

SUCH A GOOD MOVE!

A project about sustainable mobility

2 ESO – STEAM

STUDENT GUIDE

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0. INTRODUCTION

You are about to participate in SUCH A GOOD MOVE! This project will last all quarter and we will work on many aspects related to sustainable mobility.

Here are the main objectives of the project:

(O1) Become aware of the importance of building more sustainable cities and communities, paying special attention to mobility.

(O2) Make proposals to improve air quality and reduce air and noise pollution, in order to reduce health problems and take care of the environment.

(O3) Carry out research related to school mobility and look for more sustainable solutions.

(O4) Create dissemination videos of the project to increase its impact on the community.

All the activities in this Student Guide have to be developed in your STEAM notebook.

In order to provide your grade for this project, we will assess the final video of the project and all the activities developed in your STEAM notebook.

1. WHAT DO YOU KNOW ABOUT TRANSPORTATION?

Brainstorm and fill in the table for each of the following areas related to transportation:

1. What are the different ways we *use* transportation?(e.g. get to school)
2. What are the different *modes* of transportation? (e.g. car)
3. What are the different *energy sources* used by transportation? (e.g. gas)
4. What are some of the *environmental impacts* of transportation? (e.g. smog)

1. Uses	2. Modes	3. Energy sources	4. Impacts

2. HOW DOES MOBILITY AFFECT AIR POLLUTION?

The [IDAEA-CSIC](#) (Institute for Environmental Diagnostics and Water Studies) in Barcelona is a well-known scientific research center in matters of atmospheric pollution.

Based on the information presented to us, let's remember which molecules we emit into the atmosphere of our city, when we travel with a combustion vehicle.

2.1. Complete the table of the main pollutants and their effects on our health and the environment.

Pollutant	Name and definition	Sources	Affects our health and/or environment?
PM			
NO _x			
O ₃			
VOCs			
CO ₂			

Every day we breathe approximately 21,000 times, so more than 7,000 liters of air pass through your lungs. Do you know the quality of the air you breathe? We suggest you study the quality of the air around you by checking the following website:

https://mediambient.gencat.cat/ca/05_ambits_dactuacio/atmosfera/qualitat_de_laire/vols-saber-que-respires/

2.2. What is the current air quality at the Granollers measuring station?

Date: _____ Time: _____

Name of the pollutant	Concentration	Air quality level

2.3. Create a line graph that includes the measurements of the concentration of pollutants measured yesterday in Granollers (every hour). Create a legend with a different line color for each pollutant.

[Descàrrega de dades automàtiques. Medi Ambient i Sostenibilitat \(gencat.cat\)](#)

2.4. Conclusions. In pairs, analyze your graphs, assessing the air quality in Granollers looking at the concentration of the different pollutants and relating these values to the weather. Explain also how we can reduce air pollution in our city.

3. MOBILITY AND THE CARBON FOOTPRINT OF OUR CLASS

Choices made every day about how to get to school, work, the mall, etc., directly affect the size of your CO₂ (carbon dioxide) 'footprint'.

Your CO₂ "footprint" is a measurement of how much carbon dioxide is emitted into the atmosphere as a result of your individual actions. As you know, CO₂ is a greenhouse gas that contributes to the global warming of the planet. Transportation choices are just one component of the CO₂ footprint, but can often be the most significant.

How big is your transportation footprint? How does it compare with that of your classmates?

Through this activity, you'll conduct a survey to identify the different modes of transportation you and your classmates use to get to and from school. You'll then use this information to calculate the combined impact of those choices on your CO₂ footprint.

3.1 Use the following information to calculate your carbon footprint to get to and from school

a) Find out the round trip distance from your home to school. You can do this by noting the mileage as you drive or go to an online mapping program (eg. Google Maps) and put in the correct addresses to calculate the distance.

Round trip distance to and from school: _____ km

b) If you travel to and from school by car (either alone or carpooling), determine the average fuel economy of your vehicle in l/100 km. Fuel economy is the relationship between the distance traveled and the fuel consumed.

Fuel economy: _____ liters/100 kilometers

c) How do you typically get to and from high school? In the table below, find the option that best fits your mode of transportation and then complete the relevant section.

