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# Implications of the continuing decline of Science enrolments in Australian high schools

John Kennedy

University of New England, Armidale and St Andrew's Cathedral School, Sydney.



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## Is there a crisis in School Science?

The significant media coverage of the declining Year 12 Science and Mathematics enrolments over the last few years appears clear cut, but the evidence has been confusing and even contradictory. A study commissioned by Australia's Chief Scientist concluded that all the main high school sciences were experiencing continued dramatic declines (Goodrum, Druhan, & Abbs, 2011). A number of reports (e.g. Ainley, Kos, & Nicholas, 2008; Dekkers & de Laeter, 2001; Hackling, Goodrum, & Rennie, 2001; Hassan & Treagust, 2003) point to either a gradual decline in science education enrolments in Australia or, at best, zero growth over the long term. Studies into the state of mathematics (Barrington, 2006; Thomson, 2009) have reported similar levels of decline in participation. This study finally sets the story straight.

## The Australian situation

## The St Andrew's situation

### Methods, Definitions and Constraints

- State and territory curriculum authorities publish raw enrolment data annually for every Year 12 course; the national statistics presented in these graphs were **compiled** from these individual raw data sets.
- The year **1992** was selected as a **science base-level** as the work of Dekkers and de Laeter (2001) had already shown this as the year in which participation rates peaked and retention rates from Year 10 to Year 12 stabilised at around 75%.
- The year **1994** was selected as the **base-level** for **mathematics** enrolments (in keeping with Barrington and Brown(2005)) since categorising courses prior to this is unreliable due mainly to course designations in Victoria.
- Each of the different state and territory boards offers science subjects under slightly different titles:
  - enrolments for **biology** also include enrolments for human biology.
  - enrolments for geology, environmental science, and earth and environmental science are grouped under the term **earth sciences**.
  - less specialised science courses such as senior science in New South Wales, integrated science in Western Australia and science21 in Queensland are grouped as **multidisciplinary science**.
- To allow for valid comparisons between states and over time **only** enrolments in the **highest level** course available are included.
- Participation rate** is defined as being the proportion of the **total** Year 12 cohort enrolled in a particular course.
- Science and mathematics subjects are often reported as being gender biased in their enrolments (Fullarton, Walker, Ainley, & Hillman, 2003). The **sex ratio** is presented as the female proportion of **total** enrolments in a particular course.
- Year 12 students can and often do enrol in multiple science courses; however, because of the way enrolments are reported by the states and territories it is not possible to determine reliably the number of students enrolled in multiple courses.

