = [2 \cdot 4.36 + 0.5684x + 2 \cdot 1{,}065 + 0{,}032x + 0{,}243x + 2 + 0{,}08(x - 4)] \cdot 1{,}1$$

Result expressed in euros (€)

GALASA:

Variable: x = Consumo fact. Real m^3 (Actual consumption for billing, in cubic meters)

Algebraic expression:

$$C((x) = [2 \cdot 4.89 + 0.7409x + 2 \cdot 1{,}05 + 2 \cdot 0{,}71 + 0{,}2673x + 0{,}1(x - 4)] \cdot 1{,}1$$

Result expressed in euros (€)

FINAL COMMENTS

The students were highly motivated and involved in these activities. They were surprised not only for the different uses domestic water has nowadays, but also the necessary treatments and processes involved to supply drinkable water to our homes, and to carry, filter and purify it once used, and how water companies have to bill for those services.

Most of them expressed that this was the first time ever that they analyzed a bill, and it was very interesting as they now appreciate the value of water besides its cost.