If you get to and from school by...	Complete the following section
Car, driving alone	A
Carpool – with other students from your school	B
Bus – public or school bus	C
Walk, bike or other zero-emission mode	D

Students who bike or walk to school (their carbon footprint is 0), they have to complete A or B section with the information of a teacher who travels by car to school. This information will not be included in our class summary table.

Section A:

Transportation = Car, driving alone

1. Calculate the liters of petrol consumed each day to get to and from school.

Answer: _____ liters of fuel consumed.

2. Calculate the CO₂ emissions of your journey. Each liter of gasoline burned emits 2.4 kg of CO₂. Use your answer from section 1 above to help you answer this question.

Answer: _____ kg of CO₂ emitted to get to and from school.

3. Estimate your annual CO₂ emissions to get to and from school. Let's say we have 180 school days. Use your answer from section 2 above to help you.

Answer: _____ kg of CO₂ emitted to get to and from school for the whole year.

4. Estimate your school's CO₂ footprint based on transportation. What if every student emitted the same amount of CO₂ as you, just to get to and from high school? What would be your school's CO₂ footprint in terms of transportation? Multiply your answer from number 3 by the number of students in your school.

Answer: _____ kg of CO₂ generated per year at your school.

Section B:

Transportation = Carpool – with other students from your school

1. Calculate the liters of petrol consumed each day to get to and from school.

Answer: _____ liters of fuel consumed.

2. Calculate the CO₂ emissions of your journey. Each liter of gasoline burned emits 2.4 kg of CO₂.

Answer: _____ kg CO₂ emitted to get to and from school.

3. Calculate your individual impact. How many people have shared your journey? Divide your total from section #2 by the number of people in your carpool (including yourself!), in order to calculate the individual CO₂ emissions of each person in the carpool. Include only students from your high school in the carpool calculation. Do not include other people (for example, driver, siblings who go to other schools, etc.).

Answer: _____ kg of CO₂ emitted per person.

4. Estimate your annual CO₂ emissions to get to and from high school. Multiply your total from number 3 above by 180 school days.

Answer: _____ kg of CO₂ generated per year.

5. Estimate your school's CO₂ footprint based on transportation. What if every student emitted the same amount of CO₂ as you, just to get to and from school? What would be the CO₂ footprint of your school in terms of transportation? Multiply your answer from section number 4 by the number of students in your high school.

Answer: _____ kg of CO₂ generated per year at your school.

Section C:

Transportation = Bus – public or school bus

1. Estimate the amount of fuel used by the bus. Buses consume 47 l/100 km of diesel. Calculate the liters of diesel used by the bus.

Answer: _____ liters of fuel consumed.

2. Calculate the CO₂ emissions of your journey. Each liter of diesel burned emits 12.53kg of CO₂. Calculate the amount of CO₂ generated by the bus for each round trip.

Answer: _____ kg of CO₂ emitted by the bus to get to and from school.

3. Calculate the CO₂ emissions per passenger. How many people have shared your journey? Estimate the number of people who used the bus today. Then calculate the kg of CO₂ emitted per passenger on the bus.

Answer: _____ kg of CO₂ emitted per person.

4. Estimate your annual CO₂ emissions to get to and from school. Multiply your total from section 3 above by 180 school days.

Answer: _____ kg of CO₂ emitted per person the whole year.

5. Estimate your school's CO₂ footprint based on transportation. What if every student emitted the same amount of CO₂ as you, just to get to and from high school? What would be the CO₂ footprint of your school in terms of transportation? Multiply your answer from section number 4 by the number of students in your school.

Answer: _____ kg of CO₂ generated per year at your school.

Section D:

Transportation = Walk, bike or other zero-emission mode of transport

Your CO₂ footprint equals zero!

If everyone in your school traveled as you did today, this part of the CO₂ school footprint would be zero!



3.2 Summary table with our transportation carbon footprint data.

Record each student's data in the table below and add up the CO₂ emissions for the entire class.

