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Curt Gabrielson, a science teacher and an Institute Fellow, is observing the re-establishment of education in East Timor.

My Experience with Physics Education in East Timor

By Curt Gabrielson

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BAUCAU, East Timor–I came to East Timor in October 2000 with no firm plans about what to do. My partner Pamela had work lined up, and we were convinced that I could find some useful occupation. In the U.S., I taught physics and had worked with the Exploratorium Teacher Institute in San Francisco for several years leading up to my move to East Timor.

Arriving in East Timor, I set out ambitiously to learn the local lingua franca, Tetum. I found it to be an archaic language, with most "modern" words taken from Portuguese, the language of East Timor's first colonizers. Mixed with Tetum was Bahasa Indonesia, the language of East Timor's most recent occupiers. By learning parts of these three languages, I could soon make myself understood talking about science and math.

In December 2000, I was granted a two-year fellowship by the Institute of Current World Affairs. This fellowship essentially allowed me to pursue my own interests, all (reasonable) expenses paid, while writing an informative newsletter to members of the Institute once a month. This opened up great opportunities for me: I could work where I wanted without needing a salary.

While continuing work on language skills (work that has continued until today), I found two places to put my efforts. The first was a well-organized Catholic high school in Baucau, a town three hours down the coast from East Timor's capital, Dili. I had previously met the headmaster-priest, and in January 2001 I offered to work with the school's science and math teachers on various hands-on activities that could be carried out in their classrooms. I held training sessions with them once a week for several months during which time we conducted simple experiments in math, chemistry, biology, and physics. These hands-on lessons (called *pratika* in Tetum) were entirely new to these teachers. I found physics teachers who had never handled a magnet and biology teachers that had never made the connection between the curriculum they taught and the animal parts available for consumption (or experimentation) at the local market. My language skills improved more rapidly in the course of preparing and delivering these lessons.

In April 2001, I also approached the East Timor National University (UNTIL) to see if I could be of use in its Faculty of Education. I found physics to be the subject most desperately in need of teachers, and signed up to teach hands-on physics lessons to first-year students in the math and biology departments, four classes every week until July. There was no physics department, at that point.

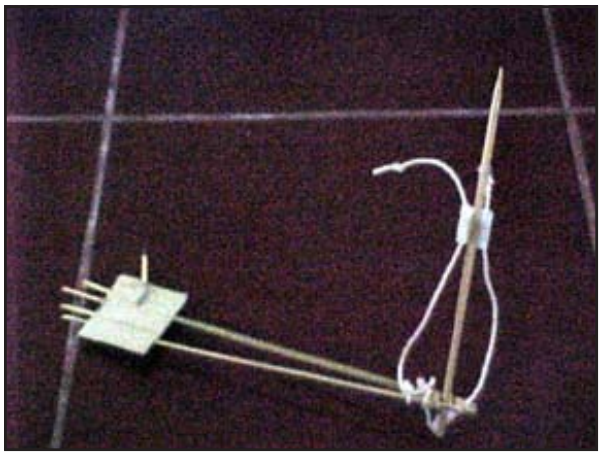
It was a light workload, and I filled my days developing activities for future use. Good activities must have a close connection to local culture and life, and make use of only the most readily available materials. My large repertoire of science and math activities from the U.S. was severely limited by the availability of supplies in East Timor, and I began to search the streets, forests and garbage dumps to determine what was out there waiting to be used in an experiment. I found:

banana leaves, palm fronds, bamboo, rocks, and various seeds and leaves from the forest; candles, rubber bands, gum balls, balloons, marbles, food coloring, and tiny straws at local shops (all for under ten cents); and limitless 1.5-liter water bottles and aluminum beer cans in garbage piles courtesy of the UN.

Here are some examples of the activities I came up with. Banana-leaf spines have a smooth track down the center, custom made for marbles to roll down. If you prop one up on a chair, you can release marbles from different lengths of spine and measure their velocity as they race across the floor, then compare kinetic and potential energy to see how much was lost to friction. You can make a one-wheeled, rubber-band-powered car out of cardboard, palm-fond spines and an aluminum can. If you make it well, it will cross the whole room. If you measure the force given by the wound-up rubber band before release, and the distance the car rolls, you can use a simple bit of calculus to determine the amount of energy it used. Trashed florescent-light units have "ballast" inductors in them that consist of fine magnet wire that you can use to make electromagnets, motors, speakers and current meters. You can use a homemade current meter to measure the strength of a battery you make by filling an aluminum wok with salty water and vinegar and plunging in a chunk of charcoal. With three kabob sticks, you can make a model of the human arm and hand in order to demonstrate muscles, tendons, ligaments and the different types of joints at each bend. The standard lung-model can be made with a bottle, balloon and plastic bag, and you can complement the experiment with a sheep's lung from the market: if you jam a straw into one of the main holes and blow, the whole thing will inflate like a puffer fish.

