SATS || SHARP

rstriemer@pembinatrails.ca

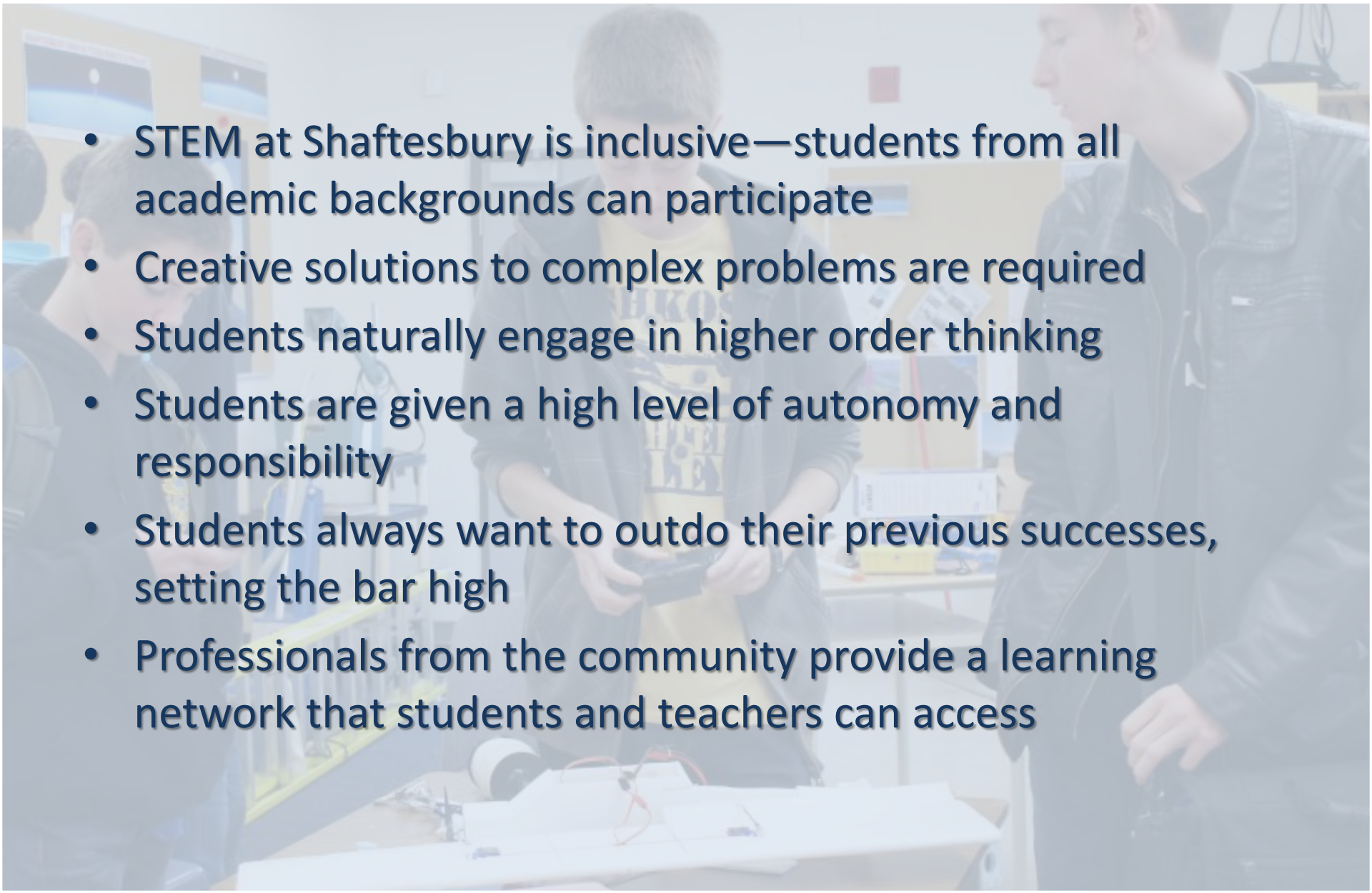
SHAFTESBURY HIGH SCHOOL

adeakin@pembinatrails.ca

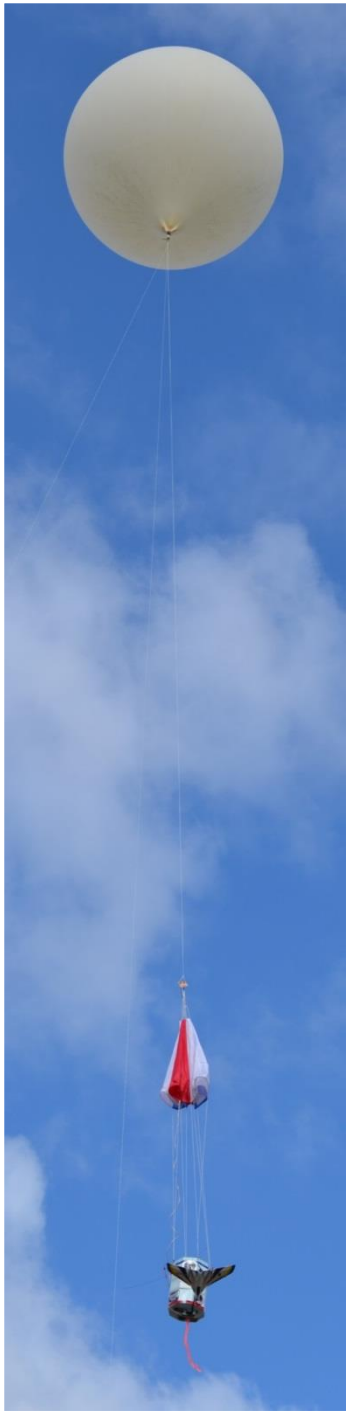
STEM Education at Shaftesbury

- **STEM** integrates ***science***, ***technology***, ***engineering***, and ***mathematics*** disciplines using real-world applications
- Students decide what they learn based on their personal interest and skills
- New students are mentored by experienced ones
- Pressure of learning a specific curriculum is lifted
- Students tackle a big question with an unknown outcome
- No testing, instead process oriented guided inquiry learning with a fun but high stakes performance task at the end
