Pop Up Classes: Physics Learning Above and Beyond “the Usual”

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R·I·T
Pop-Ups: an easy way to add elements of Physics Innovation and Entrepreneurship (PIE) to your physics curriculum

PIE elements could include:

- Professional skills development (leadership, communication, collaboration)
- Technological expertise ("hands on" skills, physics principles for innovative solutions)
- Private sector concepts (Intellectual Property, business structures and models)
Pop-Ups Elsewhere

Becoming more common in engineering and in entrepreneurship curricula – good ideas to “borrow” or emulate.

a great program of pop-ups at Texas A&M

also Stanford, Bennington, and elsewhere
**What** are Pop-Ups?

**Why** do Pop-Ups?

**How** to do Pop-Ups?

**When**, **Where**, etc?
What is a Pop-Up?

- Usually short – one to four sessions
- Volunteer faculty (not part of normal teaching load)
- Volunteer students (not credit bearing)
- Little to no cost to student (possible fees for supplies, but no tuition cost)

off the books, under the radar
Why do Pop-Ups?

- Allows faculty to try out new material
- Allows “off the mainstream” material to be incorporated without broad agreement in the department
- Allows students to “dabble” without large investment of time or commitment of credits
- Fast turn around from conception of idea to implementation – no curriculum committees to pass!

They're just FUN!
What, Why, How, When, Where

Examples from RIT
At RIT: Professional Skills
Exploring Futures, and Career Skills

- **Roundtable discussion** on *grad school options*
  (several faculty, seniors)

  programs and institutions
  sources of information, how to use these resources
  realistic expectations
  non-Physics alternatives
  deadlines, requirements, costs
Before Career Fair or Intern Interviews

- **Workshop** on **Resumes**:
  - *first session* discusses resumes in general
  - *second session* is “bring your resume” and groups work to improve them and target for specific jobs

- **Workshop** on **Elevator Speeches**:
  - practice sessions to develop snappy self-introductions
  - discussion of the importance of networking, meeting people
Mock Interviews for specific recently-posted jobs
find a half dozen relevant jobs (monster.com, etc) faculty
with relevant background study up on those companies, products!

student decides which job is of interest to them, schedules
a half hour “interview” with faculty

faculty play recruiter or interviewer, trying to play it straight

immediate feedback to student after interview
At RIT: Hands-on Skills

Simple kit building – soldering

12 students, 6 solder stations

Friday afternoon 2 hours
just before holiday break

This class filled very quickly
(I only had 12 kits)

Total mayhem! They don't know how to solder...
At RIT: Hands-on Skills

Arduino Intro

Resources: (~$300)

- 6 “shoeboxes” each with Arduino, protoboard, wires, assorted LEDs, buzzers, transistors, resistors, motors, diodes, switches, relays

- DVMs, power supplies, lab space borrowed from department

Two sessions, two hours each
Arduino classes limited to 12
Students worked in pairs if class full (6 setups)
Students brought their own laptops
Students had ALREADY installed the IDE

No prior programming experience required at all

Many students had never had Electronics Lab thus needed help with protoboard, diode polarity etc

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instructor is **VERY** busy!
Guided Exploration – Handouts:

- Begins with “type this code in, build this very simple circuit” - for ONE blinky LED
- Suggests adding another LED, changing blink sequence... let the student figure it out
- Subsequent sections add circuit elements, add code fragments
- All are just suggested fun things to try
- Builds coding skills and hardware familiarity in somewhat systematic way
**Code:**
first ... minimum to make Arduino do anything
then ... IF THEN ELSE conditionals
then ... LOOPs
then ... conditionals with inputs from user

**Hardware:**
first ... simplest Digital output
then ... Digital input and output
then ... Analog output (buzzers)
then ... Analog input and output (light controlled buzzer)
Usually by one hour in, they are “off to the races” and going off-script, trying things

They seem blissfully unaware that they are learning to code in compiled C, by just doing it

Quite a few have purchased their own Arduinos and are building things on their own or taking their skills back to research and capstone projects.
Follow up second Arduino session

more power

- Motors
- Relays
- Switching AC
Suggestions:

Keep it casual, e.g.

Keep it loose

```cpp
val = digitalRead(SWITCH);  // decide if switch pin 2 is hi or lo
if (val == HIGH) {
    // if its hi, blinky pattern
    ... insert your code for whatever blink pattern you like ...
}
else {
    // if its lo, shut the LEDs off
```
At RIT: Hands-on Skills

Machine Shop Basics

- Groups of 4 maximum
- Basic skills with drill press, band saw
- Files, tapping
- Milling machine projects under development
- Lathe projects... maybe someday
Logistics and Planning

You need a fun-looking announcement (header portion shown)

Post it where students hang out

Make sure the dept technicians are on board

Be sure to include sign-up info and size limit

Not too much advance notice or fuss
Logistics, Continued

Timing is everything
Friday afternoons
Early evening

Avoid exam times, stressful times

2 hours is plenty

Seek student input

Seek student help - students come back to help
Advice – Expect Mayhem

• Arduino class … 12 students, inexperienced programmers, no electronics background
  Me bouncing around the room: “you need a curly bracket here”... “the diode is backwards”... “add a pull up resistor”... “don't forget to compile first” ...

• Kit building class … 12 students, none have soldered before.
  Me bouncing around the room: “tin the iron first”.... “yikes you've blown the trace off the board”... “don't forget the polarity”...
Coping with Chaos

Adjust your class size to suit your tolerance
Set your expectations reasonably
Don't get flustered! The idea is to have fun!
Draft more experienced students to help
Learn to say “Just try it”, “I dunno”, and “see what happens!” (obviously better advice for an electronics class than a machine shop one).
“If you build it, they will come”
(Field of Dreams, 1989)

Students are now requesting pop-ups

Computer related:

- How to install Linux dual boot systems
- Getting started with LaTeX
- Getting started with gnuplot
- Using Numpy and Scipy within python
More student requested pop-ups:

**Hands On** related:

- More solder kits – they noticed their lack of skills
- Much more metal working machine shop
- Welding (??!!!)
- Raspberry Pi intro
- “anything else you can teach us” (sad, eh?)
More student requested pop-ups:

*Professional skills* related:

- More instances of what we're doing
- Job searching tactics
- More visiting speakers from local industry
  - Particularly those with co-op or intern opportunities
  - Recent alumni are great role models
Faculty are requesting to teach pop-ups

- Cryogenics – basics of thermometry, fluids handling, etc
- Xray Diffraction as materials characterization tool (short course over break week)
- Some astro software package intros
**What** are Pop-Ups?

*anything you want*

**Why** do Pop-Ups?

*to try out all that stuff you always wanted to do but couldn't figure out how to add any other way. It's just a cool name!*

**How** do you do Pop-Ups? ---

*however you want, on whatever you want*

**Where, When, etc**

*whatever works at your institution*
Pop-Ups: Issues Moving Forward

• Institutional backing?
  – PopUps do not generate tuition revenue
  – Uses faculty time and institutional resources
  – Better to ask forgiveness than permission

• Goal: “Badging” or some form of accreditation
  – Formalize the curricula so it “counts” for students and faculty both?

• Be careful what you wish for;
  – this can balloon into a lot of requests for a lot of things very quickly!
Acknowledgements

RIT School of Physics and Astronomy
RIT College of Science
Crystal Bailey and the APS

This material is based upon work supported by the National Science Foundation's Improving Undergraduate STEM Education (IUSE) program under Award No. 1624882. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.