Student	Kg of CO ₂ per year	Mode of transport
TOTAL FOR THE CLASS: _____ Kg de CO ₂ per year		

3.3 Analyze the results of our investigation by answering the following general questions:

- a) What is the most common way students in your class get to and from school? Why do you think this is the case?
- b) Which mode of transportation generates the most CO₂ per person in your class?
- c) How many students have generated “zero” CO₂ emissions from their commutes?
- d) Looking at the Transportation Carbon Footprint Data Summary Table, how many students in your class ride the bus to and from school?
- e) How could we increase the number of students who go to school by bus?
- f) Looking at the Transportation Carbon Footprint Data Summary Table, how many students in your class walk or bike to and from school?
- g) What might be some ways to increase walking and biking to school?
- h) If you do not currently walk or bike to school, would you consider either of these options as possible for you? Why or why not?
- i) Looking at the Transportation Carbon Footprint Data Summary Table, how many students in your class carpool to and from school?
- j) What might be some ways to increase carpooling to school?

3.4. Final reflection: How might your class decrease its transportation CO₂ footprint?

4. WHAT IS NOISE POLLUTION?

Carrying out any human activity almost always involves a more or less high sound level.

Depending on the type, duration, place and time where they occur, sounds can be annoying, uncomfortable and even alter the physiological or psychological well-being of living beings; then we call it noise and it is considered pollution.

Noise pollution can be defined as the significant increase in the acoustic levels of the environment and is one of the important factors in the deterioration of the environmental quality of the territory.

The main sources of environmental noise are:

- Traffic: road, rail and air
- Industrial and recreational activities
- The neighborhood

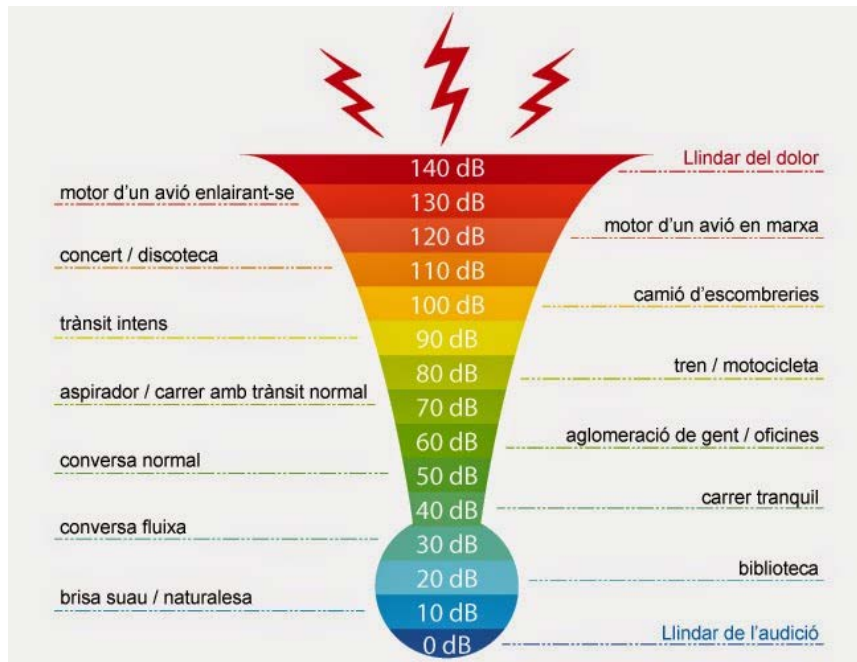
In recent years, the increase in traffic has been continuous and exponential, although many efforts have been made to ensure that vehicles make less and less noise, it remains the main cause of environmental noise.

The degree of industrialization is a generator of noise sources, as well as commercial, artisanal, agricultural, recreational activities, installations, etc. In addition, the locations of industrial activities generate strong mobility that spreads more noise.

Noise is a pollutant capable of affecting people's health and their quality of life; since, in addition to having an impact on health, it also influences communication and behavior.

Noise nuisance implicitly carries a strong subjective component. The same sound can be considered pleasant or annoying depending on its characteristics, those of the receiver and those of the moment in which it occurs.

