

THE

# STEMCrAfT PROJECT

SCIENCE, TECHNOLOGY, ENGINEERING AND MATHEMATICS

## STEM Framework Guidelines



Australian Government  
Department of Education



UNIVERSITY of  
TASMANIA

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# The STEM Framework Guidelines

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## What is STEM?

Science, Technology, Engineering and Mathematics – STEM – is based on the idea of educating students in four specific disciplines in an interdisciplinary and applied approach.

## What is STEMCrAfT and the STEM Framework?

STEMCrAfT is an acronym for: 'Science, Technology, Engineering and Mathematics Critical Appraisal for Teaching'. The STEMCrAfT project has been funded through the Australian Department of Education, Australian Maths and Science Partnerships Program (AMSPP) and is managed by the University of Tasmania (UTAS).

The aim of the project is to build capacity of STEM teachers using a peer support model and utilising the STEM Framework as a tool. During a series of workshops, staff from the UTAS Faculty of Education and Centre for University Pathways and Programs (CUPP) worked with rural and regional STEM teachers to construct the Framework based upon principles underpinning practice. Together they worked to identify the processes undertaken when reviewing STEM resources appropriate to particular student groups in particular learning and teaching contexts.

## What is the Framework about?

The Framework is a decision making tool designed to assist teachers with their selection of resources when working with students on STEM curriculum. It assists in the consideration of the capacity and needs of a particular student group (early years through to secondary school) and the resources available in particular teaching environments. It is designed by STEM teachers for use by STEM teachers, irrespective of their level of experience.

## How the STEM Framework will help you

The thinking underpinning the development of the Framework is that of reflective practice (Schon, 1983) *reflection on, in and for practice*. It is designed to help teachers focus, reflect and plan at all stages of the learning and teaching process; during Planning, Implementing and Evaluating teaching and learning.

The design of the Framework aims to make Pedagogical Content Knowledge (PCK) visible (Shulman, 1986); to do this, the process of applying the Framework should be documented. For the Framework to be a useful tool, now and into the future, it needs to be continuously evaluated by teachers of STEM as well as those working in the disciplines of STEM and STEM teacher education.

## When and how do you use the Framework

The Framework should be usable by all those involved in STEM education, whether they are experienced, less experienced, STEM teachers or non-teaching support staff. We anticipate that it will be implemented by individuals alone and/or via a collaboration of more experienced and less experienced STEM teachers. Follow this link for a [list of people](#) to consider using the STEM

Framework: who could consider using the STEM Framework and this link for [the circumstances](#) in which its use would be beneficial.

## Evaluation of the Framework

When you decide to use the STEM Framework to review the STEM resources you are considering, the project team would appreciate your feedback through participating in online forums and postings via on the [STEMCrAft website](#).

## The STEMCrAft Online Forum/ Community of Practice

In addition to the development of the Framework, the project team have also commenced the development of an online forum or community of practice (CoP). As a key focus of this project is assisting teachers working in rural and regional Australia, online resources offer a practical way to stay informed, meet with peers and continue to develop professionally.

### The role of the STEMCrAft Community of Practice

The role of the [STEMCrAft CoP](#) is to provide an online community for people working in STEM teaching and learning, and where they can engage with each other, seek advice, offer expertise and exchange ideas concerning the teaching of STEM, how to do it better, smarter, differently and ultimately reduce our isolation. An online community of practice may be useful as it turns the conversations we have into collaborations.

You can also use the CoP to:

- To provide an informal peer to peer learning environment, and
- To contribute to the evaluation of the practical application of the STEM Framework.

## Research informing practice

The STEMCrAft project has three main objectives; these are to:

1. Provide a Framework by which teachers can select STEM teaching resources (human expertise, online or material) that are best suited to their needs and context;
2. Raise the confidence and resilience of teachers in rural and regional schools in relation to maths/science knowledge and its application;
3. Assist teachers to inspire rural and regional students and improve their achievements in maths/science and inclination to continue its study beyond.

## Contributing to the project's research

Please consider contributing to the research through trialling the Framework and recording the processes you have undertaken whilst doing so. If you decide to participate in the research component of the STEM Framework, please read the [Information Sheet](#) and give written [consent](#) (both documents are included in this kit), or you can complete this documentation on our [website](#).