- Teamwork is essential to success

STEM Education at Shaftesbury



- STEM at Shaftesbury is inclusive—students from all academic backgrounds can participate
- Creative solutions to complex problems are required
- Students naturally engage in higher order thinking
- Students are given a high level of autonomy and responsibility
- Students always want to outdo their previous successes, setting the bar high
- Professionals from the community provide a learning network that students and teachers can access



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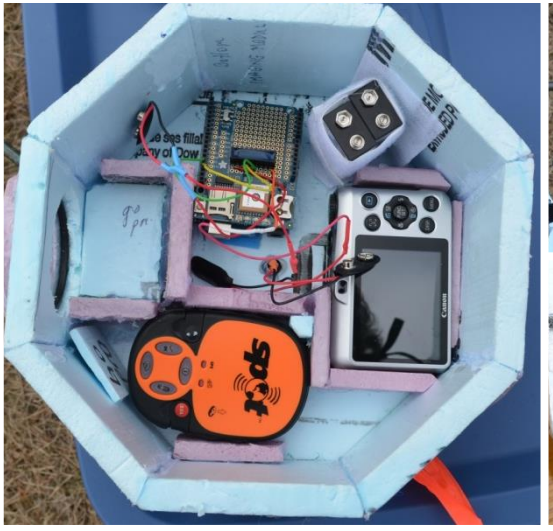
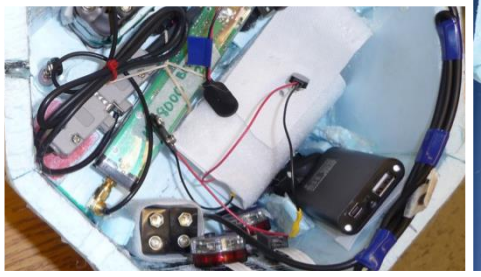