### Findings

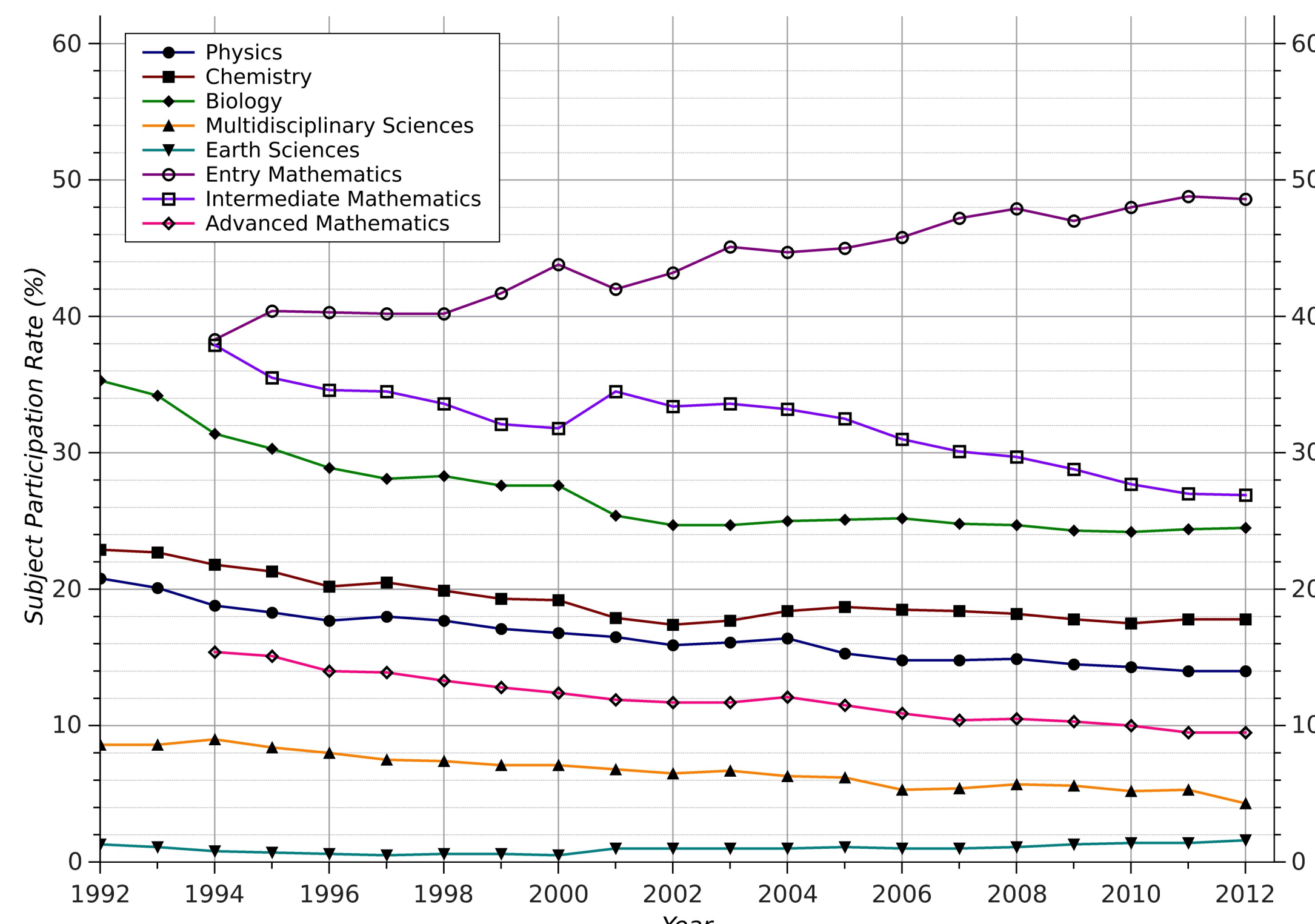


Figure 1 (from Kennedy, Lyons and Quinn (2014)) The participation rates for **almost all** science and mathematics subjects as a proportion of the overall year 12 cohort size have been declining over the period 1992 to 2012. The **exceptions** being entry mathematics and earth sciences.

It is interesting to note that **much of the declines happened prior to 2001** before the major curriculum changes of the early 2000's.

Post-2004, it is also interesting to note the **parallel declines of advanced mathematics and physics** as well as the virtual **stagnation of chemistry and biology**