To assist in the project's collection of data, there are data collection sheets available on the website for mentors and participants wanting to document their use of the STEM Framework to evaluate their

resource selection. Please complete and return these either by email to the [STEMCrAft Project Officer](#) or mail to:

STEMCrAft Project  
University of Tasmania  
Locked Bag 1354  
LAUNCESTON TAS  
7250

## Using the Framework

Whether you are a less experienced / teaching out of area STEM teacher or an experienced teacher of STEM mentoring someone with less experience, this section provides information on how to use the Framework and provide your feedback.

## Mentoring a less experienced teacher of STEM

### Process for the mentor

To apply the STEM Framework to resource selection, it will be useful to undertake the following:

1. Obtain a copy of the STEM Framework to work with (electronic or hard copy). It is electronically available at the [STEM Framework](#), or you can print off a copy from the end of this document.
2. Familiarise yourself with the contents of this kit and the Framework. If you have any questions you can contact the [project staff](#) or the STEMCrAft [Community of Practice](#) for assistance.
3. Think about who might benefit from using the STEM Framework and approach them about participating as a mentee.
4. The Framework asks a series of questions that require time for reflection; ensure you can each set time aside for this process
5. When you are familiar with the Framework and the project, meet with the mentee and discuss the purpose of the Framework with them. Introduce them to the [Community of Practice](#) where they can get assistance, advice and share their experiences with their peers, and contribute expertise
6. Set up a meeting schedule to check on how they are progressing.
7. Be there for them when they need assistance or advice.
8. Encourage them to set a deadline for completion.

### Process for the less experienced /out of area STEM teacher being mentored or working alone

To apply the STEM Framework to resource selection, give consideration to the following:

1. Obtain a copy of the STEM Framework to work with (electronic or hard copy). It is electronically available at the [STEM Framework](#), or you can print off a copy from the end of this document.
9. Familiarise yourself with the contents of this kit and the Framework. If you have any questions and you have a Mentor contact them. Or you can contact the [project staff](#) or the STEMCrAft [Community of Practice](#) for assistance.
2. The Framework asks a series of questions that require time for reflection. Make time to discuss your use of the Framework with colleagues in your school or via the [Community of Practice](#) and make sure to set aside sufficient time to work through this process.

3. Use the [Community of Practice](#) to get assistance, advice and share your experiences with your peers.
4. Set up a schedule including a deadline in order to monitor your progress.

### Project Team contact details

The project leaders are:

[Sharon Fraser](#)

[Kim Beswick](#)

[Sue Kilpatrick](#)

The Project Officer is [Suzanne Crowley](#), and the Project Support Officer is [Melissa Verschuren](#).

If you have any queries relating to the STEM Framework or the StemCrAfT Project more generally, or you want to return your feedback, you can do so as follows:

STEMCrAfT Project  
University of Tasmania  
Locked Bag 1354  
LAUNCESTON TAS 7250  
[www.stemcraft.weebly.com](http://www.stemcraft.weebly.com)

or post on the [CoP](#).

For the period of the project, the project officers can be contacted on **+61363243268**

If you are making queries post August 2014, please contact [Sharon Fraser](#) (+61363243083)

**We hope you find this Framework useful and look forward to receiving your feedback.**

## References

Schon, D. (1983). *The reflective practitioner: How professionals think in action* London: Temple Smith.

Shulman, L. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher*, 15((2)), 4-14.

## Evaluating and selecting STEM resources: capacity building for teachers in rural and regional schools

### Information sheet for Framework evaluation participants

#### Invitation

You are being invited to participate in the study, “Evaluating and selecting STEM (Science, technology, engineering and mathematics) resources: capacity building for teachers in rural and regional schools”. This study is funded by the Department of Industry, Innovation, Climate Change, Science, Research and Tertiary Education and focuses on the need to build the capacity of rural and regional primary and junior secondary teachers in the areas of mathematics and science education. Staffing challenges in rural and regional schools can often mean that teachers have low capacities and expertise in Maths/Science that impact student achievement and their subsequent ability to engage in STEM pathways to tertiary learning.