I took these prototype activities directly to trial at both UNTIL and the Baucau Catholic high school. All in all, my students were overjoyed at the opportunity to learn directly from experience, rather than from texts or a lecture.

Near the end of the semester Miguel Maia, the dean



A prerequisite for the model-arm activity is to eat three kabobs.

Historical Context for Education in East Timor

For about 400 years Portugal ruled East Timor and ran colonial schools for a very small number of children from upper-class families. The quality of education was quite good in some of the schools, if stiff and formal. From 1975 to 1999, Indonesia occupied East Timor and the education system was run the same as in other parts of the sprawling nation. Most teachers and nearly all principals in East Timor's middle and high schools were imported from other parts of Indonesia. Many were not top quality, and few were highly motivated to educate East-Timorese children. As of 1999, there was only one East Timorese physics professor at the University of East Timor.

In 1999, Indonesia's government finally allowed the East Timorese to vote on whether they wanted independence, or to be an "autonomous" region within Indonesia. On August 30, 1999, the East Timorese came out in vast numbers, in the face of massive danger and intimidation from the Indonesian military and their militias, to vote 78.5 percent in favor of independence. After the results were announced, the Indonesian military and their militias destroyed much of East Timor's infrastructure, killed thousands of East Timorese and forcibly deported close to 300,000 people, one-third of the population. After the destruction had run its course, the UN set up and led a transitional government that ended in May 2002. East Timor is now an independent nation.

Around 80 percent of the schools in East Timor were destroyed or damaged in 1999. Nearly all former Indonesian teachers left their positions before the vote. Most current education leaders have little experience in administration. Today, not a single physics teacher in the middle and high schools in East Timor holds a four-year degree in physics, and some have never studied physics. There is a dire shortage of teachers for most technical subjects. The previous university physics professor died in the violence of 1999, and the university, with its connected technical school, was destroyed by fire.

Today, most of my students at university have huge gaps in their comprehension arising from the chaos and mediocrity of their middle- and high-school experience. Many of the concepts I teach at university are taught in upper-level middle-school classes in the U.S.

With aluminum foil from a box of clove cigarettes and a couple of batteries pilfered from the family flashlight you can illustrate the principle of a fuse.

of UNTIL Education Faculty, asked me if I was writing down my activities for future reference. I wasn't, and he asked me if I could. I thought it was possible, and we discussed the idea of a manual for other teachers. I began writing drafts of activities following the format of the Exploratorium *Snackbook*: simple, clear directions, followed by a short explanation and a bit about the activity's connection to real life.

After a few months it became clear that I could write up several dozen activities and make a good-sized manual. I could include lessons about most major topics in the middle- and high-school physics curriculum. I knew I would need physics teachers for editors, and we found four who were interested. I began to meet with them once every two weeks to edit one or two lessons. First I'd do the activity with them, then we'd slog through the bad Tetum of my draft, together making decisions on how to explain things and which words to use for various concepts. These teachers were paid through UNTIL for their work.

I began recruiting any and all students interested in being models for physics-manual photos. I found plenty in various venues, and the manual became filled with local personalities demonstrating how to carry out the activities. I took digital photos and was soon learning more than I ever wanted to know about word processing and layout.

From my years at the Exploratorium Teacher Institute, I knew that if this book was to be successful, each activity needed to be tested by East Timorese teachers on East Timorese students. About that time I met Rui Belo, the head of curriculum in the East Timor Ministry of Education.[1] He was quite excited about the idea of the manual, and offered to put together a group of teachers to do the trials. He would invite several from each of the 13 districts of East Timor. In order to do this, we needed a bit of money for transportation and food for these teachers, as well as for printing and photocopying the lessons themselves. Maia and I wrote a proposal to AusAID, Australia's international-aid agency, through a small-grants program they have. We got the funding, and ended up asking AusAID two more times for money to finish the project and print 800 manuals. In October 2001, I began giving two-day training sessions, in which the group of 30 or so teachers would do about eight activities and choose one to take back to their school. At their schools, they would try the lesson with their students and report back to me on their success or lack thereof. I taught these sessions every month or so for the next eight months. This group of teachers tried over 60 lessons, and together with other informal trials I arranged, each lesson in the manual was put to test. With information from these trials, many lessons were improved. Two were scrapped completely.