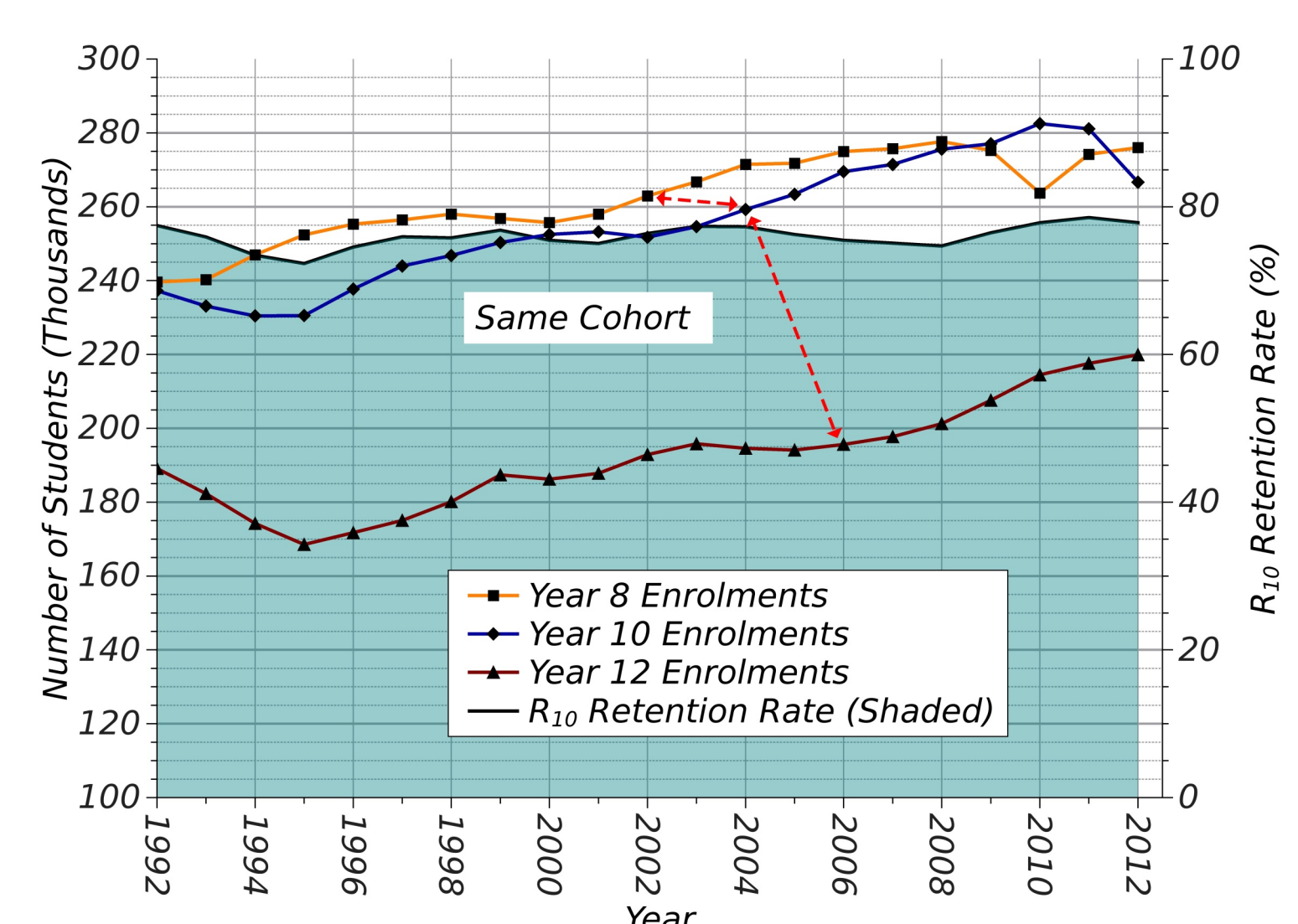


Figure 2 The trends in overall national **enrolment numbers** (left hand axis) for Year 8, Year 10 and Year 12 have been steadily **rising** from 1992 to 2012, while the **retention rates** (shaded) from Year 10 into Year 12 (right hand axis) have been fairly **stable**. (from Kennedy, Lyons and Quinn (2014))

