# The Daily Courier (Kelowna)

## Students using math to single out explosives

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Steve Coyne is looking for bombs, but he's not doing it with a dog or high-tech detection equipment.

He's using a pencil.

The 22-year-old mathematics student is part of a month-long program at a B.C. university asking students to partner with a handful of companies to solve real-world problems, like how to tell whether a piece of metal in the ground is a dangerous unexploded weapon or a harmless garden rake.

When a bomb, missile or other projectile hits the ground and doesn't explode, the shock of slamming into the Earth actually demagnetizes it, changing how it affects Earth's magnetic field. That change makes it easier to pick out when that magnetic field is measured and mapped.

As part of the mathematics camp at Simon Fraser University, Coyne's group -- Coyne, another Canadian student, two Americans and a student from Mexico -- are helping Sky Research Inc. develop a model to predict how unexploded ordnance reacts to the shock of impact.

"It tends to be the single best way to separate it (explosives) out from less harmful materials like shrapnel or garden implements," says Coyne, who is taking a double major in applied mathematics and philosophy at the University of Calgary.

"Apparently this is a very new field, and very few people have actually written anything about it."

The mathematics camp, run by a research network called MITACS, brought 30 math students from Canada and around the world to SFU in Burnaby.

Other projects include improving underwater sensors used to track the movements of marine life along the West Coast, modelling the daily energy consumption of buildings and measuring the impact of medical delays as patients move through different units of a hospital.

"We very rarely get the opportunity to apply these techniques (in the classroom), especially to problems with such urgent, important uses," says Coyne.

Sky Research and other companies are already using magnetic fields to assess underground dangers, said Steve Billings, the company's vice-president of research and development in Vancouver, but so far they must still dig a few holes to find out what's underneath.

If the students are able to solve Sky Research's problem, it will make it much easier to separate bombs and missiles from harmless horseshoes.

"We know we can apply it to certain sites, but if we come to a new site, we're not sure whether we can apply it," said Billings. "Hopefully, before we even dig a hole, we can say we think this technique will work or it won't -- at the moment we're still digging up horseshoes. It's a massive worldwide problem."

Billings said 10 to 20 per cent of all pieces of ordnance malfunction on impact and don't explode, burying themselves in the ground and leaving behind dangerous relics from conflicts or military training.

They're a troubling problem in current and former war zones such as Iraq, Afghanistan and Bosnia, says Billings, but it's also an issue in North America, where former military training grounds are sometimes abandoned and turned into residential or commercial developments.

"So if you're going to start digging holes, putting in roads, putting down foundations, there's a significant danger of a backhoe impacting an ordnance and creating an explosion," says Billings, whose company, based in Oregon with its research lab in Vancouver, has recently done work in B.C., Alberta and Ontario.

It's an example of how companies can use mathematics to solve complex problems -- something that's often overlooked by both industry and students, says Arvind Gupta, scientific director of MITACS.

"This kind of high-level industrial mathematics research is relatively new," says Gupta.

"We need to show students more broadly that this is an exciting area to do research in ... and we need to show companies the power of mathematics and what types of benefits they would get hiring students with these types of skills."