

# Hydroville Curriculum Project

## Interim Evaluation Report: Indoor Air Quality (IAQ) Implementation 2004-2005

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## Evaluation Design – Overview.

The evaluation design for IAQ was essentially the same as for Pesticide Spill and Mysterious Illness Outbreak. The most significant changes were:

- The evaluation design organized participating schools into two program groups: single teacher schools and integrated team schools. The only single teacher school was Benson (N=133 completed pre/post). The integrated team schools were:
  - Reynolds HS (N = 51)
  - Westview HS (N=27)
  - Fir Ridge Campus (N= 3)
  - Young Parent Program (N=24)
  - The Community Schoolhouse (N=39)

The total number of completed pre/post students in the integrated team schools was N=145. The small N's for the integrated team schools provided very low power for significance tests on the results of individual integrated team schools. Instead of looking at these schools individually, their results were combined to yield a larger group that is designated as the integrated team program.

- A revision of the pretest and posttest was done to accommodate changes in the curriculum content;
- The addition of a new scale that assesses risk perception; and
- Elimination of the Background Activity Knowledge Items.

## Evaluation Design – Problems and Challenges.

The problems and challenges are generally the same as the previous years. As mentioned above, the integrated team schools were collapsed into a single group designated as the integrated team program.

## Key Results: Student Evaluations

### Problem Solving Pretest and Post Test:

The Problem Solving Pretest and Post Test consisted of a 64-item evaluation instrument that was composed of three separate modules and seven distinct measurement scales or concepts:

Table 1 shows each of the six measurement scales in terms of (a) scale name, (b) scale code, and (c) a description of the scale in terms of the relationship between numerical and conceptual values. The scales are also summarized below:

- *Quality of Explanations:* This 10-item scale assesses the quality students assign to ten possible explanations for differences in cancer rates between two communities. Higher scores reflect higher quality assigned to explanations.
- *Information Seeking:* This 8-item scale assesses students' judgments of the informativeness of a number of pieces of information in the context of determining the possible cause(s) of difference in cancer incidence rates between two communities. Higher scores reflect greater informativeness of information items.
- *Personal Involvement:* This 6-item scale assesses students' self-evaluation of their capabilities working on a community committee to help identify the cause(s) of differential cancer rates between two communities. Higher scores reflect greater self-evaluations of personal capability.
- *Self-Protection:* This 10-item scale assesses students' attitudes toward self-protective behaviors from chemical and other hazards. Higher scale values reflect a more positive attitude toward self-protection. A separate 3-item scale assesses more general attitudes toward self-protection.
- *Value for Science:* This 7-item scale assesses students' perceptions and attitudes toward science in society and as part of their daily life. Higher scale values reflect a more positive attitude toward science.
- *Perceived Risk:* This 10-item scale assesses students' perceptions a range of risks both in the home and in society at large. Higher scores reflect greater perceived risk from all sources. Two separate sub-scales of three items each assess perceptions of risk from chemicals and from environmental allergens.

A complete description of each of the scales along with the wording of the items comprising the scales is available in the document titled "Indoor Air Quality (IAQ) Student Problem Solving Pre/Post Test Evaluation Scales."

Table 1. Hydroville Evaluation Scales: 2004-2005 Implementation Year  
(Indoor Air Quality)

Scale Name	Scale Code	Number of Items	Description
Quality of Explanations	<i>Explain</i>	10	Higher score indicates higher quality of explanations.
Information Seeking	<i>InfoSeek</i>	8	Higher score reflects greater informativeness of items.
Personal Involvement	<i>PersInvolv</i>	6	Higher score reflects more positive self-evaluation of capabilities.
Self-Protection 1	<i>SelfPro1</i>	10	Higher score reflects more positive attitude toward self-protective behaviors.
Self-Protection 2	<i>SelfPro2</i>	3	Higher scores reflects more positive attitude toward self-protection
Value for Science	<i>ValueSci</i>	7	Higher score reflects a more positive value for science in daily life.
Perception of Risk	<i>PercRisk</i>	10	Higher score reflects greater perceived risk.
Perception of Chemical Risks (subscale)	<i>ChemRisk</i>	3	Higher score reflects greater perceived risk from chemicals.
Perception of Environmental Risks (subscale)	<i>EnviroRisk</i>	3	Higher score reflects greater perceived risk from environmental pollutants.