The History of SHARP

- In 2009, Shaftesbury librarian asked "how do we get pictures of earth from near space?"
- ***Shaftesbury High Altitude Robotics Project*** was founded
- SHARP is a group of volunteer teachers & students engaged in engineering projects involving HABs
- Interested students adopt various portfolios
- Members meet during lunch hours at school
- Students have access to professionals from the community who act as mentors
- Ongoing fundraising through grants & donations

SHARP Student Portfolios

- Amateur radio
- Electronics
- Graphic Design & Photography
- Payload Construction
- Programming
- Public Speaking
- Radio Controlled Aircraft
- Science Experiments

SHARP & Amateur Radio

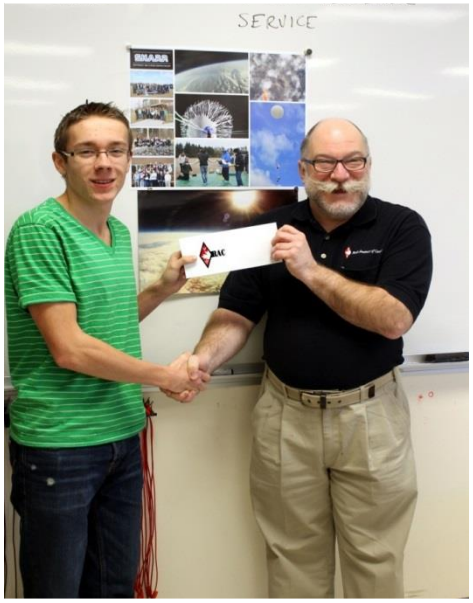
- Initial interest in amateur radio began with tracking HABs using APRS transmitter beacon
- Since 2010, twenty-four Shaftesbury students & staff members have earned their call signs through University of Manitoba and Winnipeg Amateur Radio Club radio courses
- Outside of school funding, the Ham radio community is the largest contributor to STEM programming at Shaftesbury

SHARP Missions

SHARP Mission	Balloon Weight	Apogee (feet)	Mission Objectives
SHARP1 10.22.2010	1500 g	107,000	Capture digital video containing curvature of the earth
SHARP2 10.28.2011	3000 g	127,000	Set altitude record, capture photos & HD video, collect radiation, temperature data, examine effects of radiation on seeds & chemicals
SHARP3.1 11.03.2013	3000 g	117,000	Improve launch procedures & quality of photo & video data collected, test Arduino sketches, log a broad range of atmospheric & telemetric data, conduct scientific investigations, incorporate an R/C aircraft drop

SHARP Payload Images

Shaftesbury ARISS Telebridge Service



VE4ISS Mission Statements

- To educate and train student amateur radio operators so that they may facilitate ARISS school contacts worldwide
- To provide students access to and to promote the hobby of amateur radio and satellite tracking
- To build and strengthen relationships with members of the amateur radio and satellite tracking communities
- To provide a centre for excellence in STEM education

VE4ISS Timeline

- 05.13—Stefan Wagener, VE4NSA, Canadian ARISS delegate, proposed idea of ARISS telebridge station
- 06.13—stakeholders met and steering committee struck
- 06.13—proposed equipment list and budget
- 09.13—launched fundraising campaign
- 10.13—ordered equipment
- 12.13—began assembling station
- 02.14—trained Ham radio operators
- 03.14—launched public speaking campaign
- 09.14—began operating VE4ISS

VE4ISS Funding Campaign Timeline

- 06.13—Funding request letter to Minister of Education
- 07.13—Meeting with Manitoba Aerospace
- 08.13—Meeting with Department of Education
- 09.13
  - Radio & television news interviews
  - Grant application to STAM
  - Manitoba Education letter of support
- 10.13
  - Presentations to WARC, RASC, CSS, and meetings with Literacy Partners of Manitoba & APEGM
  - WARC flea market
  - STAM excellence in education cash award
  - Shaftesbury school administration announces full support for SATS
- 11.13
  - Prairie Mobile Communications & Kenwood Canada donate TS-2000(X) radios
  - WARC donates $500 towards purchase of antenna preamp
- 12.13 to present—private donors contribute more than $3,500