Sound is measured in decibels (dB). Although it varies from one person to another, it is accepted that the hearing threshold is at 0 dB, and that from 130 dB the pain threshold appears. The decibel scale is not linear but logarithmic, so an increase of just 3-10 dB can double the noise. In these graphics , decibels are represented with examples of situations that generate them:



Decibel scale. Image source: www.ub.edu



Noise levels. Image source: <https://hearinghealthfoundation.org/decibel-levels>

As an indicative value, we can consider the level of **acoustic comfort** at **55 dB outdoors**, and **between 30 and 45 dB indoors** (residential, hospital, educational and cultural uses). **The desirable upper limit would be 70 dB.** Above this level, sounds can affect our rest and communication.

In addition, prolonged exposure to excessive noise, or occasional exposure to a very intense sound, can cause damage to health, in the medium or long term. We may have temporary hearing loss, ear injuries, loss of balance or deafness. Other non-auditory problems can be headaches, insomnia, stress, irritability, fatigue, lack of attention and concentration.

4.1. These are documentaries about noise pollution in our contry:

- "Combatre el soroll", broadcast on 27/04/2012 on TV3, in a Quequicom program (duration 17 minutes, play until minute 17). This report talks about noise and gives a scientific and very comprehensible explanation of what sound is, what its intensities are and how it can be isolated. It also talks about how noise can affect people's daily life and health.

<https://www.ccma.cat/tv3/alacarta/quequicom/combatre-el-soroll/video/3015010/>

- "La contaminació acústica", broadcast on 11/11/2011 on TV3, in the program Espai Terra (duration 14 minutes). This section of the program deals briefly with what noise pollution is, focusing on the problem in big cities, what negative effects it can have on people and explains some measures that exist to reduce this problem.

<https://www.ccma.cat/tv3/alacarta/espai-terra/sorolls/video/4750891/>

When finished, summarize the most important points of these reports in your notebook.

5. SOUND MAP OF OUR SCHOOL'S NEIGHBORHOOD

Now we put into practice what we have learned about sound and noise pollution.

You have to measure the intensity of the sounds in some points and compare them with the recommended levels. The data measurement will be done with the mobile phone sensors and the [Physics Toolbox Sensor Suite](#) application (sound meter).

For example, it would be interesting to compare the noise of the Ronda de Granollers and Carrer Esteve Terrades, in front of our high school. With this data, we will create a sound map along a series of points on Carrer Esteve Terrades. We will mark the points on a map of the neighborhood, using the color scale of the decibel scale.

6.HOW WALKABLE AND BIKEABLE IS YOUR COMMUNITY?

What are some of the benefits of walking or cycling?

- Improved fitness
- Cleaner air
- Reduced risks of certain health problems
- Greater sense of community (when you get out a walk, you run into neighbors and can develop good relations with your community)

What factors can make it difficult to walk places?

- Lack of sidewalks or bike lanes
- Busy traffic streets / hard to cross from one side of the street to the other
- No amenities (e.g. shade, interesting places to walk to)

[Granollers Pedala](#) association gives us a talk to explain to us how bikeable is our city is. It is an association that wants to promote urban cycling in the area of Granollers, Canovelles and the Franqueses del Vallès. From the association, they want to articulate and energize the group of people who use bicycles, and make proposals to local administrations to develop mobility by bicycle in our city and our surroundings. Its work is also aimed at providing the necessary support and services to facilitate the use of the bicycle as a regular mode of transport, which contributes to a more sustainable urban development.

6.1 Checklist - How walkable is your community?

You have to identify a place to walk. This could be the route to school, to a friend's house or simply to a place you would like to go. Each student can choose a different location for his or her walk.

You can do this walk with your family, and then you have to fill in the *How walkable is your community?* Checklist from the [Mineta Transportation Institute \(MTI\)](#) at San Jose State University. It evaluates, on a scale from 1 to 6, different aspects that are taken into account at the urban planning level in order to assess how walkable our neighborhood is.

Once you finish completing the checklist, we will have a group discussion and a final reflection in the notebook.

Name: _____

Student Worksheet/Checklist

How Walkable Is Your Community?