### Scale Means by Program and All Schools Combined.

Table 2 shows the scale means by single teacher, integrated team and for all schools combined. For each of the program types (i.e., single teacher vs. integrated team) pretest and posttest means are shown as well as the number of students with complete pre/post protocols (N). Differences scores are shown along with a test of statistical significance of the value of the difference. At the far right of the table a between-program significance test is shown. This is test between the two program types done on their respective pretest, posttest and difference scores. Listed below are highlights drawn from Table 2; additional discussion of scale results is presented in a subsequent section of this report.

- Of the nine scales shown in Table 2, three evidenced significant pre/post changes for the Integrated Team Program. These were for the scales *PersInvolv*, *ValueSci*, and *EnviroRisk*. For the Single Teacher Program, only the *SelfPro2* scale resulted in significant pre/post change.
- The largest (and most statistically significant) pre/post change was for the scale *PersInvolv*, but only for the Integrated Team Program. In general, students were more likely to express positive attitudes about their capability to participate in a variety of activities relating to discovering the causes of health effects in the hypothetical community of Mayville.
- A moderately significant effect was obtained on the *EnviroRisk* scale for students in the Integrated Team Program. This three-item subscale of the Perception of Risk scale assessed students' perceptions of risks from environmental allergens. Change scores were in the direction of greater perceived risk in the posttest than in the pretest assessment.
- A weakly significant result was obtained for pre/post change scores on the *SelfPro2* scale for the Single Teacher Program. This result was largely due to responses to a single item: "For most of the chemicals I am exposed to in daily life, including chemicals in the environment, I feel I know how to protect my health and safety." Pre/post change scores in response to this item were in the direction of more positive agreement, suggesting that students were more likely to see themselves as knowledgeable about self-protection with respect to chemical risks. This change was significant for both the Single Teacher and Integrated Team Program at the  $p < .05$  level, and was significant at the  $p < .01$  level for all schools combined, owing to the larger sample size and greater statistical power.
- A weakly significant result was obtained for the *Explain* scale for All Schools Combined.

Table 2. Scale pretest and posttest means, and mean difference scores by program type and for total sample.

Scale	<i>All Schools Combined</i>					<i>Single Teacher<sup>a</sup></i>					<i>Integrated Team<sup>b</sup></i>					<i>Between-program Significance</i>		
	N	Pre	Post	Diff <sup>c</sup>	<i>t-test</i> <sup>d</sup>	N	Pre	Post	Diff	<i>t-test</i>	N	Pre	Post	Diff	<i>t-test</i>	Pre	Post	Diff
EXPLAIN	255	2.37	2.44	0.07	*	123	2.36	2.45	0.09	p=.07	132	2.37	2.43	0.06	ns	ns	ns	ns
INFOSEEK	273	2.86	2.87	0.01	ns	132	2.82	2.79	-0.03	ns	141	2.90	2.95	0.05	ns	ns	**	ns
PERSINVOLV	275	2.63	2.79	0.16	***	132	2.61	2.72	0.10	ns	143	2.64	2.85	0.21	***	ns	p=.09	ns
SELFPRO1	276	3.41	3.32	-0.09	*	133	3.30	3.22	-0.08	ns	143	3.51	3.42	-0.09	ns	*	*	ns
SELFPRO2	247	2.86	2.94	0.07	p=.09	119	2.82	2.95	0.13	*	128	2.90	2.93	0.02	ns	ns	ns	ns
VALUESCI	270	2.62	2.68	0.06	p=.07	131	2.65	2.67	0.02	ns	139	2.59	2.70	0.10	*	ns	ns	ns
PERCRISK	257	2.81	2.86	0.06	ns	125	2.79	2.81	0.02	ns	132	2.82	2.90	0.09	ns	ns	ns	ns
CHEMRISK	258	2.85	2.89	0.04	ns	126	2.83	2.82	-0.01	ns	132	2.87	2.97	0.10	ns	ns	p=.07	ns
ENVIRORISK	249	2.77	2.88	0.12	*	122	2.76	2.82	0.05	ns	127	2.78	2.95	0.17	**	ns	p=.10	ns

<sup>a</sup>Single teacher school = Benson HS

<sup>b</sup>Integrated Team = Reynolds HS, Westview HS (Catapult), Fir Ridge Campus, Young Parent Program, The Community Schoolhouse

<sup>c</sup>Mean Difference Scores are computed across subjects by taking the average difference of the posttest minus the pretest.

<sup>d</sup>*t-test* for signed difference scores: \*p<.05; \*\*p<.01; \*\*\*p<.001

Table 3. Summary of significant scale pre/post change scores by program type.