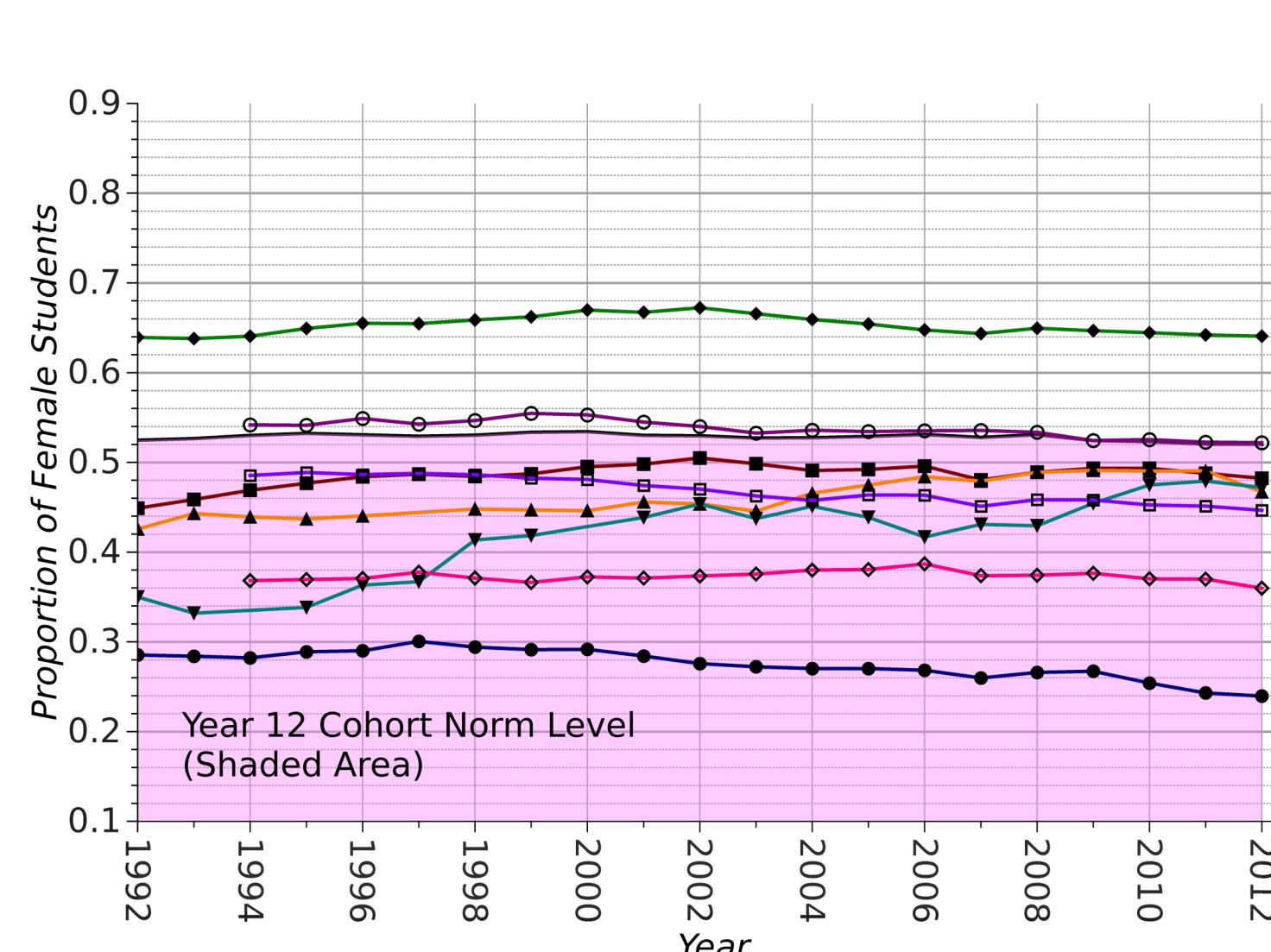


Figure 3 Subject sex ratios for science and mathematics courses from 1992-2012 with the overall sex ratio of the Year 12 cohort shown shaded. (from Kennedy, Lyons and Quinn (2014))

Note that **biology** has been **consistently female biased** and **physics and advanced mathematics** have been **consistently male biased**. Most other courses have been historically male biased but have tended closer to equality over time.

### Summary of National Trends

- The total number of students in Year 12 **increased** by around 16% from 1992 to 2012.
- The participation rates for **most science** and mathematics subjects **fell** (biology (-10%), chemistry (-5%), physics (-7%), multidisciplinary science (-5%), intermediate mathematics (-11%), advanced mathematics (-7%)) in the same period.
- There were **increased participation rates** in earth sciences (+0.3%) and entry mathematics (+11%).
- In each case the **greatest rates of change** occurred **prior to 2001** and have been slower and steadier since.

### Research Questions

- Do the trends in science at St Andrew's Cathedral School reflect those of the rest of the country?
- How do students perceive science in Years 11 and 12? Are they intending to enrol on a science course?
- What can we do in our Year 10 classrooms to promote the uptake of science in Years 11 and 12?

### Methods

Existing literature (e.g. Lyons and Quinn, 2010; Osborne et al., 2003) indicates that among a number of factors affecting student enrolments there are two factors that are particularly important; namely **student engagement** with the subject in the years before stage 6, and student's perceptions of "**value**" for a particular course.

An online survey (using sogosurvey.com) was developed based on the work of Schreiner and Louis (2006) to assess **current levels** of student engagement with science together with their **enrolment intentions** for Year 11 2015. This was delivered to all of Year 10 just prior to the end of Semester 1 2014.