Our Supporters

VE4ISS Equipment

ARISS Primary Antennas		
	22-Element CP 2m Yagi Specs	42-Element CP 70cm Yagi Specs
Model	2MCP22	436CP42UG
Frequency Range	144 to 148 MHz	430 to 438 MHz
Gain	14.39 dBic	18.9 dBic
Front to Back	25 dB Typical	25 dB Typical
Elipticity	> 3 dB	1.5 dB Typical
Beam Width	38°	21° Circular
Feed Type	Folded Dipole	Folded Dipole
Feed Impedance	50 Ohms Unbalanced	50 Ohms Unbalanced
Max VSWR	1.4:1	1.5:1

ARISS Secondary Antennas	Rotors/Cables	Radios & Additional Antennas
• 2 Gulf Alfa Dual Band 2m/70cm satellite yagis (phased for 2m & 70cm) • RF HamDesign HamTV 1.5m dish (Kuehne LNB downconverter)	• RF HamDesign 1x Spid RAS HR, MD-01 controller • RF HamDesign 1x Spid Big RAS HR, MD-01 controller • All LMR400/600 cables to station	• Kenwood TS-2000 & TS-2000X (1° & 2° radios) • Kenwood TM-D710A Mobile • Yaesu FT-8100 • Diamond 2m/70cm vertical • 2m Tape Measure Yagi • 2x ICOM V80 Handheld • 2x Baofeng UV5R Handheld

Software		TNC
• SatPC32 • Nova for Windows • Orbitron	• UISS • DireWolf • FL-digi / FL-digi HAB	• 2 Signalink USB • 2x Kenwood PC-1A Phonepatch

Current STEM Projects

- VE4ISS station operation training
- Amateur radio basic examination training
- World Space Week tethered camera rocket launch
- SHARP4 Lite mission objective planning
- Kerbal Space Program presentation on orbital mechanics
- 3DR ArduCopter Quad drone assembly
- Installation of FPV camera on RC trainer plane
- RC flight simulation pilot training
- Soldering training
- Developing an Arduino controlled Iridium satellite transceiver HAB cut down sketch—VE4MRH
- Collaboration with Manitoba Association of Physics Teachers

Lessons Learned from VE4ISS

- Challenges:
  - Steep learning curve
  - Lack of funding
  - Delays in purchasing, shipping, construction
  - Workplace Safety & Health regulations
  - Divisional operating procedures (IT, buildings & grounds)
  - Wind, snow, rain & cold temperatures
  - Frequent adjustments to equipment, malfunctions, and failure (rotors & antennas)
  - Much time dedicated to problem solving
  - Limited access to building
  - Unfavourable satellite pass times
  - Infrequent HamTV availability

STEM Education Celebrations

- VE4ISS is Canada's only permanent ARISS telebridge station
- Students awarded special recognition at University of Manitoba Schools' Science Symposia & Dream Big Event
- Shaftesbury STEM programs raised over $35,000 through grants, awards, and donations since 2009
- 2 Canadian Space Agency visits to Shaftesbury since 2009
- Students shared their experiences & results with hundreds of students at schools in Manitoba & the United States
- Many graduates pursue careers in engineering & science
- Coordinators earned 4 awards for collaboration and excellence in teaching, including the Prime Ministers' Award for Teaching Excellence

Looking to Incorporate STEM Education?

- **THINK BIG**—provide opportunities for broad student engagement
- **INITIATE**—getting started builds positive momentum
- **COLLABORATE**—together we make things better
- **GATHER SUPPORT**—a supportive administration is key
- **PROMOTE**—essential people, funding, and materials will arrive
- **PERSEVERE**—the level of achievement is related to the level of investment

Shaftesbury High School
Winnipeg, Manitoba, Canada
R3P 0P7
Tel:204.888.5898 Fax:204.896.5492
http:www.pembinatrails.ca/shaftesbury

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http://sballoonproject.pbworks.com