Program Type	Scales with Significant Pre/Post Change Scores
Single Teacher	<i>SelfPro2*</i>
Integrated Team	<i>PersInvolv***, ValueSci*, EnviroRisk**</i>
<i>All Schools Combined</i>	<i>PersInvolv***, Explain*, SelfPro1*, EnviroRisk*,</i>

\*p<.05, \*\*p<.01, \*\*\*p<.001

### Individual Scales.

This section examines each of the scales separately in terms of the patterns of change exhibited by the individual scale items. In previous years' evaluations, a scale titled *IntuiTox* was included in the evaluation results. Despite several revisions of the scale, and acceptable level of internal consistency (i.e., Cronbach's alpha) was never obtained. Evaluation reports for Pesticide Spill and for MIO presented the scale but also presented a discussion and interpretation of the items comprising the scale, treating them as separate dependent variables. In this report, we drop the use of the *IntuiTox* scale altogether and present the items pertaining to Intuitive Toxicology as a separate group with its own discussion. The purpose of these items is to assess student change with respect to attitudes and perceptions of chemical and other hazards, and that reflect intuitive notions of the relationship between concepts such as exposure and harm.

### Quality of Explanations (*Explain*).

Results for items comprising this scale are shown in Table 4. This is the *Explain* scale and is an assessment of how students evaluated the quality of a number of explanations for a differential health effect (percentage of cancer cases) between the fictional community of Mayville and the state in which Mayville is located as a whole. Scale responses ranged from "1" (Not A Good Explanation) to "4" (Very Good Explanation).

Although this scale did not show a strong pattern of pre/post change with respect to statistical significance, a different picture emerges when we examine individual items. Looking at the results for All Schools Combined, in the posttest students were more likely to assign a great quality of explanation to (a) use of household chemicals, (b) types of buildings in Mayville, and (c) and types of businesses in Mayville. Conversely, they were more likely to as a lesser quality of explanation to (a) lifestyles of Mayville residents and (b) the natural environment. The offsetting effects of assigning greater quality to some explanations and lesser quality to others pre/post tended to attenuate the overall change in terms of the scale score. Students in both program types tended to give greater credence to factors associated with chemical exposure and air quality in the posttest than the pretest assessment.

Table4. *Explain* Scale: Summary of individual items by single teacher, integrated team and all schools combined.

Differences in:	<i>All Schools Combined</i>					<i>Single Teacher<sup>a</sup></i>					<i>Integrated Team<sup>b</sup></i>					<i>Between-program significance</i>		
	N	Pre	Post	Diff <sup>c</sup>	<i>t-test<sup>d</sup></i>	N	Pre	Post	Diff	<i>t-test</i>	N	Pre	Post	Diff	<i>t-test</i>	Pre	Post	Diff
Use of household chemicals	228	2.06	2.41	0.36	p<.0001	108	2.06	2.31	0.25	p<.05	120	2.05	2.50	0.45	p<.0001	ns	ns	ns
Use of agricultural chemicals	232	2.50	2.64	0.14	p=.08	110	2.47	2.61	0.14	ns	122	2.53	2.67	0.14	ns	ns	ns	ns
Lifestyles of people in Mayville	243	2.59	2.22	-0.37	p<.0001	120	2.63	2.34	-0.28	p<.05	123	2.56	2.10	-0.46	p<.001	ns	p=.07	ns
Types of buildings in Mayville	229	2.09	2.73	0.64	p<.0001	109	2.09	2.54	0.45	p<.001	120	2.09	2.91	0.82	p<.0001	ns	p<.01	p<.05
Types of businesses or industries	231	2.29	2.52	0.23	p<.01	110	2.25	2.50	0.25	p<.05	121	2.33	2.53	0.20	p=.07	ns	ns	ns
Natural environment	238	2.92	2.68	-0.24	p<.01	117	2.95	2.64	-0.31	p<.01	121	2.90	2.73	-0.17	ns	ns	ns	ns
How well scientific study done	228	2.47	2.57	0.10	ns	110	2.35	2.59	0.24	p<.05	118	2.58	2.56	-0.03	ns	p=.08	ns	ns
How people perceive environmental health risks	230	2.51	2.42	-0.10	ns	107	2.52	2.39	-0.13	ns	123	2.50	2.44	-0.07	ns	ns	ns	ns
Geographic location of Mayville	227	2.14	2.24	0.10	ns	112	2.19	2.29	0.11	ns	115	2.10	2.19	0.10	ns	ns	ns	ns
No real difference. Just a matter of chance	219	2.00	2.07	0.07	ns	109	1.98	2.14	0.16	ns	110	2.01	2.00	-0.01	ns	ns	ns	ns

<sup>a</sup>Single teacher school = Benson HS

<sup>b</sup>Integrated Team = Reynolds HS, Westview HS (Catapult), Fir Ridge Campus, Young Parent Program, The Community Schoolhouse

<sup>c</sup>Mean Difference Scores are computed across subjects by taking the average difference of the posttest minus the pretest.