Location of walk: _____

Rating Scale: _____

1. Did you have room to walk?

- Yes Some problems:
- Sidewalks or paths started and stopped
 - Sidewalks were broken or cracked
 - Sidewalks were blocked with poles, signs, shrubbery, dumpsters, etc.
 - No sidewalks, paths, or shoulders
 - Too much traffic
 - Something else _____

Rating (circle one) Locations of problems:
1 2 3 4 5 6 _____

4. How about safety? Could you and your child...

- Yes No Cross at crosswalks or where you could see and be seen by drivers?
- Yes No Stop and look left, right and then left again before crossing streets?
- Yes No Walk on sidewalks or shoulders facing traffic where there were no sidewalks?
- Yes No Cross with the light? _____

Rating (circle one) Locations of problems:
1 2 3 4 5 6 _____

2. Was it easy to cross streets?

- Yes Some problems:
- Road was too wide
 - Traffic signals made us wait too long or did not give us enough time to cross
 - Needed striped crosswalks or traffic signals
 - Parked cars blocked our view of traffic
 - Trees or plants blocked our view of traffic
 - Needed curb ramps or ramps needed repair
 - Something else _____

Rating (circle one) Locations of problems:
1 2 3 4 5 6 _____

5. Was your walk pleasant?

- Yes Some problems:
- Needed more grass, flowers, or trees
 - Scary dogs
 - Scary people
 - Not well lighted
 - Dirty, lots of litter or trash
 - Dirty air due to automobile exhaust
 - Something else _____

Rating (circle one) Locations of problems:
1 2 3 4 5 6 _____

3. Did drivers behave well?

- Yes Some problems: Drivers...
- Backed out of the driveways without looking
 - Did not yield to people crossing the street
 - Turned into people crossing the street
 - Drove too fast
 - Sped up to make it through traffic lights or drove through traffic lights?
 - Something else _____

Rating (circle one) Locations of problems:
1 2 3 4 5 6 _____

How does your neighborhood stack up?

Add up your ratings and decide

1. _____ **26-30** Celebrate! You have a great neighborhood for walking.
2. _____
3. _____ **21-25** Celebrate a little. Your neighborhood is pretty good.
4. _____ **16-20** Okay, but it needs work.
5. _____ **11-15** It needs lots of work. You deserve better than that.
- Total: _____ **5-10** It's a disaster for walking!

7. CHARACTERISTICS OF SUSTAINABLE MOBILITY

By now, you already know a lot about mobility and transportation. If someone asked you what sustainable mobility was, you'd probably say something, but if you had to define it, it might be a bit difficult for you. Mobility is sustainable when it ensures the needs of present generations, without compromising the needs of future generations". Sustainable mobility has to do with the use of public transports, such as buses, metro and train. It could also be about using fuel efficiently. It might be about how employers can solve transportation problems by allowing their workers to telecommute, or work longer hours so they do not have to make as many trips to work. It can also be about making it easier to go to school by bike. All these concepts, and many others, are part of sustainable mobility.

What do you think are the desirable characteristics of sustainable transportation?

7.1. Complete the table below to identify and explain six desirable characteristics of sustainable transportation.

Characteristic	Why is it desirable?
1.	
2.	
3.	
4.	
5.	
6.	

7.2. Now evaluate the advantages and disadvantages of some common modes of transport, for each of these desirable characteristics, **on a scale from 1 to 10**.

Mode of transport	Fast	Convenient	Efficient	Non-polluting and cares for the Earth	Fair / affordable	Safe for people and animals
BUS						
METRO						
TRAIN						
GASOLINE CAR						
ELECTRIC CAR						
BICYCLE						
PLANE						

7.3. We will hold a final debate about the "degree of sustainability" of each of the transports analyzed and write down our conclusions in the notebook.

