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Outdoor Physics

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Introduction

School physics should deal with our natural and technical surroundings, it should guide the interest of the students to physical phenomena and it should offer insight into the scientific development of physics and related fields. Students complain very often, however, that physics teaching is done on a very theoretical level, and surveys around the world have revealed that students have problems to connect the formulae and laws they learn at school with their experience, with what they are seeing and doing in everyday life.

One way to overcome this unsatisfactory situation and to bridge this gap between theoretical framework and practical application is to implement more realistic examples in the teaching of physics; many teachers and several authors of text books, for example, adopted this idea already. Another way would be to go out of the schoolhouse and to do physics "on the spot". The second suggestion does not mean that the students are out in the fields all the time, but I would like to advertise regular organizations of such outdoor events. This idea is not new, and teachers lead excursions to (science) museums, factories and technological parks. But this program could be extended, and in the following, I will propose outdoor trips to places that are usually not connected with physics but have, in my opinion, appealing attributes:

- they are easily accessible,
- they offer interesting physics,
- they are attractive to students, at least to a majority of them.

Traffic Physics

Too many children and adults die every year in traffic accidents. Therefore there exists a common consensus around the world that an intensive discussion of risks and dangers

connected with moving bikes, motorbikes, cars has to be an indispensable (and maybe life-saving) part of each physics curriculum [1]. Besides theoretical explanations of speed, acceleration and the respective forces and energies, it is necessary to really experience these quantities.

Students could try to estimate the speed of passing cars on streets near the school or on throughways. In order to check their estimates, the students can mark out a certain distance on the side of the street, they can measure the time a car needs for this distance with a (stop) watch, and then they can calculate the average speed of this car. The police is (in general) very cooperative when traffic safety is concerned. Therefore it is likely that an invitation to take part in such a demonstration is accepted and that a police officer checks these estimates with a laser gun. Of course, the excitement is largest, when the students themselves are allowed to measure with the laser gun.

Estimations of the braking distances of motor bikes and cars are of crucial importance in traffic safety, both for drivers and pedestrians. An empty parking lot, for instance of a supermarket or a sports arena, is an ideal place for experiments of this kind. The car of the teacher or of some parent can be the experimental tool, also driving schools are often willing to offer cars and drivers. The students can plan and organize measurements of speeds and breaking distances. Different ground conditions can be provided by spreading sand on the asphalt or by wetting it.

A more ambitious, but for the students more impressive, excursion is to a training camp as they exist for professional drivers in the police, red cross or fire brigades. Being allowed to sit in the cars, the students get a feeling of the enormous forces which can act in accelerated cars. The students should also calculate these forces, but the calculated numbers should be brought in relation with the experienced forces.

Night Physics

Students, and not just those living in cities, are no more familiar with the natural, the "eternal", surroundings as it is given, for instance, by the star-filled sky. Students are barely able to name a star (besides the sun) and many of them are incapable of finding a given star in the night sky. They have never observed the permanent movement of the stars consciously. Reportedly, quite many students (and adults) have problems in explaining the day-and-night change or the phases of the moon [2].

Especially for younger students it is a motivating task to meet for a physics lesson at night time (experience has shown that it is also exciting for accompanying parents). For a first session it is even not necessary to provide the students with a telescope: naked eyes or maybe field glasses do a good job. The students can locate the Big Dipper and then the Polaris. The notion of Polaris leads to the knowledge of the four directions of the compass. Measuring the angle between Solaris and horizon gives the latitude (a “literal” rule of thumb: with a stretched hand and spread-out fingers, the distance between the tips of thumb and little finger covers an angle of about 20 degrees). How many stars does one see? - Students can try to find strategies to guess or to “count”. The Milky Way shows the plane of our galaxy. In fact, all objects in the sky which are visible by the naked eye in the northern hemisphere belong to our galaxy, with one exception: the Andromeda nebula. This object gives also the “oldest light” one can observe, it started about 2,5 millions of years ago. The Andromeda nebula is also a nice constellation to focus with a field glass.

Even the view of the moon with a field glass gives new and surprising insight for most people. A rare and therefore more exciting event would be the observation of a shooting star.

Of course, an excursion to an observatory would be the logical final step in bringing some students closer to the fascination of astronomy.

