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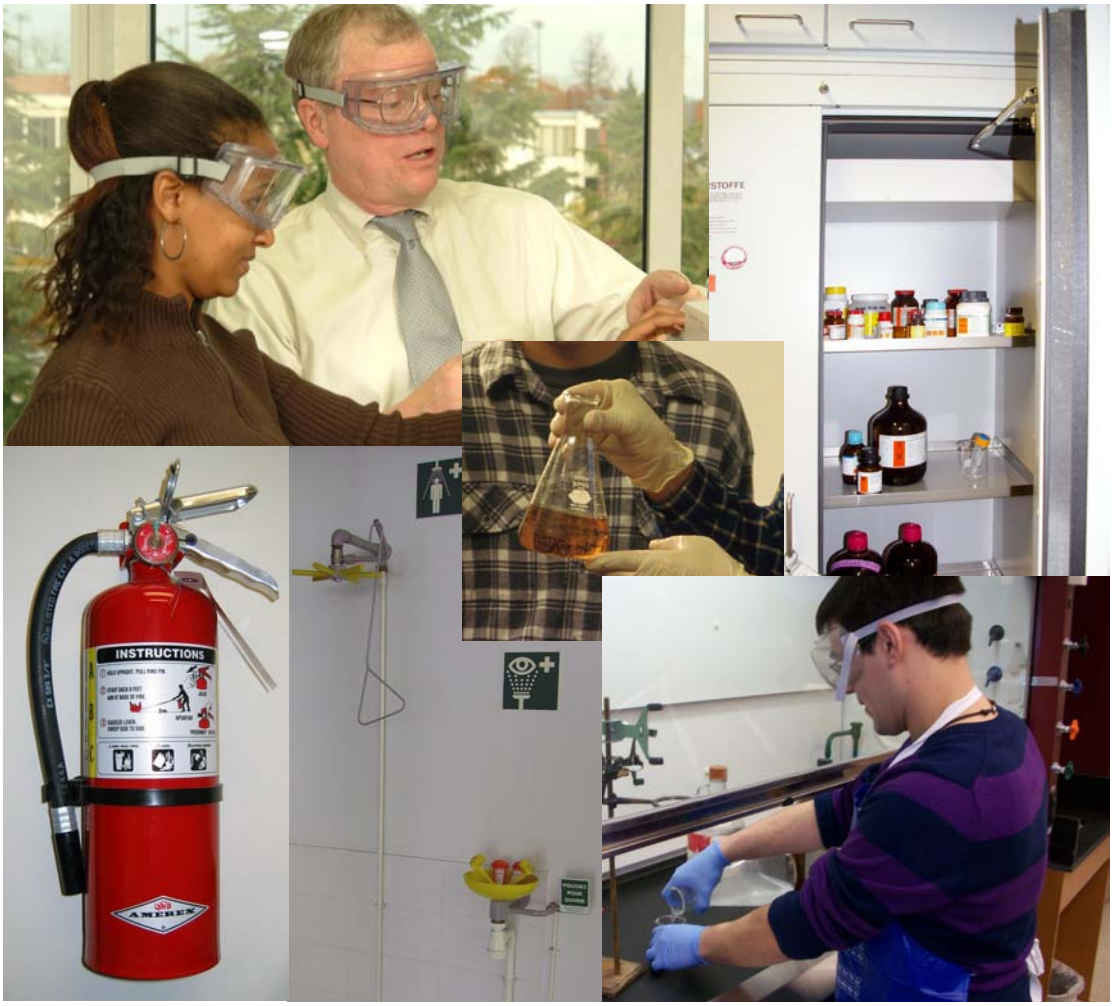
ACS Office of Two-Year Colleges

Two-Year College Chemistry Landscape 2012

Safety Practices Survey Summary Report
Fall 2012



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Background

According to the US Bureau of Labor Statistics, around 20% of post-secondary chemistry faculty work at two-year colleges.[1] The National Science Foundation reports that approximately 40% of bachelor's and master's degrees in science are awarded to students who attended a two-year college at some point in their academic careers.[2]

The *Two-Year College Chemistry Landscape 2012: Safety Practices*[3] survey was designed to provide a snapshot of safety practices in the two-year college chemistry community. The survey was released in early March 2012 and closed in early June 2012. The survey was hosted by the Statistical Research Center of the American Institute of Physics and conducted simultaneously with a faculty status survey from the American Association of Physics Teachers.