When the trials, photos and content editing were finished in May 2002, the *Manuál Lisaun Prátika Fízika* was sent to the National Linguistic Institute where several local linguists made corrections to standardize spelling and Tetum usage. The Manual contains a glossary of technical terms, listed in Tetum, Portuguese, Bahasa Indonesia, and English. Seventy-two experiments and over 500 photos appear in its 350 pages. It is the first technical book published in Tetum, and a step toward developing the language of Tetum for use in technical subjects.

Jumping back a bit, during East Timor's 2001 school break — August and September — I was asked to participate in creating a physics department within the education faculty of UNTIL. I worked with the one teacher in the country with a bachelor's degree in physics, Teresinha Soares. She completed her degree in the year 2000, and was frankly not so interested in becoming the director and sole faculty member of the UNTIL physics department. But with sufficient prodding by higher-ups and colleagues, she rose to the occasion. We looked at

If you skewer a guava on a nail, you can paint the equator on its waist and insert a pin, the head of which will represent the island of Timor. A gumball skewered on another nail will represent the moon. Both nails can be stuck into a banana-leaf spine, and when you hold this fully rotating and orbiting apparatus under the sun, you can demonstrate day and night, seasons, moon phases and eclipses. Here, our neighbor Zeze models a solar eclipse on Timor.

[1]The Ministry's full name is "East Timor Ministry of Education, Culture, Youth and Sport," and is the largest and best funded ministry in the government. By some accounts, it is also the most chaotic.

various other universities' curricula, and designed a three-year curriculum specifically to produce future middle- and high-school physics teachers.

In October 2001, 60 students were accepted into the university's physics department. As I write this, they still have no textbooks to use. Truth be told, most classes at UNTIL use no textbooks, because books are not readily available in East Timor, are expensive when one can find them and no public money has been budgeted for them. Teresinha teaches from her own books and the students spend a lot of time copying what she writes on the board. Occasionally they put up money to photocopy her notes or textbook pages, but at five cents a page, this is quite expensive for students. Nor does there exist any formal laboratory facility. I have taught university lab classes for a year and a half using normal classrooms and cheap, ordinary articles as teaching tools.

Our physics students are slated to become teachers, but due to poor conditions in schools and moderate salaries, the best students will undoubtedly look for better jobs. I think a realistic prospect is for probably 25 to 35 new, well-qualified physics teachers to enter the nation's middle and high schools by October 2004. To make things worse, many of those resigned to teaching will attempt to get positions in Dili instead of returning to their home districts, leaving the remote schools to languish without qualified teachers.

At mid-year 2001, I also got to know the Catholic Teacher Training College of Baucau. Marist Brothers, mostly from Australia, run the College and put on teacher-training courses in a number of subjects. The director, Brother Mark Paul, was very keen to begin offering courses in physics. He offered to procure a small set of materials that the teachers could haul back to their schools and use for carrying out hands-on physics lessons. He also offered to buy full sets of quality physics textbooks from Indonesia so that East-Timorese teachers would have a source of reference. I assisted him in this preparation and began giving full-week courses through the Catholic College in late 2001. I taught mostly prototype activities from the Manual-to-be. Teresinha worked with me during these sessions, teaching theory and exercises related to the hands-on activities. At each session we would give out "science kits" — locally hand-made basket filled with class sets of simple science gear (prisms, magnets, lenses, tape measures, stopwatches, spring scales, scissors, tape, straws, etc.) — as well as a set of reference books, one to each school.

These courses proved to be invaluable in enabling me to understand the situation in East Timor's schools. I

Making and playing a bamboo slide whistle gives great insight into the concepts of frequency, wavelength and resonance.

solidified my initial feeling that what we were offering was vital: inspiration for overworked teachers bored with teaching directly from the textbooks, a new pedagogy, additional knowledge and help understanding basic concepts, as well as new gear and reference texts. More importantly, though, I learned that what we were offering was insufficient. I became aware that four main problems prevented most teachers from carrying out the hands-on activities in their schools.

First, many of the schools had no security whatsoever. Schools were fortunate if they had received a new roof and classroom furniture after the destruction of 1999. Solid doors and windows were few and far between. Thus some of the kits we handed out, which contained many items tantalizing to the average curious student, were soon ransacked. Second, most teachers were unable to make the connection between the concepts in the hands-on activities and the national syllabus for physics. Naturally, this connection existed, but it was beyond the capacity or confidence of most teachers to decide where to insert a given activity. Third, the national physics syllabus, carried over from Indonesia's education system, was bloated: too many topics for the time allotted for teachers to teach.[2] Teachers could find no time to offer interesting activities in the midst of spewing forth all the theory. Finally, and possibly most significant, the teachers were not required by the national syllabus to do hands-on activities. Ultimately, hands-on education requires more preparation, and any sort of new method requires courage and confidence. If not highly motivated and also not required to try new methods, many teachers will opt for the familiar (and mostly ineffective) lecture.