Amusement Park Physics

A visit to an amusement park is an exciting event not just for young people. Amusement parks exist in or close to all major cities, but transportable arrangements are touring through the countryside as well. Especially in the United States, there is some tradition to use amusement parks also for physics education [3]. Physics should not take away the fun, but add knowledge about the functioning of the various arrangements. Why does nobody fall out of a swing even if it turns around completely? How does a roller coaster work? How many times is the gravitational force imposed on a person at the bottom of a catapulted coaster?

I want to stress that the students should not just work on a qualitative level. Velocities can be determined with the help of measuring tape and stop watch. Quantities like energies or centripetal forces can be calculated and discussed. Again, an important point is that the students should experience, they should "feel" the very quantities they are introduced to at school on a purely theoretical level (including lab demonstrations).

Sports Physics

Most of the students are interested in sports, many of them are doing some kind of sport themselves actively. In the following, some examples are given where the fascination of sports could be connected to the curiosity of how things work as they do [4]. Again, we will concentrate on some examples which are easily accessible.

Physics in the billiard saloon

Billiards is not always given the attribute "sport", many people put it in the category "adult´s game", even "men´s game". The more surprising and attractive it is for students when a teacher proposes to transfer the physics-class to a billiard saloon. Although it will be the first time in the life of some (many - depending on age) students to push a billiard ball with a cue, even the beginners can perform some experiments and try to solve various tasks [5].

Where does one have to hit the ball so that it rolls and does not slide? (It is 2/5 of the radius above the center of the ball, and because of that reason, the border is also set this height.) When a ball hits a second one, what is the angle between the two outgoing balls? (90 degrees.) Does the law of reflection hold in the interaction of ball and border? (Usually not, depending on the spin of the ball.) When a ball with a top spin hits a ball at rest, what happens to the balls? (The second ball takes the speed of the first one, the first one comes to a stop but starts again to "follow " the second one.)

Physics in the swimming pool

The teacher can raise different questions when she/he splashes around in the pool with the students [6]. Since the density of human beings is less than the density of water, how is it possible that one drowns? Practical exercises in the water should lead to the discussion of the mass distribution within the body. The students can do some diving. Even a moderately deep pool gives already an impression of the pressure put on the body and the air-filled cavities in the body. The students can try to make twists and turns in the air while jumping into the water. They will find out that it is much easier to work with reaction forces from the diving board than to use just the mobility of the body being already in the air.

Physics on the (crazy) golf course

Especially younger students are excited by crazy golf. From a physical point of view, the laws of reflection can be studied (on the golf club as well as on the border). The conditions can be investigated when a ball "jumps off" a curved surface.

A more ambitious project is a visit to a driving range of a golf court, where even inexperienced persons are allowed to take their first (guided) steps. During practice one can argue about the speed, spin or energy involved in this game. Students have not much problems in believing that the speed of the ball can exceed 200 km/h, but it is almost unbelievable to them that the ball can rotate up to 50 or 60 times a second giving rise to a range of the ball of up to 300 m [7].

Conclusions

I presented some proposals of what kind of activities connected with physics one could do outside of the classroom. Of course, this causes additional organizational work for the teacher. In some cases, he/she has to rely on help from experts in the respective field. But I am sure that the effort pays off in several aspects and that such physics lessons are not wasted time at all.

References

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GIREP as a non-exclusive club

Many people like to join clubs of various kinds. As well as clubs simply for meeting people, talking and eating and drinking, there are clubs for pursuing enjoyable activities, such as football or music. Some clubs are non-exclusive, open to anyone who wants to join; others have an exclusive membership policy and are very careful whom they admit. Some are free; others are expensive.

There are also many professional associations, sometimes called "Learned Societies". There are such associations for medical doctors, dentists, lawyers and, of course, professional physicists. They usually require strong evidence of professional qualification for admitting you to membership. In physics, this can mean that teachers of physics are excluded: it took some time before the UK Institute of Physics made school teachers of physics welcome as members, for example, though now it certainly does so.

GIREP, it seems to me, is more like a club than like a professional association. As clubs go, it is not at all expensive, and so far as I know anyone who wants to join may do so: no test to pass, no referees to produce, no curriculum vitae to produce in proof of fitness. Interest in research in physics education is enough. Particularly, from the beginning, school teachers have been welcomed as members.

GIREP exists, however, largely through its conferences. In between conferences, a few people – President, Secretary, Treasurer, Editor of the Newsletter – are all that keep it going. Thus the feeling that GIREP provides, as a kind of club, depends on the nature of its conferences. Getting that right or wrong gets everything right or wrong.