<sup>d</sup>T-test for signed difference scores: \*p<.05; \*\*p<.01; \*\*\*p<.001; \*\*\*\*p<.0001

**Information Seeking (*InfoSeek*).**

The Information Seeking scale builds on the Mayville story problem by posing the context of a community program solving committee that has an opportunity to collect information. Students judge the usefulness of information gathered from each of a number of activities with respect to helping the committee solve the problem of Mayville's cancer rate. The response scale range from "1" (Not useful for helping solve the problem) to "4" (Very useful for helping solve the problem.). Results for the individual items associated with this scale are shown in Table 5.

Although the *InfoSeek* scale did not show an overall pattern of statistically significant change from pretest to posttest, the individual items exhibited many differences. Looking at the pre/post change results for All Schools Combined, students tended to see more usefulness in (a) interviewing local citizens who have been ill, (b) seeing how large buildings in the community were ventilated, and (c) visiting homes of ill citizens to see how they were constructed. They tended to see less usefulness pre/post in (a) having soil tests done, (b) checking for contaminants in drinking water, and (c) determining where Mayville gets its water supply. This pattern of results tended to be observed for both the Single Teacher and Integrated Team Programs, though at lower levels of significance.

Students may have been sensitized by the curriculum to the relevance of indoor air quality as a determinant of public health. At the same time, other possible sources of health hazard and explanation for the Mayville problem, particularly water-related issues, were discounted.

Table5. *InfoSeek* Scale: Summary of individual items by single teacher, integrated team and all schools combined.

	All Schools Combined					Single Teacher <sup>a</sup>					Integrated Team <sup>b</sup>					Between-program Significance		
	N	Pre	Post	Diff <sup>c</sup>	<i>t-test</i> <sup>d</sup>	N	Pre	Post	Diff	<i>t-test</i>	N	Pre	Post	Diff	<i>t-test</i>	Pre	Post	Diff
Interview locals who have been ill in past year	268	2.82	3.07	0.25	***	130	2.75	3.02	0.26	*	138	2.88	3.12	0.24	**	ns	ns	ns
Have soil test done to see what chemicals in soils	266	2.99	2.72	(-0.27)	***	130	2.95	2.64	(-0.31)	**	136	3.04	2.79	(-0.24)	*	ns	ns	ns
Check local library for newspaper reports on enviro problems	272	2.68	2.58	(-0.09)	ns	131	2.61	2.50	(-0.11)	ns	141	2.74	2.66	(-0.08)	ns	ns	ns	ns
Visit larger buildings to see how ventilated	262	2.61	3.08	0.48	****	128	2.59	2.93	0.34	**	134	2.63	3.23	0.60	****	ns	**	p=.09
Check drinking water to see if elevated levels of contaminants	267	3.38	3.15	(-0.23)	***	128	3.38	3.03	(-0.35)	***	139	3.37	3.26	(-0.12)	ns	ns	*	p=.06
Check Internet for info on causes of illnesses	269	2.61	2.58	(-0.03)	ns	131	2.48	2.50	0.02	ns	138	2.74	2.66	(-0.08)	ns	*	ns	ns
Determine where Mayville gets its water supply	265	3.07	2.86	(-0.21)	***	128	3.02	2.80	(-0.21)	*	137	3.12	2.91	(-0.20)	*	ns	ns	ns
Visit homes of people who were ill and how houses constructed	270	2.75	2.99	0.24	**	131	2.79	2.95	0.17	ns	139	2.72	3.02	0.30	**	ns	ns	ns

<sup>a</sup>Single teacher school = Benson HS

<sup>b</sup>Integrated Team = Reynolds HS, Westview HS (Catapult), Fir Ridge Campus, Young Parent Program, The Community Schoolhouse

<sup>c</sup>Mean Difference Scores are computed across subjects by taking the average difference of the posttest minus the pretest.