From this insight, I began to develop a vision of how physics education in East Timor could be improved. First

[2] I recognized this "more is less" problem from my years in China. Since the all-important national exam primarily checks for information retention, the national syllabus has been loaded with an unbelievable amount of information. Middle- and high-school teachers are stuck with the job of cramming enormous quantities of esoteric information down students' throats day after day, year after year. Students' interests, opinions and ideas have no value in the system, and are actually detrimental to "success" as defined by the system.

of all, the national syllabus would need weeding: topics of lesser import would need to be cut out to leave more time for a few important ones as well as openings for hands-on activities. This trim syllabus, as well as the hands-on activities in the Manual-in-progress, would need to be linked directly to the textbooks in use. The new, do-able national syllabus, including the hands-on activities, would then need to be required for all teachers. East Timor has decided to continue national examinations, an artifact of questionable value left over from Indonesia's education system, so these exams would need to include questions on topics in the syllabus, as well as each hands-on activity. Finally, each school would need to receive a "science kit" complete with all the special materials necessary for each of the required hands-on activities. For security, a sturdy, lockable cabinet would need to be placed in each school.

All my experience in the U.S. and China has led me to be highly skeptical of standardized syllabi, required lessons, and the like. It was therefore very difficult for me to come to the above conclusions. Won't such a rigid system stifle teachers' abilities to inspire their students? No, I realized, the teachers of East Timor have such poor preparation for their current jobs that they need a solid structural base to work from, a clear path to tread. In addition, they need the motivation of a required syllabus. The syllabus must contain plenty of hands-on lessons with ample leeway for creative adjustment and fine-tuning to follow the interests of both student and teacher. Through the process of learning these required activities, teachers would become familiar with the methods of learning from observation, discovering physical principles directly from experimentation and using scientific method to deduce and prove concepts in the classroom. They would also begin to fill gaps in their own understanding. In the future, the state would be able to give teachers freedom to develop and teach their own activities, ideally linked to their own communities as well as to the standard body of physics knowledge. The syllabus I envisioned was a necessary first step.

Playing guitar could be East Timor's national pastime. If you bite a guitar as it is strummed, you can learn something about where the sound comes from.

In January 2002, I asked Rui in the Ministry of Education to tell me who was working on the national physics curriculum. He groaned, said no one was, and that it was increasingly difficult to get *any* teachers to come to the Ministry to work on curriculum because there was no money to pay stipends, or even transport. I proposed that I get a few good, interested teachers, pay their transport to and from our work sessions, and revamp the entire middle- and high-school syllabus. Rui agreed on the spot, and I went off to find five of the teachers I had noticed to be the sharpest among the group of teachers doing trials on the hands-on activities. Each lived near Dili, and each was more than willing. I arranged a few dollars each for transport each time we met. Together with Teresinha from UNTIL, we met six afternoons over the course of a couple months and pulled off a very thorough weeding job on the national syllabus as well as planting hands-on activities from the Manual, now nearly completed, among the various topics in the syllabus.

One thing I had noticed early on was that the physics textbook used at the high-school level was of very poor quality. The curriculum group heartily agreed, and I asked of the director of primary and secondary education if it was possible to purchase new ones. He told us to make a recommendation, and he'd see what he could do. Since there is nothing resembling a book store in East Timor, we went on a wild chase for textbooks: the teachers brought their own ragged volumes, ransacked their own schools in search of odd, old ones and confiscated any that students brought to class. We were able to get examples from five different publishers in Indonesia.[3] Using phone numbers in these books, we called up each publisher (on my phone) and asked for a free, complete set. Remarkably, each publisher came through and shipped a set within a month, and we were able to make a detailed comparison of each text's treatment of various topics. We chose the one best suited for East Timorese students, and wrote our recommendation back to the Director.

To make a long story longer, the Director sat on the recommendation for a month, approved it, sent it on to the Minister of Education, who himself sat on it for several weeks, then wrote a preface for it (a requirement for any textbook coming from Indonesia) and sent it to the folks in the Ministry of Education Finance office, who wrote up a requisition order and sent it off to National Treasury. Treasury soon sent it back to Finance saying the funds were not available. Only then did the folks in Finance look at the Ministry of Education's budget, and sure

[3]Though the official languages of East Timor are Tetum and Portuguese, virtually no one under 40 speaks Portuguese, and no science books exist in Tetum. Thus, middle and high schools use textbooks from Indonesia, and learn in Bahasa and Tetum, as well as their own local language.

enough, in the category of high-school supplies there was nothing like the US$90,000 required. This was all a bit disheartening, but fortunately a friend of a friend in AusAID offered to look at a proposal. I helped the Minister write a quick proposal for the funds and AusAID approved it within three weeks. The new texts are on their way.

