Developing Photonics Education in Iowa’s Rural High Schools (DPE)
(Developing __________ Education in __________’s Rural High Schools)
Project Y2, Q3
HI-TEC 2020 Transformed

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Please feel free to send questions or comments.

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Pathway to Careers
• Population of IA: 3.1 million in 99 counties; ~31.3k per county
  • IHCC’s 10 - county area: 137,900; ~13.9k per county; 44% of state average.
  • Currently 4 – high schools have 17 students attending LEO 103 out of 1170.
  • School year 2020 – 2021: increase recruiting outreach area.

• IHCC understands the national demand for Laser & Optics ( photonics) technicians and seeks to increase the supply across the U.S.

• IHCC’s Lasers & Optics Technology program began in 1985.
  • First graduating class was May 1987; Average 20 graduates per year
  • Graduates employed by 140 companies, in 42 states & 2 European countries
  • 8 – 10 job opportunities per graduate; 4 - 5 job offers; averaging $57.5k
  • Less than 1% of these grads employed in Iowa. We inform them they will move.
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• 2014: The Midwest Photonics Education Center (MPEC) was established as a NSF ATE center (2014 – 2018) at Indian Hills Community College (IHCC) in its Advanced Technology Center, Ottumwa, IA.
  • MPEC: Worked with a network of educational institutions and business partners in states throughout the Midwest and across the nation to lead an effort to increase the number of trained photonics technicians.
  • MISSION: To introduce university, community college, high school and middle school teachers to lasers & optics ( photonics).
  • MPEC ended 8/2019 after a one year extension; its influence has not.
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• 2018: The NSF ATE project grant, Developing Photonics Education in Iowa’s Rural High Schools (RIPE), was awarded to IHCC (2018 – 2021).
  • A three-year mission to bring educational programming in the high-growth, high-demand field of photonics to a population rarely afforded such opportunities: rural Iowa high school students and teachers.
• Our primary goal is to increase the number of rural Iowa high school students in the photonics technician pipeline.
  • Leverage MPEC’s associations with industry partners to enhance the project’s activities.
  • Develop new relationships with rural Iowa secondary schools and homeschool groups to build sustainability.

To date
This goal will be met through three objectives:

1. Offer an engaging, dual credit photonics course to rural Iowa high school students via a hybrid online learning platform.

2. Provide photonics-related professional development and follow-up assistance to science and technology teachers to have photonics concepts infused into their courses.

3. Host a photonics summer institute to provide high school students & teachers with more in-depth exposure to the field.
1. Offer an engaging, *dual credit photonics course* to rural Iowa high school students via a *hybrid online* learning platform

- High School Photonics Fundamentals courses (2)
  - Two, eighteen week high school semesters.
  - Together they transfer as the IHCC Photonics Fundamentals course (1)
- Each course consist of three learning units (LU) which include
  - *Online* “lecture” content (syllabus & course schedule) for
    - LU reading assignments (texts supplied by IHCC)
    - LU slide presentations with audio & transcript
    - LU Study Guide which is submitted/graded
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Each course consists of three (3) learning units which include:

- LU Lasers & Optics Labs: 15 total: 2/LU - Course 1 (6); 3/LU - Course 2 (9)
  - *Hands-on* labs (IHCC supplies the kits)
    - These Kits have the necessary components and equipment to set-up and complete 30 photonics labs
  - Lab Instruction Booklet included with purchase of Photonics Kit
- Instructions for each lab are contained in the course learning unit
  - 2 – videos are supplied to assist in lab completion.
- Lab Write-Up is submitted & graded
- LU Test
  - Students may use the presentation, study guide, text and lab results
  - Each LU test has a time limit.
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- Optical Breadboard/Plate & 45.7mm (18”) Stainless Steel Ruler
- 2 - large & 2 - small storage boxes
- Photometer Detector with Thumb Screw & Cord placement
- Lens Cleaning Wipes & Tissues
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Location of components in Small Storage Box #2

- Mounted 50 μm Precision Pinhole
- Polarizer, Glass, green, 25mm diameter
- Microscope Slide
- 2 – Lens Mount, Fixed
- Razor blade
- 2 – Laser Diodes with cords neatly wrapped

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Location of components in Small Storage Box #1

2 – Prism, Right Angle
Prism, Equilateral
Bi-Concave Lens Ø25.4mm f = -25mm
Plano Convex Lens Ø25.4mm f=200mm
Bi-Convex Lens Ø25.4mm f = 25.4mm
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Location of components in Large Storage Box #2

- 2 – Right-Angle Clamp/Post Holder
- 7 – Posts, 2 piece
- 6 – Post Holders
- 2 – Dual Filter Holders
- Mounted Single Slit, 100μm
- Block, Acrylic
- Wave Plate, Multiple Order, ¼ Wave
- 2 – Base, Mounting

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Location of components in Large Storage Box #1

