

Titolo del modulo/lesson:	Electrostatic Phoenomena
Livello	intermediate
Classe:	IV Scienze Applicate
Materia:	Physics
Contenuto:	Insulators and conductors; electroscope; charging methods; electronegativity; kinds of electric charge; charge conservation; polarization.
Tempi:	3 h
Autori	Bicego-Pacia

Subject prerequisites:	Basic atomic structure; direct and inverse proportionality.
Learning aims: Physics Content students will know	the difference between insulators and conductors; how many kinds of electric charge exist; how a body can be electrically charged; the meaning of electronegativity; the meaning of polarization.
Learning aims: Physics Skills students will be able to	define a conductor; describe what happens inside a polarized body; explain how a body can be electrically charged; quantitatively link polarization to electric permittivity.
Language prerequisites	Present and past tenses, passive form, conditionals.
Learning aims: language content students will achieve the following skills	Speaking: discussion in class on the texts Reading: comprehension of the physics texts given by the teachers Writing: brief statements, summaries Listening to descriptions of electrical materials and experiments; Vocabulary related to electrostatics.
Materials	Internet material, copies provided by teachers

LESSON 1 (introduction and practice): ELECTRIC CHARGES.

Warm up (10 min.) SPEAKING

- Ask the students to suggest words which can be related to the study of static electricity.

Key-words: Charge, positive/negative, amber, electron/proton/neutron, rub, electronegativity, electroscope, induction, contact, triboelectric effect, conductor/insulator, dielectric constant (electric permittivity), polarization.

- Ask the students to explain the origin of the term "electricity".
- Ask the students to explain what "charge" means.

--> Electrostatics has to do with attraction.

Activity 1: (10 min.) SPEAKING

- Use an electroscope to show how charge is detected
- Use a metal bar to show the existence of materials that "cannot" be charged.
- Use a plastic/glass bar to show the two types of charge.
- Use a plastic balloon to show that a charged body can attract a neutral one.

--> Ask the students for questions.

- Why can some materials be easily charged, while others can't?
- Why does a charged body attract a neutral one?

Activity 2 : (15 min.) LISTENING+ SPEAKING

Show the video <https://www.khanacademy.org/science/physics/electric-charge-electric-force-and-voltage/charge-electric-force/v/conductors-and-insulators>

Up to minute 7:00.

task 1 Ask the students, as they watch the video without subtitles, to write down all the verbs which describe the charged particles' actions. For ex: move around.

move around/about / are stuck /fixed / surround / wiggle around / jiggle / travel / migrate / jump around / bunch up /repel / attract /jump off / reside/ flow/ concentrate/spread out

task 2 Ask the students, after they have watched the video, to compare their answers in small groups of three and to write a paragraph describing the main differences between an insulator and a conductor using at least 6 verbs from task 1.

In a conductor electrons can **move around** freely, whereas in an insulator they **are stuck**. If we add extra negative charges in an insulator, they won't be able to **flow** freely and, if you want, you can distribute the charges uniformly; if you prefer you can make them **bunch up** on one side. If you add extra negative charges to a conductor, they will **repel** each other and **concentrate** on the outside of the conductor. You can only add an extra positive charge if you take away a negative one.

task 3: (10 min.) ask the students to answer the questions on the worksheet in small groups of three. Choose a representative from some groups to relate and invite the class to discuss.

Activity 3 / HOMEWORK : ask your students to access the page <http://education.jlab.org/reading/electrostatics.html> and ask them to do the multiple choice exercise.

LESSON 2 (practice and consolidation): CHARGING METHODS, MICROSCOPIC VIEW .

Warm up (10 min.)

Ask the students if the homework was clear enough and ask for their final score: then ask them to summarize the most important points and write them on the board.

- All substances can be (roughly) divided up into conductors and insulators
- Insulators can be easily charged, because the electrons can't move
- There are two types of electric charge; like charges repel, opposite charges attract

Activity 1: (3 min.)

task 1 lead in: Ask the students what questions/problems still have to be tackled and write them on the board.

1. Explain how a body can be given an electric charge.
2. Explain why a charged body attracts a neutral one.

Today's lesson is about the first.

task 2: (5 min.)

Show the video http://www.ck12.org/physics/Electrostatics/lecture/Electrostatics/?referrer=featured_content up to min 4:40.

Activity 3: (10 min.)

Invite the students to read the summary on electrostatics, find the wrong words and substitute them with the correct ones.

(Activity 4: - 10 min) – if there is time (*or, alternatively, give this activity for homework*).

Answer the questions at

http://www.ck12.org/physics/Electrostatics/asmtpractice/Electrostatics-Practice/?referrer=featured_content

Activity 5 (remedial work): (10 min.). (*other eventual homework to do*)

- Watch the video <https://www.khanacademy.org/science/physics/electric-charge-electric-force-and-voltage/charge-electric-force/v/conductors-and-insulators>
From minute 7:00 to 12:00

LESSON 3 : POLARIZATION.

Warm up phase: correct homework and fix the main points of the previous lesson. (3-4 min.)

- Charge is conserved
- Charging a body means to produce a charge imbalance
- There are (at least) three different ways we can charge a body: friction, contact, induction
- Only conductors can be charged by induction

Activity 1: (15 min.)

- Ask the students what still remains to be explained.

---> Last task: Explain why a charged body attracts a neutral one.

- Watch the video <https://www.youtube.com/watch?v=x1-SibwIPM4> From 5:30 to 15:30.
- Any question? Discussion in class (compare and share your ideas)

Activity 2 (going deeper): (10 min.)

Show Coulomb's law, define the relative electric permittivity (dielectric constant) and explain its meaning.

Activity 3: (5-10 min.)

- Show a table of permittivity.
- In pairs: discuss (3 min.) why salt dissolves in water.
- Discuss with the class.

Activity 4: assessment. (10 min.)

1. What happens when a glass bar is positively charged by rubbing it with some piece of cloth?
 - a) Some electrons jump from the cloth to the bar
 - b) Some electrons jump from the bar to the cloth**
 - c) Some protons jump from the cloth to the bar
 - d) Both protons jump from the cloth to the bar and electrons from the bar to the cloth
2. You want to charge by induction a neutral electroscope using a charged body. Here are the actions you can perform, written in a casual order:
 - a) 3 remove the connection of the electroscope from the ground
 - b) touch the electroscope with the charged body
 - c) 2 o 1 connect the electroscope to the ground
 - d) 1 o 2 bring the charged body close to the electroscope, without touching it
 - e) 4 turn the charged body away from the electroscope

fill in the blank spaces with the number indicating the correct order of the action; pay attention: one of the actions must not be done: leave the space empty!

3. Fill in the blanks

 like charges attract;

 opposite charges repel .

4. Why is it not possible to charge an insulator by induction?

Because charges cannot move, therefore there is not a real separation, but only a polarization, that is a deformation of the electrons' orbits or an orientation of polar molecules.

5. Where do the excess electrons end up in a negatively charged conductor, and why?

On the surface of the conductor, because, being free to move, the charges tend to go as far as they can from each other.