And well they should be, since our curriculum group had written the national high-school syllabus around these hoped-for books. Now it looks like it will all work out.

Meanwhile, on the kit front, things were feverishly coming together. Grants from four different donors covered the creation of kits for all 150 middle and high schools in the nation.[4] I found money to be the least of my problems.[5] How does one procure 1,500 nylon graduated cylinders by e-mail and phone from East Timor? How does one find even a single source, let alone a reasonable price? How many shops in Dili does one have to visit before finding 1,500 mirrors? What if a foreign company requires payment before shipment and the donor requires shipment before payment? What happens when 1,000 multimeters show up different from the ones ordered? This logistical nightmare occupied me for the better part of five months in early 2002.

Various vendors from Indonesia and Australia eventually supplied the items not available off-the-shelf in Dili. The gear seeped slowly in through customs and was stacked in the Ministry's storeroom. I then paid various neighbor kids to help me divide the mountain of equipment into class sets and pack them into rice bags (donated by the World Food Program) in preparation for delivery to the schools.

I managed to have storage cabinets made by a group of local carpenters and coaxed the Ministry's lumbering logistics unit into hauling them off to each individual school in the farthest corners of this nation along treacherous mountain roads. This also took several months of patience and persistence, with gifts and sweet-talking to all sides.

At this point, the only element missing was training the teachers. For teachers so new to this pedagogy, good training was going to be crucial. Of course, how to teach hands-on lessons is best learned by doing hands-on lessons! I found that Manuela Gusmao in the National Teacher Training Center had no funds or staff to carry out the training. I told Brother Mark of the Catholic College about the situation and he stepped up to fund and administer the training courses. It was more complicated than that, however. The kit was necessary to teach the

The Kit

Each middle and high school in East Timor will receive the supplies listed below. Together with the cabinet, the cost per kit came out to US$380. Two-thirds of the activities in the Manual use only items that students can find, bring from home or buy for less than ten cents. Just one-third use special materials.

Item	Quantity
Compass, magnetic	10
Diffraction cloth	10 pieces
Electrical components	10, 6 kinds
Food coloring, powder	1 pack
Glue	3 bottles
Graduated cylinder, 500 ml	10
Hand lens	10
Knife	1
Light bulbs, 3V	100
Magnet, large	1
Magnet, small	60
Mirror	10
Multimeter	10
Nails	1/2 kg
Prism	10
Protractor	10
Ruler	40
Scissors	10
Screwdriver, Philips	1
Slinky	1
Speaker	1
Speaker jacks	5
Spring scale, 5 newtons	10
Stopwatch	10
Straws	6 packs
String, cotton	3 rolls
String, plastic packing	1 roll
Syringe, 10 ml	10
Tape measure, 1.5 meters	10
Tape, masking	6 rolls
Tape, packing	2 rolls
Thermometer	10
Thread	3 rolls
Transformer	1
Translucent plastic bags (for optics)	7 packs
Tubing	3 meters
Used disposable camera	1
Wire, connection	6 meters
Wire, magnet	200 meters

[4] Many times during this process I thanked my lucky stars that this nation is so small. The problems here of communication, transportation, bureaucracy and lack of experience are all so overwhelming that it is a breath of fresh air to find the numbers involved in any given operation so small. With a population of around 800,000, East Timor is about the size of San Francisco.

[5] Before I came to East Timor, I knew nothing about donors and fund-raising. I still know nothing – the funds I was able to raise came to me by way of chance aquaintances and instances of bizarre happenstance. All my attempts at methodical searching let to naught. In the end we used US$157,000, including the new high-school textbooks, and not counting several thousand contributed by the Catholic College of Baucau through its programs.

national curriculum, so training would be required for all teachers. Thus, we couldn't just invite interested teachers; we had to make it mandatory. For this to happen, we had to work closely with the Ministry of Education.

Working closely with the Ministry of Education is like working closely with a nice, but utterly senile grandparent. Every step requires assistance, prodding, kind reminders, fond threats, long repetitive discussions. Every activity must be rechecked to be sure it goes in the desired direction. Himalayan patience is a daily requirement and outside psychological support is helpful. To make it even harder, in the middle of our operation the UN transitional government shut down and East Timor became an independent nation. This was a good thing, don't get me wrong, but the UN also pulled out a lot of the logistical support they had been giving to the half-island, especially communication and transportation. So it is that to this date, we still don't know exactly how many physics teachers are in each district, how many never received information about our courses nor how many received the information but were unable to find transport to attend.