This research is led by Professor Sue Kilpatrick, Director of the Centre for University Pathways and Partnerships and Associate Professor Sharon Fraser from the School of Education at the University of Tasmania who are joined by researchers from across UTAS, Edith Cowan, Deakin, Southern Cross Universities and the University of South Australia. A full list of project researchers is below.

#### University of Tasmania:

- Professor Sue Kilpatrick, Director of the Centre for University Pathways and Partnerships
- Associate Professor Sharon Fraser, School of Education
- Professor Kim Beswick, Dr Noleine Fitzallen, Dr Andrew Fluck, School of Education
- Dr Irene Penesis, Associate Professor Giles Thomas, Dr Christopher Chin, Associate Professor Dev Ranmuthugala, David Harte, Australian Maritime College
- Dr Bernardo A. Leon de la Barra, Lecturer, School of Engineering
- Dr Andrew Seen, School of Chemistry

#### Other Universities:

- Associate Professor Paul Newhouse and colleagues, Centre for Schooling and Learning Technologies, Edith Cowan University, Western Australia
- Associate Professor Bernadette Walker-Gibbs, School of Education, Warrnambool Campus, Deakin University, Victoria
- Professor Guy Robinson, Whyalla Campus, University of South Australia
- David Ellis and colleagues, School of Education, Southern Cross University, New South Wales

The project has the following partners:

#### Education system and teacher association partners

- Tasmanian Department of Education (Lead partner)
- Western Australian Department of Education
- Australian Association of Mathematics Teachers
- Australian Council for Computers in Education
- Society for the Provision of Education in Rural Australia (SPERA)

#### Industry partners

- Engineers Australia
- Australian Scientific & Engineering Solutions Pty Ltd
- Department of Defence

#### **What is the purpose of this study?**

This project has developed a Framework for the teacher analysis, critique, and evaluation of STEM resources developed and evaluated collaboratively to encompass contextual differences and which is consistent with the national maths and science curricula; links to maths and science resources (including human expertise, online and material) that rate highly on the analysis framework; and validated supporting materials for professional development leaders (e.g. lead and highly accomplished teachers) to equip teachers effectively to use the Framework.

#### **Why have I been invited to participate?**

You have been selected to participate in this study because you are a teacher participant in one of three workshops that will develop and refine the Framework.

Participation in an interview is voluntary and there are no consequences for not participating. It will not affect your relationship with the participating universities or your ability to participate in the workshop.

#### **What will I be asked to do?**

Participants will be asked to participate in a short individual or small group interview of approximately 30 minutes. The interview will be focused on your experience of development of the Framework. The interview questions may include:

- Suitability of the content covered in the Framework,
- Suitability of the design of the Framework,
- Suitability of the Framework for a range of teaching contexts,
- The effectiveness of the workshop program and activities,
- Anticipated ease of implementation of the Framework.

With permission, all interviews will be recorded, transcribed and analysed for general themes at a later time. Individuals who participate in an interview will have the opportunity to review the themes and key points that emerged from the interviews.

You will also be asked to agree to the templates and/or surveys you have completed during the workshop to be used in research publications. All templates and/or surveys will be completed anonymously.

**Are there any possible benefits from participation in this study?**

By participating in this study, you are helping to develop a tool that will assist teachers of maths and science to select appropriate STEM resources for their classes. This will assist teachers to inspire students to achieve in STEM and continue into STEM related higher education courses.

**Are there any possible risks from participation in this study?**

There are no foreseeable risks to participating in this study.

**What if I change my mind during or after the study?**

All participants are free to withdraw at any time up to 30 days from the time of their interview. Interviews will then be removed from the study and transcripts of their interview will be destroyed.

**What will happen to the information when this study is over?**

All data will be kept in a confidential manner and stored at the University of Tasmania for a minimum of five years from the time the results are published and will then be destroyed. All hard copies of data, transcripts of interviews and survey results will be stored in a locked file cabinet.

**How will the results of the study be published?**

The Framework will be available via the project website. This website will be linked to and from education system, teacher association and industry partner websites. A page will be added to the website with all results of this study.

**What if I have questions about this study?**

Any questions relating to this study can be directed to the project leader, Professor Sue Kilpatrick at [sue.kilpatrick@utas.edu.au](mailto:sue.kilpatrick@utas.edu.au) or at 03 6324 3632.