The survey was sent to 1,093 two-year college campuses. Just over 400 contacts completed at least some portion of the survey, for a response rate of 38%. While a single contact was identified for each campus, the role of that contact varied from chemistry faculty to division dean. Participants were not required to respond to all questions, resulting in significant variation in the number of responses per question.

The survey questionnaire can be downloaded at www.acs.org/2YColleges.

Respondent characteristics

Respondents were categorized by the types of chemistry programs reported to be offered at their institutions. The types of programs were:

- ***Chemistry transfer degree programs:*** institutions offering a transfer degree, such as an associate of science or certificate in chemistry, but not chemistry-based technology programs.
- ***Chemistry transfer only programs:*** institutions offering chemistry transfer programs without chemistry or chemistry-based technology degrees.
- ***Chemistry-based technology programs:*** institutions offering chemistry-based technology degree programs, in addition to other programs.
- ***No dedicated chemistry programs:*** institutions that did not fit into any of the above categories.

The total number of students enrolled in all chemistry courses was also considered. The distribution of survey respondents in these categories is shown in Table 1.

Safety management and funding

Safety management

As shown in Table 2, management of chemical health and safety was most commonly reported to be assigned to faculty, in addition to their other obligations. However, while only 9.8% of respondents reported working with Environmental Health & Safety (EHS) professionals within their own division, 42.6% of all respondents indicated EHS professionals were involved in some capacity.

Respondents who selected "Other" reported that chemical safety was managed by a variety of groups. These groups included campus security, the facilities department, the human resources department, or a safety committee that did not include EHS professionals.

There was little correlation between the responses and the types of programs reported to be offered. However, just over 67% of respondents with fewer than 100 chemistry students reported that faculty were responsible for chemical safety, and none reported working with any type of laboratory personnel.

As the number of reported chemistry students increased, so did the likelihood that respondents worked with EHS professionals. Of the respondents who reported over 500 chemistry students, 14% reported having an EHS professional for their own department, 21% reported sharing an EHS professional, and 25% reported that safety was managed by a team that included an EHS professional.

Safety training

Survey participants were asked how frequently full-time faculty, part-time faculty, laboratory technicians, and student helpers received training in chemical safety protocols, proper use of equipment, and/or waste management. It is worth noting that 10% of respondents selected "Not Applicable" for part-time faculty, 22% for

Total number of chemistry students	*Percent of all responses*	*Chemistry transfer degree programs*	*Chemistry transfer only programs*	*Chemistry-based technology programs*	*No dedicated chemistry program*
< 100 students	26.1%	14.3%	24.3%	12.0%	39.7%
100-250 students	32.4%	29.5%	34.0%	28.0%	34.6%
251-500 students	20.3%	25.7%	20.4%	20.0%	16.7%
> 500 students*	21.2%	30.5%	21.4%	40.0%	9.0%

**** Respondents in this category reported a broad range of chemistry student enrollments, from 500 to over 2,500.***

Table 1. Percent distribution of reported total number of chemistry students, by type of program (out of 414 responses). Due to rounding, distribution may not add up to 100%.

	*Percent respondents who selected this option**
One or more Environmental Health & Safety (EHS) professionals within our department/division	9.7%
One or more EHS professionals shared with other departments/ divisions	17.8%
One or more faculty members, in addition to their regular teaching duties	45.0%
A team comprised of faculty, EHS professionals, and others	17.5%
Lab or stockroom personnel	6.2%
Not sure	10.2%
Other	4.9%

**** Because participants were allowed to select more than one option, percentages do not add up to 100%.***

Table 2. Percent of respondents regarding who is responsible for the management of health and safety practices (out of 369 responses).

laboratory technicians, and 24% for student helpers, presumably because they did not have people in those positions.

The percent distribution of responses, with the "Not Applicable" responses removed from the calculations, is shown in Table 3. Respondents from campuses offering chemistry or chemistry-based technology degree programs were slightly more likely to report safety training for staff once a year or more. The remaining respondents did not have a significant difference in their distribution of responses.