### Findings

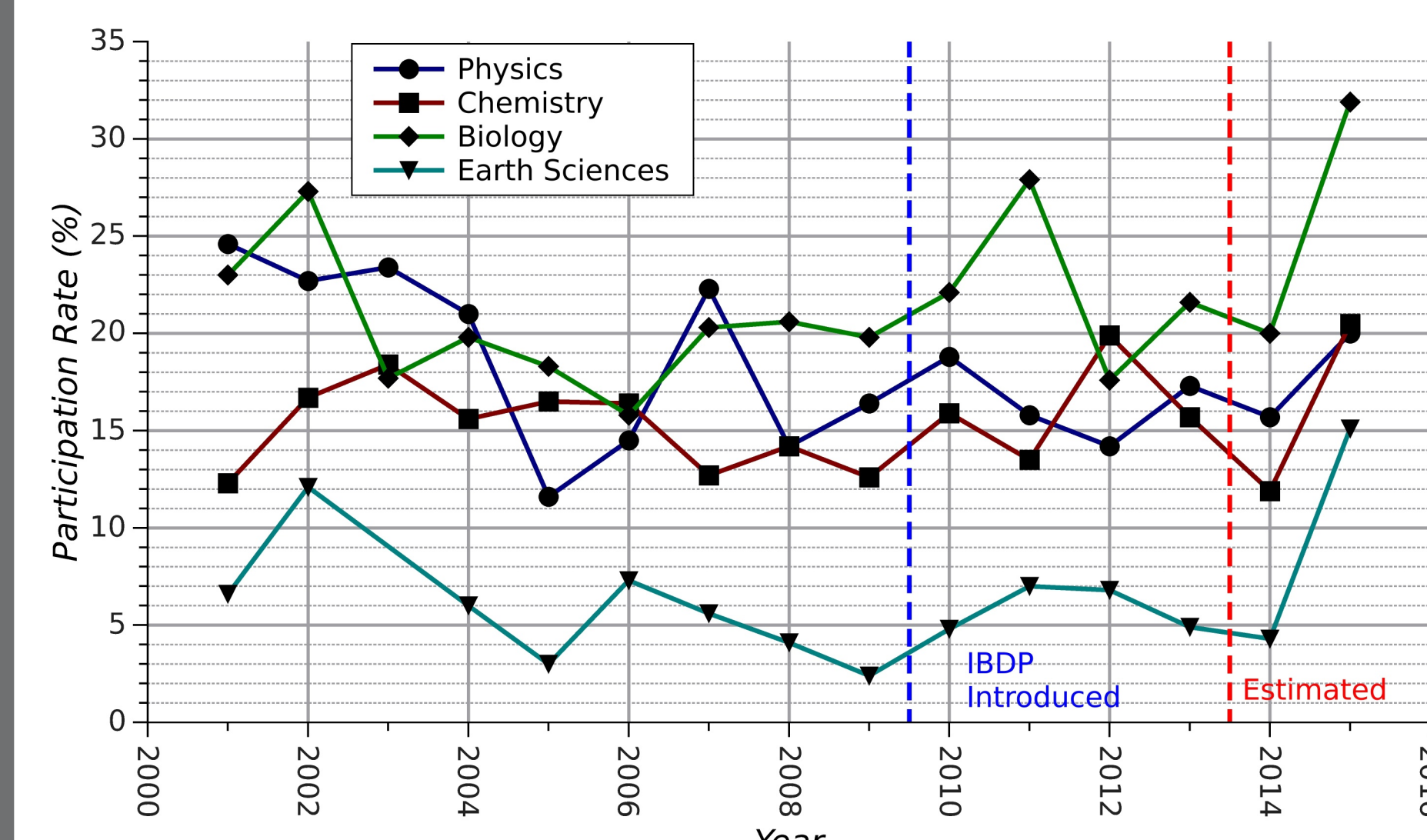


Figure 4 The science trends at SACS show **some similarities** to the national trends when accounting for the volatility.

- Chemistry shows a similar, almost stationary trend, although the participation rate is slightly lower.
- Biology and Physics show slightly steeper declines.
  - Biology has had consistently lower participation rates
  - Physics has had consistently higher rates
- Earth Sciences grew nationally but SACS enrolments have fallen significantly.
  - But SACS participation rates have been consistently and significantly larger than the national trends.

#### Figure 5

- The survey **response rate** was 57% (n=73; 59% male: 54% female).
- Student responses covered the full range of the scale from 1 (strongly disengaged) to 7 (strongly engaged).
- The **mean response** was 4.67 (neutral-slightly engaged).
  - Responses show significant **skew** towards the "engaged pole"
  - But there is significant **kurtosis** towards the central region.