This study has been approved by the Tasmanian Social Sciences Human Research Ethics Committee. If you have concerns or complaints about the conduct of this study, please contact the Executive Officer of the HREC (Tasmania) Network on (03) 6226 7479 or email [human.ethics@utas.edu.au](mailto:human.ethics@utas.edu.au). The Executive Officer is the person nominated to receive complaints from research participants. Please quote ethics reference number **H13371**.

**This information sheet is yours to keep, if you would like to be involved, please refer to the attached consent form.**

## Evaluating and selecting STEM resources: capacity building for teachers in rural and regional schools

### Consent Form

1. I agree to take part in the research study named above.
2. I have read and understood the Information Sheet for this study.
3. The nature and possible effects of the study have been explained to me.

I understand that the study involves providing my feedback on the Framework. The questions will be focused on my experience of using the STEM Framework for Evaluating and selecting STEM resources.

4. The questions I will respond to include my reflections on my experience of using the STEM Framework for evaluating and selecting STEM resources
  - The process
  - Planning
  - Context
  - Resource usability
  - Support required and
  - Implementation
5. I understand that the templates and/or surveys that I complete will remain anonymous.
6. I understand that participation involves no foreseeable risks.
7. I understand that all research data will be securely stored on the University of Tasmania's premises for a minimum of five years from the publication of the study results, and will then be destroyed.
8. Any questions that I have asked have been answered to my satisfaction.
9. I understand that the researchers will maintain confidentiality and that any information I supply to the researchers will be used only for the purposes of the research.
10. I understand that the results of the study will be published so that I cannot be identified as a participant.
11. I understand that my participation is voluntary and that I may withdraw at any time before 30 days from the time of the interview without any effect.  
If I so wish, I may request at that time that any data I have supplied be withdrawn from the research.

Participant's name: \_\_\_\_\_

Participant's signature: \_\_\_\_\_

Date: \_\_\_\_\_

**Statement by Investigator**

I have explained the project and the implications of participation in it to this volunteer and I believe that the consent is informed and that he/she understands the implications of participation.

If the Investigator has not had an opportunity to talk to participants prior to them participating, the following must be ticked.

The participant has received the Information Sheet where my details have been provided so participants have had the opportunity to contact me prior to consenting to participate in this project.

Investigator's name: \_\_\_\_\_

Investigator's signature: \_\_\_\_\_

Date: \_\_\_\_\_

## Appendix 1 - Circumstances in which to consider using STEM Framework

### When

- A new topic is being introduced
- Teaching teachers; it could be applied as a mentoring tool
- Undertaking an excursion; it could be applied individually or in collaboration with another teacher
- Planning a learning sequence, unit and /or lesson plans
- Comparing resources used by different teachers, and
- Checking for continuity from grade to grade
- Selecting resources for 'one-off' lessons
- **Planning for:**
  - visiting performers /presenters /guest speakers
  - museum visits
  - professional development events
  - competitions,
  - investigations
- **Selecting resources:**
  - Online resources
  - Game based learning resources
  - Text books
  - Manipulatives e.g. decipipes, counters
  - Visual displays, posters
  - Science kits
  - Applets/Apps
  - Tablet device including software
  - Software including for example:
    - Geogebra,
    - Bubbl.us,
    - TinkerPlots,
    - Inspiration,
  - Video and audio, youtube
- **Engaging with your Community of Practice**

## Appendix 2 - Who could use the STEM Framework:

### Less experienced STEM teachers

- 1<sup>st</sup> & 2<sup>nd</sup> year-out teachers
- Teacher Education students
- Relief teachers/Rural and remote teachers
- Indigenous or English and Additional Language specialist teachers
- ‘Out of area’ teachers who are covering for more than a week
- Senior teachers who have moved up and now teaching out of area

### Experienced teachers

In mentoring situations and when working with

- ‘Out of area’ teachers who are covering for more than a week
- Rural and remote teachers
- Indigenous or English and Additional Language specialist teachers
- STEM planning teams

### Non-teaching staff

- Teachers’ aides
- CSIRO staff
- Museum education officers
- Science road show staff
- Community members
- Industry partners
- School laboratory technicians