A striking variation was noted in the responses from campuses with fewer than 100 chemistry students. These respondents were more likely to report "Not Applicable" for part-time faculty, laboratory technicians and student helpers (23.9%, 45.2%, and 36.5%, respectively). They were also more likely to report that people in these positions never receive safety training (47.8%, 32.6%, and 24.1%, respectively).

As the number of chemistry students increased, so did the likelihood that respondents reported regular safety training for faculty and staff.

Safety resources

Table 4 shows the percent of survey respondents who reported having access to specific safety resources. Over 90% of respondents reported having access to safety information and reference materials. Just under 90% reported having access to personal protective equipment; because this category was undefined in the survey, it is uncertain whether respondents included goggles or disposable gloves in their responses.

Overall, respondents who reported fewer numbers of chemistry students were also less likely to report having access to safety resources, particularly EHS professionals, personal protective equipment, and storage areas compliant with the U.S. Occupational Safety and Health Administration (OHSA) regulations.

There was little variation among responses when the respondents were grouped by types of programs they reported offering, with one exception. While over 30% of respondents from chemistry transfer programs (with and without degrees) reported having access to EHS professionals, 20% of respondents from colleges with chemistry-based technology programs and 13% of respondents from colleges without dedicated chemistry programs reported such access.

Among ACS resources the participants reported using, the ACS safety videos were most commonly cited. Many respondents reported using the ACS safety recommendations, both in the safety publications and in the *ACS Guidelines for Chemistry in Two-Year College Programs*, to shape safety policies at their institutions and highlight areas for continued improvement. Some respondents used the Guidelines to develop safety quizzes for their students, while others used them to support limiting the number of students in their laboratory sections.

The ACS Division of Chemical Health and Safety (CHAS) was also cited as a useful resource. The division's listserve and workshops were reported to be particularly good sources of information.

Safety budget

Table 5 shows the sources for safety funding identified by survey respondents. Over half of the respondents reported that funds were secured as needed, while 19% reported their institutions had a dedicated safety budget. Most of the "Other" responses indicated that safety was included

	Never	*Upon start of employment*	*Less than once a year*	*Once a year*	*More than once a year*	*Number of responses*
Full-time faculty	26.2%	26.0%	15.7%	25.4%	6.6%	362
Part-time faculty	32.3%	29.2%	9.6%	22.4%	6.5%	322
Laboratory technicians	16.8%	31.1%	11.7%	24.2%	16.1%	273
Student helpers	16.2%	47.4%	3.4%	19.2%	13.9%	266

Table 3. Percent distribution of frequency of safety training reported for faculty and staff at responding institutions. Due to rounding, distribution may not add up to 100%. [*Note*: responses marked "not applicable" were removed from the calculation and are not reported here.]

	All respondents	*< 100 students*	*100-250 students*	*251-500 students*	*> 500 students*
Written chemical hygiene plan	60.9%	48.9%	56.4%	72.4%	70.9%
Chemical waste disposal facilities	51.4%	33.0%	51.3%	64.5%	60.8%
Safety information and reference materials	92.3%	93.6%	87.2%	97.4%	93.7%
Personal protective equipment	89.3%	85.1%	88.9%	92.1%	92.4%
OSHA-approved chemical storage areas	74.6%	63.8%	70.1%	84.2%	84.8%
EHS professionals	23.5%	5.3%	24.8%	31.6%	35.4%
Number of responses	***366***	***94***	***117***	***76***	***79***

Table 4. Percent of respondents who reported having access to specified safety resources, by number of students enrolled in all chemistry courses.

	*Percent respondents who selected this option**
There is a dedicated budget for chemical safety items.	8.3%
There is a dedicated safety budget shared with other departments/ divisions.	11.0%
Funds to address safety issues are procured as needed.	54.4%
I'm not sure.	22.5%
Other	8.6%

**** Because participants were allowed to select more than one option, percentages do not add up to 100%.***

Table 5. Funding sources for chemical safety, by percent of responses (out of 373 responses).

in the chemistry or divisional budget; a few respondents indicated that there was no safety budget.

There was little change in the distribution of responses by either programs offered or number of chemistry students. However, about 63% of campuses with fewer than 100 students reported that safety funds were procured as needed, while respondents from campuses with degree programs were slightly more likely to report having a dedicated safety budget.