By the time we were developing the national training courses, I could see the end of my stay in East Timor approaching. I wanted to prepare people to take my place when I was gone, so I asked Brother Mark if he would fund the training of trainers. He agreed, as did the five teachers I had been working with to develop the syllabus. We met several times and I attempted to download to them what I know about the art of teacher training. We also planned the courses together, choosing and reviewing lessons from the Manual to present and deciding which concepts were most important. Our goals were to take three steps: 1) teachers carry out the activities and learn from them; 2) teachers learn how to teach using hands-on activities; 3) teachers increase their understanding of various physics concepts.

Our 12-year-old neighbor Ana understands why pressure increases as you go deeper in the ocean or the atmosphere.

At the first national training course in June, my trainer mentees were on the front line. I sat in the back and watched while they carried out the training of their peers. From time to time I would step in and make corrections or add things they had missed. All in all it worked well, and by the end of two courses, we had reduced the number of trainers necessary to two, plus Teresinha to work some exercises with the teachers and me as on-call mentor, now reading (and writing newsletters!) in the back of the room.

Why is this boat floating? East Timorese students can do Archimedes' experiment to find out more about this integral element of Timorese culture.

These courses were intense: Monday through Saturday, 8am to 9pm, with short breaks for food and bathing. We had divided the nation into four sections and conducted these courses in four central locations throughout the country. Twice they were held in a high school with teachers sleeping on grass mats at night in a bare classroom, eating in another classroom and bathing in the squalid school washrooms. We offered no entertainment beyond the experiments themselves (which were often quite entertaining, mind you).

Nevertheless, the teachers' response was spectacular.[6] They showed up on time, stayed awake and never complained about the conditions. Three-quarters of the nation's middle and high schools sent teachers. A few teachers traveled to other regions to participate more than once. Nearly all wanted more! (And the reality is, they need more. In our weeklong course, we carried out only 23 lessons touching on most major topic areas, and quickly demonstrated about ten more. There are 41 required hands-on lessons for middle schools and 44 for high schools.)

Personally, I must say it was a nonstop thrill to watch

[6]The Catholic College of Baucau has a policy of charging for its courses. The theory is that teachers paying for the courses will be more serious. Teachers were charged US$10 apiece for this 55-hour course. This money did not even cover their food for the week, but was still a steep price considering their US$150 monthly salaries. Some teachers complained about the price, and we discussed this issue at length, in part because this course was a national requirement. In the end a compromise was reached: teachers could attend the course for free, but if they wanted the certificate to prove they had completed the course, they needed to pay. The Catholic College paid for teachers' transport to and from the courses. I'm personally not satisfied that the compromise was adequate, but the trainings to date have been successful beyond my expectations.

group after group of teachers perform the simple activities, then become engrossed in genuine discussions about what they observed and its meaning. One by one they discovered that their subject is not just a set of isolated factoids, and is in fact tightly woven into their own everyday lives and those of their students. Seeing them make these realizations was like witnessing the spring thaw.

We will give a total of six courses in four months. At the end of each course, we have the pleasant job of handing out a set of reference texts, the new Manual for teaching hands-on lessons and a complete kit of gear for the teachers to take back and put in their newly delivered cabinets. Watching the happy teachers walk away with their loot at the end of an exhausting week reminds me of the summer camps of my youth.

I'll be departing East Timor in November, which will leave the UNTIL lab courses without instructors. UNTIL needs a lot of support to develop proper laboratories for biology, chemistry and physics. Until this happens, our plan is to use lessons from the Manual as the lab curriculum. My mentee teachers, as the most qualified lab teachers in the country, have each chosen a lab course to teach in the coming year. Before leaving, I'll help them develop the activities to a higher level, and take advantage of some of the equipment we found in dusty boxes left over from

(top, left) Some of the 150 kits we distributed. (top, right) Nuno, one of the trainers-in-training, giving directions for an activity on Archimedes' principle. (bottom, left) Marcal from Aileu district displaying his kit. (bottom, right) A group of teachers thinking hard about atmospheric pressure.

Indonesian times. For the next two years this should be adequate. After that, high-school students entering UNTIL will have already seen many of the activities and will need more rigorous lab courses.

As it stands today, the problems with physics education in East Timor are broad and various, beginning with general chaos at the Ministry level, and no science and math coordinator. Many teachers at the elementary level completely avoid science education. No proper lab facilities exist in middle or high schools. Most teachers suffer from poor preparation and there are not enough teachers, with few rising to fill in the gaps. At the university level, there's no laboratory, no books, only one moderately qualified teacher and no international help.