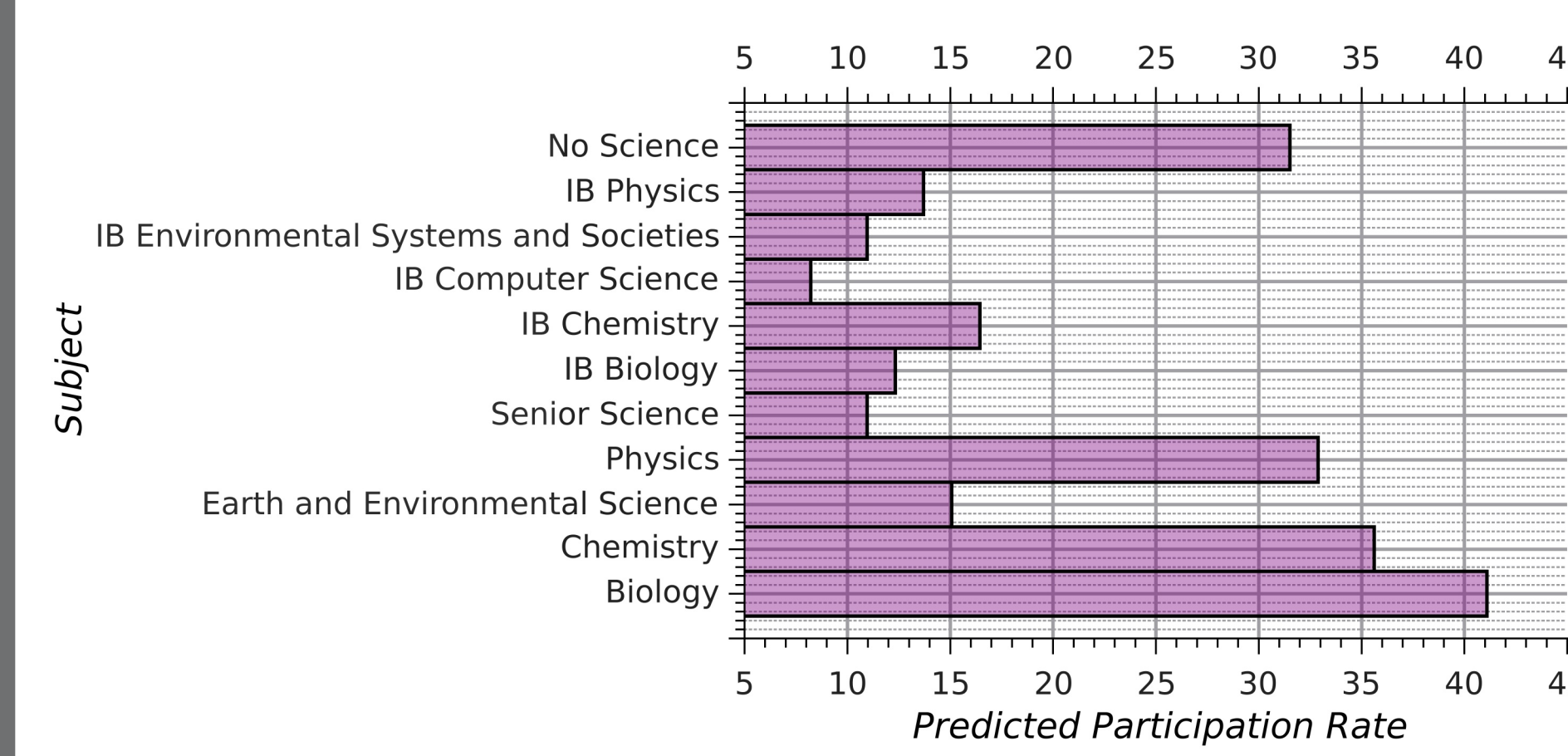
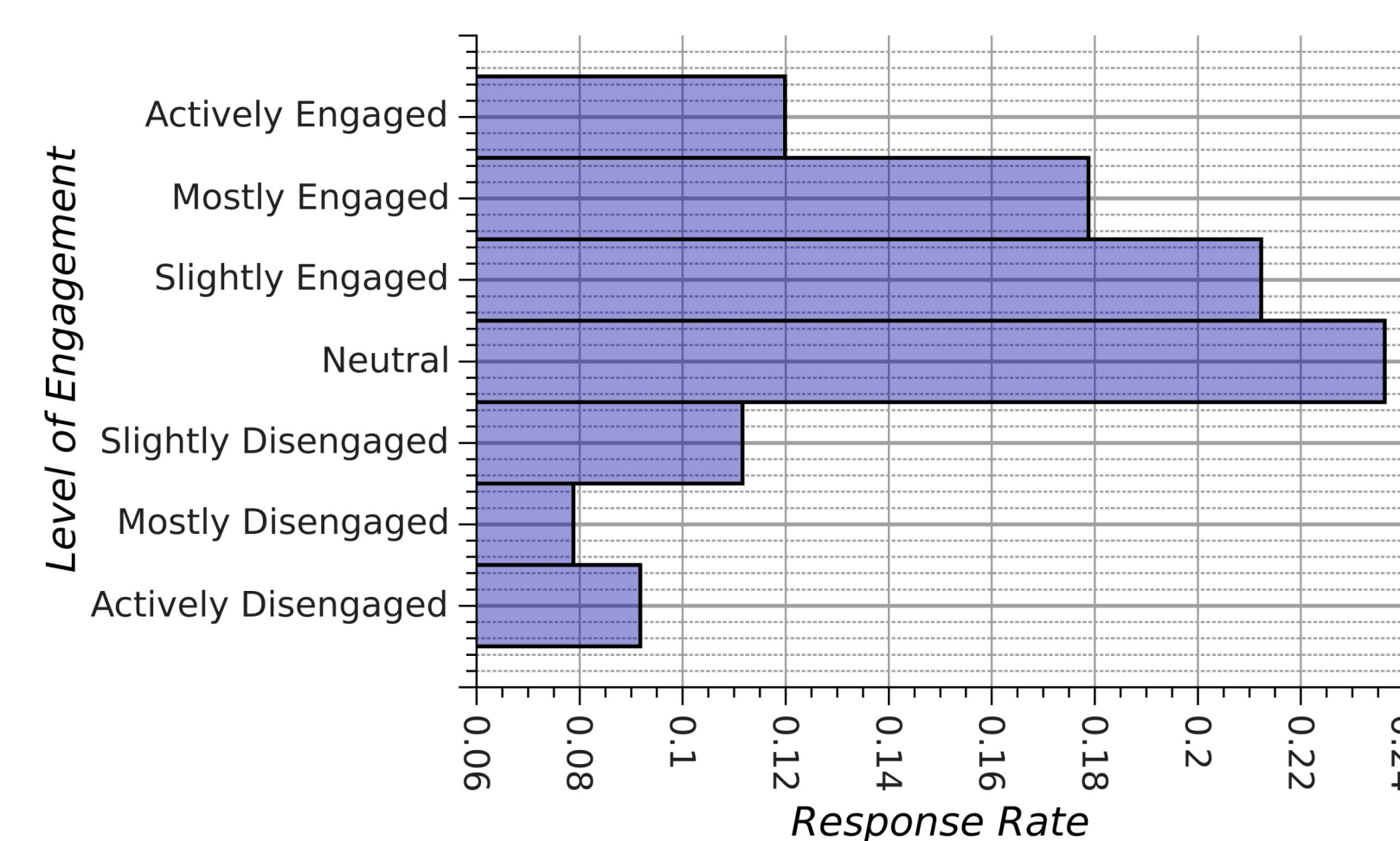