Incorporation of safety into the chemistry curriculum

Table 6 shows survey participant responses to the methods in which safety topics can be incorporated into the chemistry curriculum.[4] Some respondents marked one or more methods as "Not Applicable," presumably because they were not used; these responses were removed from the percent distributions shown.

There was little variation observed when the respondents were grouped by types of programs they reported offering, with one exception: respondents from institutions offering chemistry-based technology programs were more likely to report incorporating safety topics into lectures in some chemistry courses.

About 66% of respondents from campuses with more than 500 chemistry students reported incorporating safety topics into lectures in some courses. Additionally, over 90% of these respondents reported using safety quizzes. Otherwise, there was little variation among respondents grouped by size.

Participants reported a variety of other methods for incorporating safety into their curricula. The viewing of safety videos by students was most commonly reported. Most respondents reported using videos from ACS, the Laboratory Safety Institute, or Flinn Scientific, Inc. Some respondents had created their own videos, and one respondent reported using a video developed by the college's ACS student chapter.

Uses of emergency drills and safety contracts were also reported, as well as laboratory exercises focused on safety topics.

Safety practices, successes, and challenges

Safety recognition and sharing of effective practices

Table 7 shows the ways in which survey respondents reported that safe practices were recognized and shared at their institutions. Just over 40% of respondents reported using safety posters and literature. About 38% of respondents reported having scheduled safety meetings, and 28% reported the use of a database to track safety incidents.

Most of the write-in responses in the "Other" category indicated no systematic sharing of safe practices, or that safety was only discussed after an incident. Several noted the incorporation of safety education into the courses. Two respondents commented on the implementation of cross-disciplinary safety teams, and one indicated leveraging the results of a liability insurance inspection.

There was little variation in the distribution of responses based on either the types of programs offered or the number of students taught. However, scheduled safety meetings were reported most frequently by respondents whose institutions offered chemistry transfer programs without degrees and those that had more than 500 students.

	Not used in any chemistry courses	*Used in some chemistry courses*	*Used in all chemistry courses*	*Number of responses*
Safety overview at the beginning of the term	1.4%	5.2%	93.4%	364
Safety overview at the beginning of each laboratory exercise	1.1%	27.4%	71.5%	358
Chemical safety topics incorporated into lectures	15.7%	53.4%	30.9%	324
Reports and/or presentations by the students on safety topics	72.8%	18.7%	8.5%	283
Safety quizzes and/or safety questions incorporated into exams	22.0%	44.1%	33.9%	322
Evaluation of real or hypothetical scenarios	49.7%	38.3%	12.1%	290

Table 6. Percent distribution of frequency with which various methods are used to incorporate safety into the chemistry curriculum. Due to rounding, distribution may not add up to 100%. [*Note*: responses marked "not applicable" were removed from the calculation and are not reported here.]

	*Percent respondents who selected this option**
Awards administered by department, division, and/or institution	1.9%
Safety posters and literature	41.5%
Periodic safety reports or newsletters	14.9%
Scheduled safety meetings	38.2%
Incident reporting database	27.9%
Inclusion of safety practices in personnel evaluations	17.1%
Not sure	19.8%
Other	10.8%

**** Because participants were allowed to select more than one option, percentages do not add up to 100%.***

Table 7. Ways in which safe practices are recognized and shared, by percent of respondents (out of 369 responses).

Successful practices

Over 100 respondents shared their effective safety practices. The use of safety contracts, quizzes, and/or exams was most commonly reported. In some cases, students developed their own safety quizzes. One respondent required students to pass a lab safety quiz with 90% or better within three attempts, commenting that students who met this criterion were typically those who were best prepared for lab.

One respondent reported using a rubric to evaluate students' safety practices throughout the term. Another reported assigning 10% of the students' grades to "Lab Etiquette." Multiple respondents indicated that simply reinforcing safety concepts throughout the term was sufficient to keep students thinking about them.

At least one respondent engaged EHS personnel to provide safety training to the students. Another reported having students use the eyewashes at the beginning of the term, to reduce reluctance to use them when needed.

Some respondents modeled their safety practices on those of industry. One respondent reported following the industry standards set by OHSA. Another respondent reported that students developed industry-style standard operating procedures, including safety precautions, for laboratory experiments.