At the same time, physics teachers in East Timor go to school and teach classrooms full of students every day. Now, many have at least some ideas about how to carry out hands-on education. They have a manual to give them step-by-step directions for activities, a bit of gear locked in a cabinet to use for these activities, textbooks of tolerable quality, a set of reference texts, and a national syllabus that is reasonable and gives them space to be creative. In short, middle- and high-school physics teachers in East Timor are equipped, required and generally inspired to begin working out how to teach with a method new to them, a method that puts great value on students' observations and on their culture and daily lives.

These teachers, however, are not satisfied. They have created the *Forum Komunikasaun Mestre/a Fizika Timor Lorosa'e*, an organization devoted to further development of East Timor's physics curriculum. (Incidentally, the *Forum* is looking for funding, primarily for teachers' transport and photocopying. If you have ideas, please contact me at cake@exploratorium.edu). I have every reason to believe that the state of physics education in East Timor will continue to improve long after I'm gone. ❑

(top, left) Believe it or not, this old woman knows all about angular momentum and inertia. The fat, heavy bottom on her spinning rod is not just for looks. (top, right) What happens if you turn on your radio then stick it in a pot and put on the lid? Try it! (right) A couple of crackers and some rice porridge make a model of plate tectonics that you can use to explain earthquakes and nearby volcanoes. The model can be eaten when you're done.

Sample lesson from the *Manuál Lisaun Prátika Fízika*

This lesson's name means "Winnowing Rice." The concept is that dense, compact things will move more easily through a fluid, such as air, than things with large surface areas. This principle is used to winnow grain, and is key to life in East Timor in that most people winnow rice daily to remove hulls and other foreign objects before preparing it to eat. It is also the principle behind a simple toy that can be made from string, a stick and plastic sack cut into a long strip.

The sections are standard to each activity in the Manual: **Supplies The Student Will Bring, Supplies The Teacher Will Bring, Group Size, To Do It, What Happened, Connection To Life, Connection to Textbook.**

Tahek Foos

Hadulas tali, ai no plástiku ikun atu komprende oinsá halo ketak foos nia isin no kulit.

Sasán ne'ebé estudante atu lori:	Sasán ne'ebé mestre atu lori:
•ai baluk •plástiku	•tali •tezoura

Tamañu grupu nian: konforme – estudante ida-idak bele halo mesak

Atu halo:

1. Tesi plástiku lotuk no naruk hanesan metru ida ka rua. Mós, bele uza tali rafia.

2. Kesi plástiku ba ai, no mós kesi tali ba ai.

3. Ba li'ur, kaer tali no hadulas hanesan foto iha kraik. Haree sá mak mosu.

4. Fila ba sala no halo diskusaun kona-ba sá mak mosu.

Sá mak mosu?

Tanbasá tali loos de'it maibé plástiku halo forma hanesan kabuar? Tanbasá ai sempre ba primeiru no plástiku tuir?

Atu komprende esperimentu ne'e, tenke hanoin kona-ba anin. Ai, tali, no plástiku semo iha anin nia laran. Anin fó forsa [gaya] ba sira. Forsa ne'e naran forsa friksaun [gaya gesekan] anin nian. Forsa ne'e sempre ba iha diresaun opostu ba sira nia diresaun semo.

Forsa friksaun anin ba buat ruma depende ba anin hira hasoru ho buat ne'e. Hanoin uluk kona-ba tali. Tali lotuk liu no hasoru ho anin uitoan de'it. Tuirmai hanoin kona-ba ai. Ai boot liu tali, maibé sei ladún boot. Ai hasoru ho anin ladún barak. Agora hanoin kona-ba plástiku. Plástiku boot liu – uluk ita tesi nia, nia boot hanesan saku plástiku. Nune'e, nia hasoru malu ho anin barak liu. Ne'e duni, forsa friksaun anin nian boot liu dudu ba plástiku.

Entre tali, ai, no plástiku, ai todan liu. Tanba ne'e, nia iha enerjia barak liu atu hasoru ho anin, no dudu anin. Plástiku no tali kamaan, no la iha enerjia barak atu dudu anin.

Mestre bele halo demonstrasaun balu atu hatudu ba estudante sira sá mak mosu bainhira troka tali, ai, no plástiku.

- Hakotu plástiku no hadulas ai iha tali de'it. Haree sá mak mosu.
- Hasai ai husi tali no hadulas tali de'it. Haree sá mak mosu.
- Kesi plástiku diretamente ba tali no hadulas tali. Haree sá mak mosu.