- 2 – Kinematic Mirror Mount with mirror
- 2 – Polarizers, slide mount
- LED Inspection Flashlight
- 6+ each Socket Head & Set Screws
- 7-piece, Hex Key (Allen wrench) Set
- V-Clamp, Cylindrical Laser Mount, with Clamping Arm (packed separately)
- 5 – index cards & protractor
- Filter Set, Color (RGB, CYM)
- 1000 lines/mm Diffraction Grating
- Rotation Mount & Rotation Stage
- Rotation Mount & Rotation Stage
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- Placement with storage boxes removed
- All Equipment Documentation
- 2 - A/C Cords for Power Supplies
- Photometer, Digital, 2µW, 2mW, 20mW settings
- Photometer Detector with Thumb Screw & Cord
- Translation Stage, Single Axis
- Spectroscope
- Base with Rod for Optical Detector
- 2 - Laser Diode Power Supplies (bottom to bottom) with cords neatly wrapped

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Lab Instruction booklet contains thirty labs that can be completed using the Photonics Kit.
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2. Provide photonics-related professional development and follow-up assistance to science and technology teachers to have photonics concepts infused into their courses. Photonics Symposium.

- Conducted first one Aug 5 & 6, 2019
- Tentatively #2 is Aug 3 & 4, 2020 (COVID19)
- Each school has a STEM “facilitator” to oversee the class time.
  - Ensure security for the lab kits and answer ancillary questions.
- Laser/Optics Technology Symposium: 2 – days each summer.
  - Generated and presented for STEM teachers.
  - CEU’s may be obtained.
  - 4 – hours: Presentation on the basics of photonics
  - 12 – hours: Hands-on training with the RIPE (MPEC) Photonics Kit
3. Host a photonics summer institute to provide high school students & teachers with more in-depth exposure to the field. Photonics Institute.
   - First one was scheduled for July 2020 but was cancelled (COVID19)
   - Photonics Fundamentals Institute: 4 – days each summer.
     - Meet & greet; tour of IHCC facility with emphasis on Laser Optics lab; expert panels; local company tours utilizing lasers; hands-on lab activities for teacher/student teams, etc.
     - CEU’s may be obtained
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• Compared to other teaching methods
  • Online/hybrid dual credit
    • Lecture content is online
    • Lab content is hands-on with donated labs
  • Online
    • No hands-on labs.
  • Face-to-face
    • Not available to multiple high schools and therefore students/teachers
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• Strengths, Weaknesses
  • Strengths:
    • Available to large number of students in multiple high schools
    • Outreach to include more high schools and their administration
  • Weaknesses:
    • Most high school students have not taken an online course
    • Most STEM Facilitators do not know the content
    • Communication factor is highly reduced even though we are using Blackboard Collaborate, etc.
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• Opportunities, Threats
  • Opportunities
    • Students and teachers (facilitators) are becoming informed and involved
    • Educate students/teachers/counsellors about benefits of lasers & optics
    • Increase the number of students in photonics careers.
  • Threats
    • The fear of the unknown to be voiced to other students
    • Lack of commitment for sustainability
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• How best applied/implemented
  • Expert knowledge person to develop content and labs
  • Available teacher/trainer
    • The four high schools (6 sessions) have class times at six intervals from 8:00 a.m. to 3:22 p.m.
• Necessary lab components in a single kit to support all labs
• Enough kits for all involved students
  • One kit per two students
    • One kit per three is acceptable with designated roles that rotate
      • Lab Scribe
      • Lab Technician
      • Lab Team Leader/Safety Officer
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• 2019 – 2020, Year 2 results:
  • Contacted eight high schools
  • Four participated
  • Seventeen starting students
    • 19 original with 2 withdrawing within a week
  • Nine completers: 53% completion rate.
    • Hands-on labs were eliminated as equipment was stored within the high school building.
    • Creative pedagogy was used to fulfill course objectives.
  • Five of those are interested in photonics: 56% interested
  • One of the five has registered for FA2020: 20%
• **2020 – 2021, Year three plans:**
  • Contacted all IHCC area high schools: 21
  • Narrowed that to fifteen, response was normal
  • Then COVID19 (C19) happened
    • Unable to have face-to-face administrative meetings and/or student presentations
    • Continued communicating; minimal response
    • Conducted two area wide ZOOM outreach meetings
      • Three high schools responded
      • Two students have registered; not from one of the originals
      • IHCC’s Connect 2 College office anticipates that when the schools resume, more will register
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• 2020 – 2021, Year three plans:
  • Continuing to communicate to superintendents, principals, counsellors and teachers
  • Attend & participate in a greater number of high school career days
  • Offer & conduct Photonics Fundamentals I & II
    • LEO103 & 104 which correspond to IHCC’s LEO102
  • Plan for 2 symposiums and 2 institutes summer 2021
  • Submit a supplemental grant proposal for one year extension
    • C19 eliminated the effectiveness of meeting the objectives
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Please email me your questions and/or comments or feel free to give me a call.

Thank you for your attention.

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