Several respondents noted that having dedicated EHS or chemical hygiene officers and/or chemical hygiene plans promoted a safety culture. Having an institutional safety policy helped the students understand that safety practices were more than just the requirement of an individual instructor.

See the appendix for more successful practices reported by survey participants.

Working alone in the laboratory

Over 200 respondents reported on whether faculty or students could work alone in the laboratory. In most cases, students were barred from being in a laboratory without the supervision of chemistry faculty or staff. One respondent commented on pressure from outside the department to allow students to work unsupervised, although that proposal was ultimately defeated.

Fewer than 15 respondents reported that students could work in the laboratory without direct supervision under limited circumstances. Such circumstances included conducting independent research, using analytical equipment, or completing paperwork.

Roughly 100 respondents commented on faculty working alone in the lab; most acknowledged that faculty could and did work alone. Typically, faculty and staff worked on preparations for student laboratories; a handful worked on independent research. Some worked nights or weekends. Some respondents noted that they made sure to alert someone else when they were working alone. However, those who were the sole chemistry faculty for their campus often had no one to contact.

Challenges

Just over 130 respondents commented on challenges associated with implementing safety practices and resources at their institutions. About 20 respondents reported having no safety challenges on their campus.

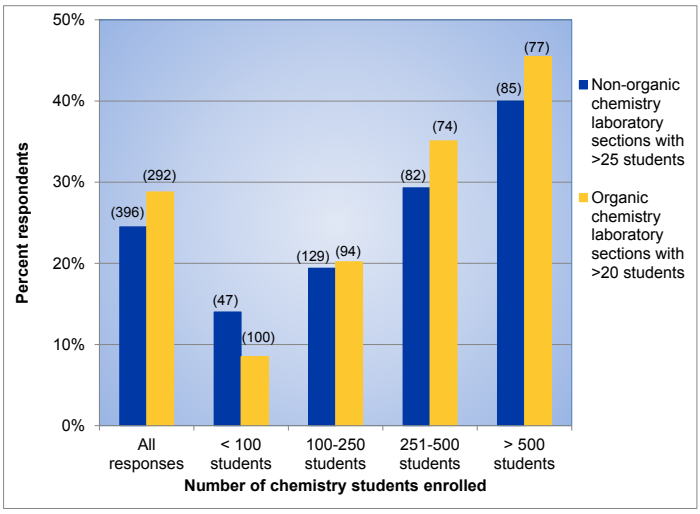

Figure 1. Responding institutions reporting chemistry laboratory sections larger than that recommended by ACS, by total number of chemistry students. (Number of responses in each category indicated in parentheses.)

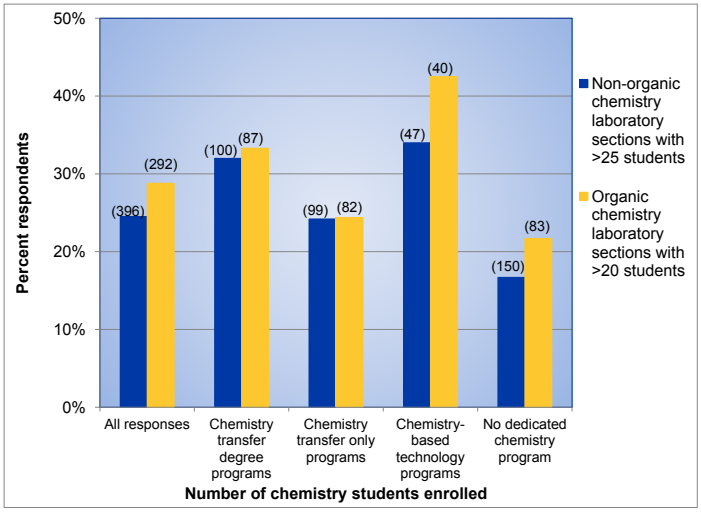

Figure 2. Responding institutions reporting chemistry laboratory sections larger than that recommended by ACS, by type of program offered. (Number of responses in each category indicated in parentheses.)

Among those who did report challenges, lack of funding was commonly cited. As a consequence, some respondents reported an inability to hire safety personnel or provide safety training to faculty and staff. A number of respondents reported working in older facilities in need of maintenance or a complete overhaul in order to be aligned with modern safety practices.

