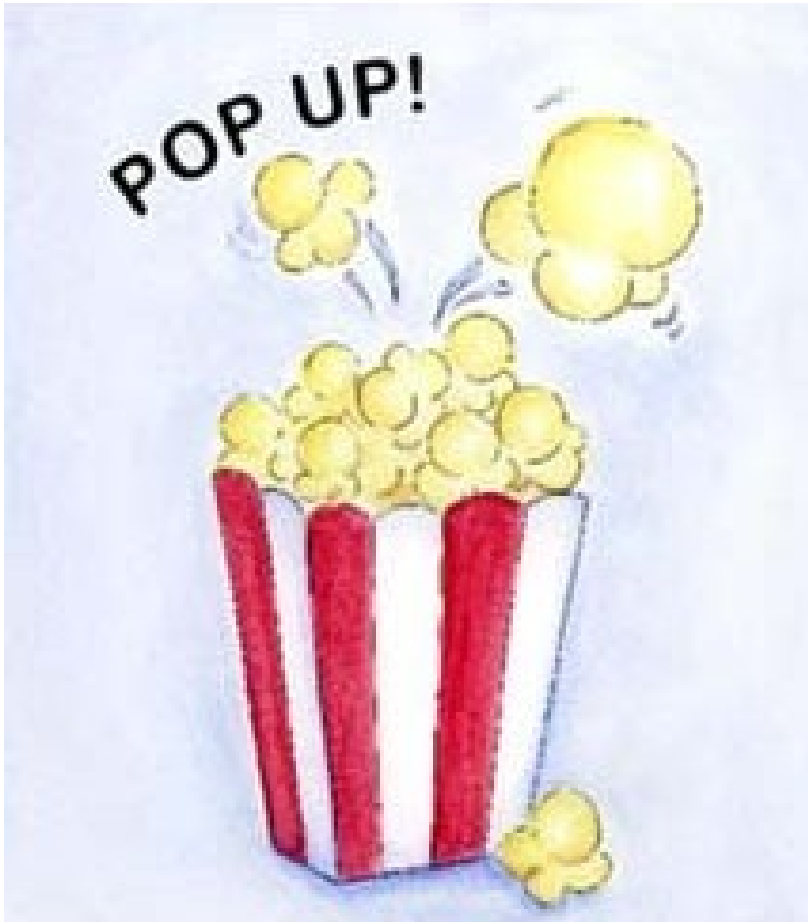


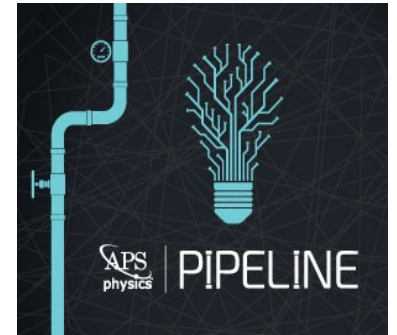
***Pop Up Classes: Physics Learning  
Above and Beyond “the Usual”***



*Linda Barton*



# ***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

## ***Before Career Fair or Intern Interviews***

- **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...



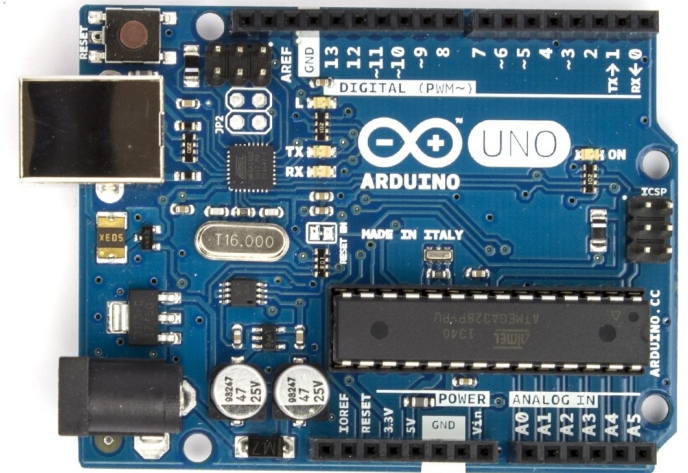
# *At RIT: Hands-on Skills*

## Arduino Intro

Resources: (~\$300)

- 6 “shoeboxes” each with Arduino, protoboard, wires, assorted LEDs, buzzers, transistors, resistors, mot 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

---> 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.



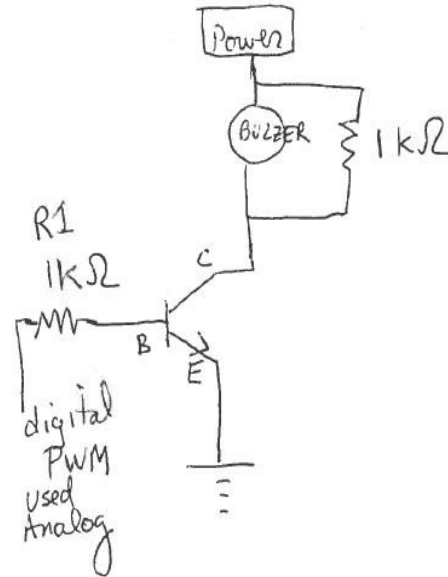
# Follow up second Arduino session

more power

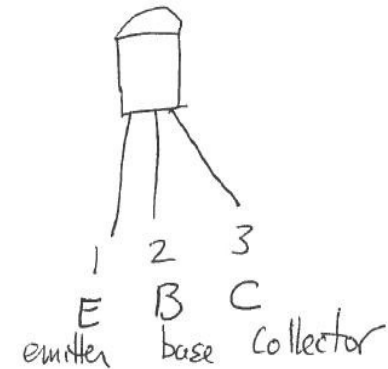
- Motors
- Relays
- Switching AC

# Suggestions:

Keep it casual, e.g.



2N3904 NPN  
from Sparkfun  
Flat side towards you



Keep it loose

```
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
```

Keep it fun

open ended hardware suggestions,  
just snippets of code as teaser examples

# ***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

**POP~UP CLASS**

**BEGINNING ARDUINO**

*..... it's Tinker Time !! .....*

Come join us for a just-for-fun session or two where you can play with an Arduino, and learn some things about how to make it work.

*Blinky lights! Tone generators! Motors!*

# ***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”... “dont 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.