Figure 6 The enrolment intentions of Year 10 give these **predicted participation rates**.

- If these predicted participation rates were to translate into actual enrolments, then all four science strands would see significant jumps in 2016.
  - Biology rises to 53%,
  - Physics rises to 47%,
  - Chemistry rises to 47%,
  - Earth Sciences rises to 26%.
- This would continue the significant gains seen in enrolments for 2015.

### Student Explanations

- Most students chose not to elaborate on their answers, but of those that did:
  - student explanations for their engagement responses tended to focus more on the negative responses.
  - student explanations for future enrolments tended to focus on value for career and long-standing interest.

"There's so much to say about what I enjoy in science," without giving anyone else a chance to talk," human body and it's processes, I also want to do something in medicine after school,"

"I love science," "My class is to loud and rowdy, I find it hard to concentrate and participate in class discussion," "Whatever course is most relevant to the course I want to do at Uni."

"I quite like science but I don't think some of the things we have learned are explained very well," "I get bored in science class"

"[I] find some subjects uninteresting due to having previously learned about them at a higher level," "Science is not taught in a way that interests or engages me"

"It is more relevant to the degree that I want to do,"

"I try and learn in class but all my teacher does is spend a whole lesson talking about one thing" "I only enjoy learning biology and about these areas"

"I want to be a vet when I grow up"

These explanations emphasise:

- that students do **not** generally find science "**too hard**",
- show the importance of **engaging** students in the classroom **early on**.
- the importance of the **teacher-student relationship**
- that students select subjects based on their **strategic value** to their **future career** intentions or long standing interests.

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