Consistency among instructors was another common challenge. Many respondents reported having no unified safety policy, leaving individual faculty to develop their own practices. Some respondents reported resistance among their colleagues in considering changes to their safety practices. A few noted that providing appropriate training to adjunct faculty, who have a variety of safety backgrounds and a high turnover, was challenging.

Several respondents reported a need for resources that could be implemented easily, such as a specific plan for the management of laboratory waste. Lack of time for such activities as training, developing safety management plans, and implementing new practices were cited as impediments. Additionally, multiple respondents reported difficulty communicating their safety needs to their administrations.

Respondents also addressed challenges presented by students who do not appreciate the need for goggles and appropriate lab attire. Other challenges included communication with students whose first language was not English or who required individual assistance due to physical or developmental disabilities.

Course section sizes

For both safety and pedagogical reasons, ACS recommends that the number of chemistry students per laboratory section not exceed 25 (20 for organic courses).[4-6] Survey participants were asked about the number of laboratory sections that exceed these recommendations.

As shown in Figures 1 and 2, about 76% of respondents reported keeping the number of students in non-organic chemistry laboratory sections below 25, and 71% reported keeping the number of students in organic chemistry laboratory sections below 20.[7]

The percentage of institutions reporting larger than recommended section sizes increased with the total number of chemistry students reported. Additionally, respondents from institutions offering chemistry and chemistry-based technology degree programs were more likely to report larger than recommended sections.

Conclusions

Most of the trends observed with regard to safety were aligned with the number of chemistry students taught, rather than the types of programs offered. This correlation was most prominent with regard to laboratory section sizes, access to safety resources, and the availability of safety training for non-faculty staff.

Funding and resources were a consistent challenge for the survey participants. While most had access to safety information and personal protective equipment, only 60% reported having a chemical hygiene plan, just over half reported access to chemical waste facilities, and just under half reported not having a designated safety budget. Despite the challenges, most respondents reported success in integrating safety into the chemistry curriculum using ACS, non-ACS, and personally-developed resources. In many cases, students were actively engaged in safety practices through quizzes, reports, and other methods. Over 70% of respondents reported having safety training for full-time faculty, and few permitted students to work alone in the laboratory.

References

1) US Bureau of Labor Statistics. *Occupational Employment Handbook, May 2009*. www.bls.org (accessed January 2011).
2) Mooney, G.M.; Daniel J. Foley, D.J. *NSF InfoBrief*. "Community Colleges: Playing an Important Role in the Education of Science, Engineering, and Health Graduates." July 2011. http://www.nsf.gov/statistics/infbrief/nsf11317/ (accessed October 2012).
3) The survey also assessed use of the *ACS Guidelines for Chemistry in Two-Year College Programs* for internal metrics.
4) American Chemical Society, Society Committee on Education. *ACS Guidelines for Chemistry in Two-Year College Programs*. ACS: Washington, DC, 2009; www.acs.org/2YGuidelines (accessed July 2012).
5) American Chemical Society, Committee on Professional Training. *ACS Guidelines and Evaluation Procedures for Bachelor's Degree Programs.* ACS: Washington, DC, 2008; www.acs.org/cpt (accessed July 2012).
6) American Chemical Society, Committee on Chemical Safety. *Safety in Academic Chemistry Laboratories, 7th ed*. ACS: Washington, DC, 2009; www.acs.org/safety (accessed July 2012).
7) Participants were asked how many laboratory sections exceeded ACS recommendations but not how many students were in each section.

Appendix. Selected successful safety practices reported by survey participants

Department/campus practices

- Development and implementation of a campus-wise chemical hygiene plan
- Consistent enforcement of safety practices across campus, supported by
    - Chemical safety officer
    - Administration
    - All faculty
- Communication of safety practices and potential concerns among faculty (including adjunct faculty)
- Implementation of safety standards used in industry

Educator practices

- Student development of safety quizzes or videos
- Laboratory inspections by safety personnel
- "Scaled down" experiments that require smaller amounts of chemicals
- Allowing plenty of time to complete experiments
- Incorporation of safety into grade through quizzes, homework, observation of student behavior

Student activities

- Safety contracts
- Student development and compilation of Material Safety Data Sheets
- Hands-on training in use of safety equipment
- Purchased or in-house safety videos and posters

Support for the Two-Year College Chemistry Landscape 2012 survey

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