8. STEAM NOTEBOOK – CO-ASSESSMENT AND TEACHER EVALUATION

Nom i cognoms de l'alumne/a que ha elaborat la llibreta		Curs	
Nom i cognoms dels alumnes que han revisat la llibreta			
Indicadors per a la valoració de la llibreta	FET	NO FET	
S'ha lliurat amb puntualitat dins del termini fixat			
Té una portada amb totes les dades necessàries (títol del projecte, nom de l'alumne/a, nivell i curs)			
La presentació dels fulls és neta			
La presentació dels fulls és endreçada			
Totes les pàgines tenen la data en què es va fer l'activitat			
Hi ha marges (esquerra i inferior és superior al dret i inferior)			
Conté poques faltes d'ortografia			
Totes les activitats estan ben corregides			
Conté totes les activitats / continguts treballats durant el projecte (el llistat d'activitats que ha contenir la llibreta s'escriuen a la pissarra) 1 punt per activitat			
El que més ens ha agradat de la teva llibreta és...			
El que hauries de millorar: - -			
Data:/...../20....		Qualificació	
		/8+ número d'activitats completades	

9. VIDEO CONTEST ABOUT SUSTAINABLE MOBILITY

This is the final work of the project and you will work in groups of 3-4 people. Your work can be based on a vehicle, a transport system or an idea to improve sustainable mobility. You can use some of the materials worked on throughout the project or create new ones.

Here are some final product suggestions. CHOOSE ONLY ONE:

- Technological project. You can design your own sustainable transport system. It could be, for example, a new car, an improved bus or a transport plan for an entire city.
- Legislation. If you were mayor or president, which laws do you think would help improve mobility? Develop local or state laws that promote sustainability in transportation and explain why they would be beneficial. What problems still need to be solved in your neighborhood/city or country?
- Research study. Document good sustainable mobility practices in your community. The project can include any transportation mode, method or any other action that promotes sustainable transport, wherever you live or study. Are these practices successful? How can they be improved? What problems are still not being addressed? What particularly groups of people are not being served? How would you serve them better?

9.1. For this final work, you must create a dissemination video of the project, maximum 2 minutes long. Use the scaffolding provided to create good quality video material.

9.2. During the visualization of the videos in class, you must write down any questions that you may have for each one of the groups. You can get 1 extra point in your final work if you ask questions or provide feedback to your classmates.

9.3. The jury will evaluate all the videos. The best 2nd of ESO videos will be posted on our school website and social media.

RUBRIC FOR VIDEO PROJECT

	EXPERT	AVANÇAT	APRENENT	NOVELL
CONTINGUT	Treballa el tema amb profunditat, amb detalls i exemples. El coneixement del tema és excel·lent. (4 punts)	Demostra un bon coneixement del tema. El contingut és bo. (3 punts)	Inclou la informació essencial sobre el tema. (2 punts)	El contingut és mínim i hi ha força errors. (1 punt)
ÚS DEL LLENGUATGE	Comunica amb la terminologia científica pertinent. No presenta errors gramaticals ni ortogràfics. (4 punts)	Comunica amb la terminologia científica pertinent, però hi ha algun error ortogràfic o gramatical. (3 punts)	Comunica amb un llenguatge planer i hi ha algun error ortogràfic o gramatical (2 punts)	No utilitza un llenguatge adequat de comunicació i/o hi ha molts errors ortogràfics i gramaticals. (1 punt)
VIDEOGRAFIA - INTERÈS	Utilitza diferents angles de càmera. Inclou efectes de so. Els efectes visuals i sons del vídeo són variats i correctes. (1 punt)	Inclou efectes de so i visuals, però sempre des de el mateix angle de càmera. (0,75 punts)	Hi ha poca varietat d'efectes sons i visuals. (0,5 punts)	El vídeo no presenta efectes de so ni visuals. (0,25 punts)
VIDEOGRAFIA - CLAREDAT	La qualitat del vídeo és excel·lent (1 punt)	La qualitat del vídeo és bona, la major part del temps (0,75 punts)	Presenta alguns errors que perjudiquen la qualitat del vídeo. (0,50 punts)	La qualitat del vídeo no és correcta. (0,25 punts)
PUNTUACIÓ TOTAL				/ 10 punts

La present rúbrica és una modificació de la següent:

"Rúbrica para evaluar un vídeo en el aula" dels REA "Trabajo por proyectos en Geografía e Historia en Secundaria" de CEDEC, i es troba sota una llicència Creative Commons BY-SA 4.0

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