Se anin la iha, esperimentu ne'e sei sai la hanesan. Tuir teoria, tali, ai, no plástiku bele dulas loos de'it. Mós, bele halo esperimentu ne'e iha bee nia laran – iha tasi nia laran. Sá mak sei mosu? (Forsa friksaun bee nian boot liu forsa friksaun anin nian.)

Ligasaun ba moris:

Esperimentu ne'e importante tebes ba ita nia loroloron nia moris. Ita uza konseitu ne'e atu hasai foos nia kulit husi ninia isin depois fai hare. Bainhira ema tahek foos, foos nia isin no kulit sa'e ba leten. Tanba forsa gravidade, sira mós tun fali. Foos nia kulit boot no hasoru ho anin barak – nia tun neineik. Foos nia isin kiik no todan – nia tun lalais. Tanba forsa friksaun anin nian, ema bele halo ketak foos nia isin no kulit. (Atu hetan informasaun tan, haree lisaun "Galileo.")

Lisaun ne'e liga ba:

Eskola Pre-sekundária Livru Testu Fízika 1B, Konsep 5, p. 20.
Eskola Sekundária Livru Testu Fízika 1A, Bab II, p. 43, no mós 3A, Bab II, p. 19.

INSTITUTE OF CURRENT WORLD AFFAIRS

Fellows and their Activities

Martha Farmelo (April 2001- 2003) • **ARGENTINA**
A Georgetown graduate (major: psychology; minor, Spanish) with a Master's in Public Affairs from the Woodrow Wilson School at Princeton, Martha is the Institute's Suzanne Ecke McColl Fellow studying gender issues in Argentina. Married to an Argentine economist and mother of a small son, she will be focusing on both genders, which is immensely important in a land of Italo/Latino machismo. Martha has been involved with Latin America all her professional life, having worked with Catholic Relief Services and the Inter-American Development Bank in Costa Rica, with Human Rights Watch in Ecuador and the Inter-American Foundation in El Salvador, Uruguay and at the UN World Conference on Women in Beijing.

Curt Gabrielson (December 2000 - 2002) • **EAST TIMOR**
With a Missouri farm background and an MIT degree in physics, Curt is spending two years in East Timor, watching the new nation create an education system of its own out of the ashes of the Indonesian system. Since finishing MIT in 1993, Curt has focused on delivering inexpensive and culturally relevant hands-on science education to minority and low-income students. Based at the Teacher Institute of the Exploratorium in San Francisco, he has worked with youth and teachers in Beijing, Tibet, and the Mexican agricultural town of Watsonville, California.

Andrew Rice (May 2002 - 2004) • **UGANDA**
A former staff writer for the *New York Observer* and a reporter for the *Philadelphia Inquirer* and the Washington Bureau of *Newsday*, Andrew will be spending two years in Uganda, watching, waiting and reporting the possibility that the much-anticipated "African Renaissance" might begin with the administration of President Yoweri Museveni. Andrew won a B.A. in Government from Georgetown (minor: Theology) in 1997 after having spent a semester at Charles University in Prague, where he served as an intern for *Velvet* magazine and later traveled, experienced and wrote about the conflict in the Balkans.

Matthew Z. Wheeler (October 2002-2004) • **SOUTHEAST ASIA**
A former research assistant for the Rand Corporation specializing in South and Southeast Asia, Matt will spend two years looking into proposals, plans and realities of regional integration (and disintegration) along the Mekong River, from China to the sea at Vietnam. With a B.A. in liberal arts from Sarah Lawrence and an M.A. from Harvard in East Asian studies (as well as a year-long Blakemore Fellowship in Thai language studies) Matt will have to take long- and short-term conflicts in Burma, Thailand, Laos and Cambodia into account as he lives, writes and learns about the region.

James G. Workman (January 2002 - 2004) • **Southern Africa**
A policy strategist on national restoration initiatives for Interior Secretary Bruce Babbitt from 1998 to 2000, Jamie is an ICWA Donors' Fellow looking at southern African nations (South Africa, Botswana, Mozambique, Zambia and, maybe, Zimbabwe) through their utilization and conservation of fresh-water supplies. A Yale graduate (History; 1990) who spent his junior year at Oxford, Jamie won a journalism fellowship at the Poynter Institute for Media Studies and wrote for the *New Republic* and *Washington Business Journal* before his six years with Babbitt. Since then he has served as a Senior Advisor for the World Commission on Dams in Cape Town, South Africa.

Institute Fellows are chosen on the basis of character, previous experience and promise. They are young professionals funded to spend a minimum of two years carrying out self-designed programs of study and writing outside the United States. The Fellows are required to report their findings and experiences from the field once a month. They can write on any subject, as formally or informally as they wish. The result is a unique form of reporting, analysis and periodic assessment of international events and issues.

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