Conferences vary a great deal. Some have huge numbers of people attending, and hundreds of papers or posters – after all, poster sessions were invented to deal with the fact that more people wanted to give papers than could be fitted into the time available, as was the idea of parallel paper sessions. At the other extreme, some organisers of conferences have to persuade people to offer papers.

The big question is: to whom are the papers addressed? Are they there to get something on the record, and to add another item to one's list of publications? Or are they addressed to like-minded members of a club, sharing and trying out new thoughts? If the latter, there is an important consequence that many find hard to accept. It is anyone can offer and make a contribution, without any previous test of quality. Sitting in your club, you do not have to ask permission to join a conversation. "Joining in" is what club members do. By contrast, many international conferences set up elaborate systems for prior "vetting" of proposed contributions, and people spend hours of time reading and approving (or not) papers submitted. Spoken of as a burdensome duty, it is also an exercise of power, that at least some people enjoy.

It follows, it seems to me, that if GIREP is a club, its conferences have to find a place for what some would regard as tedious or unnecessary contributions. Clubs have to manage "the Club Bore" as well as the brilliant conversationalists. This is because the feeling of belonging is vitally important. A club that anyone can belong to must be a club that lets all who join feel that they belong.

I think that, in its history, GIREP has broadly accepted these principles. It has been an inclusive (non-exclusive) club, and at its meetings there has often been space for all to make their contributions, large or small, greater or lesser. But I have a slight fear that as GIREP grows larger, and as the imperatives of academic competition grow stronger, its conferences may find less and less space for everyone to contribute. There might even be a move to restrict membership to people who have been "approved" in some kind of way.

I do hope not. There is, I believe, a real place for and a real value in a club for those who are interested in physics teaching and research in physics education. And there is a disease that such a club can help to cure, or at least ameliorate. The disease is the wide lack of interest in and respect for research in physics education, amongst school teachers of physics. I have to say that researchers often suffer similar disease symptoms: they quite often regard teachers as a major obstacle to their ideas. At least, in GIREP up to now, the two have come together. That is rare and is worth preserving.

So let's keep GIREP as a club. Let's resist special conditions on membership, if they are proposed. Let's not have an elaborate system for controlling conference contributions. Let's agree that holding a conversation amongst members means that some people will be a bit bored from time to time, in service of the greater good of letting every member join in.

Jon Ogborn, UK

Girep 2002 conference in Lund, Aug. 4-9

Physics in new fields and modern applications
– opportunities for physics education.

The GIREP conference of 2002 will be held in Lund, Sweden, during the week of August 4 – 9. The conference will focus on the problem of making the physics education relevant for modern students – to apply it to new fields and modern applications. Speakers and contributions will deal with the problem of recruiting students to physics by finding novel approaches. Among already confirmed speakers can be mentioned Leopold Mathelitsch on “Physics of acoustical phenomena”, Jessica James on “Physics and Finance”, Max Thompson on “Physics and peacekeeping”, Henrik Lundstedt on “Living with our star”, and Per-Erik Bengtsson on “Combustion Physics”. A preliminary program for the conference will be posted and distributed in the middle to end of November, and the registration will start in the middle of January 2002.

You are welcome to contribute to the conference with different types of presentation. Guidelines will be available from the middle of January on the webpage.

For further information and registration, we refer to the conferences homepage at www.girep.fysik.lu.se or pinf.fysik.lu.se.

GIREP committee at the seminar in Udine in September 2001

To our members!

At the General Assembly, it was decided that GIREP Newsletter should be published on our homepage. We will announce the publishing of a new Newsletter through e-mail.

Please fill in the members' form and check your e-mail addresses on our homepage

http://www.pef.uni-lj.si/girep (try also: **http://www.girep.org)**
User name: girep, password: duis98

Look at our home page! There you will find all GIREP Newsletters from the beginning!

Our treasurer C. Ucke has scanned all the former editions and transformed into pdf-files. The first editions were generally printed in a relatively bad quality. That is why the scanned versions have also not a good quality.

Please send contributions for next GIREP Newsletter till January 2002!

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In cases of real difficulty to arrange payment, please contact the Secretary or the Treasurer who are ready to advise whether special arrangements can be made.
General Assembly of GIREP members in Udine (August 1995) accepted the following supplementary new article for the GIREP statutes:
Each year in October, those members who have not paid for the previous two years will be removed from the membership list.

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