<sup>d</sup>*t-test* for signed difference scores: \*p<.05; \*\*p<.01; \*\*\*p<.001; \*\*\*\*p<.0001

**Personal Involvement (*PersInvolv*).**

Problem solving in the context of environmental health sciences issues often requires social participation, such as public meetings or committees. For students to utilize the environmental health science knowledge gained through the Hydroville Curriculum, they must also have acquired a base of teamwork skills upon which they can draw as well as the self-efficacy to utilize those skills in cooperation with others. The PERSINVOLV scale assesses, through self-evaluation, students' competence and capability with regard to a number of social participation activities in the context of group problem solving. A higher scale score indicates a more positive self-evaluation of how "qualified and capable" students view themselves with respect to a number of different roles and activities that are part of a hypothetical committee problem-solving exercise. The response scale for individual items ranged from "1" (Not qualified and capable) to "4" (Very qualified and capable). Table 6 summarizes pre/post responses to the individual items comprising this scale.

The *PersInvolv* scale generally exhibited the largest (most statistically significant) pre/post change. Most of that change was due to three items relating to:

- (a) helping design a scientific study,
- (b) preparing a written report of committee findings, and
- (c) presenting an oral report to a large audience.

All three of these activities are consistent with element of the IAQ curriculum, particularly the oral presentation of group work. This pattern of results was more pronounced for the Integrated Team Program than for the Single Teacher Program. As with previous year evaluations, the group work aspect of the curriculum and the oral presentation of results appears to greater student self-efficacy with respect to taking an active role in community problem solving around environmental health issues.

Table 6. *InfoSeek* Scale: Summary of individual items by single teacher, integrated team and all schools combined.

	All Schools Combined					Single Teacher <sup>a</sup>					Integrated Team <sup>b</sup>					Between-program Significance		
	N	Pre	Post	Diff <sup>c</sup>	<i>t-test</i> <sup>d</sup>	N	Pre	Post	Diff	<i>t-test</i>	N	Pre	Post	Diff	<i>t-test</i>	Pre	Post	Diff
Interview locals who have been ill in past year	268	2.82	3.07	0.25	***	130	2.75	3.02	0.26	*	138	2.88	3.12	0.24	**	ns	ns	ns
Have soil test done to see what chemicals in soils	266	2.99	2.72	(-0.27)	***	130	2.95	2.64	(-0.31)	**	136	3.04	2.79	(-0.24)	*	ns	ns	ns
Check local library for newspaper reports on enviro problems	272	2.68	2.58	(-0.09)	ns	131	2.61	2.50	(-0.11)	ns	141	2.74	2.66	(-0.08)	ns	ns	ns	ns
Visit larger buildings to see how ventilated	262	2.61	3.08	0.48	****	128	2.59	2.93	0.34	**	134	2.63	3.23	0.60	****	ns	**	p=.09
Check drinking water to see if elevated levels of contaminants	267	3.38	3.15	(-0.23)	***	128	3.38	3.03	(-0.35)	***	139	3.37	3.26	(-0.12)	ns	ns	*	p=.06
Check Internet for info on causes of illnesses	269	2.61	2.58	(-0.03)	ns	131	2.48	2.50	0.02	ns	138	2.74	2.66	(-0.08)	ns	*	ns	ns
Determine where Mayville gets its water supply	265	3.07	2.86	(-0.21)	***	128	3.02	2.80	(-0.21)	*	137	3.12	2.91	(-0.20)	*	ns	ns	ns
Visit homes of people who were ill and how houses constructed	270	2.75	2.99	0.24	**	131	2.79	2.95	0.17	ns	139	2.72	3.02	0.30	**	ns	ns	ns

<sup>a</sup>Single teacher school = Benson HS

<sup>b</sup>Integrated Team = Reynolds HS, Westview HS (Catapult), Fir Ridge Campus, Young Parent Program, The Community Schoolhouse

<sup>c</sup>Mean Difference Scores are computed across subjects by taking the average difference of the posttest minus the pretest.

<sup>d</sup>*t-test* for signed difference scores: \*p<.05; \*\*p<.01; \*\*\*p<.001; \*\*\*\*p<.0001

### **Self Protection (*SelfPro1* & *SelfPro2*).**

Key objectives of the Hydroville Curriculum are for students to develop appropriate increases in self-protective behavior with respect to environmental health and safety risks. The *SelfPro* scale assesses student change with respect to self-protective behavior using student perceptions and attitudes toward chemical products in the home, product instructions and warning labels, and other self-protective behaviors in the home. Two self-protection scales were administered. One scale, *SelfPro1*, was comprised of 10 self-protective activities around the home. A higher scale score indicates a more positive attitude toward self-protective behaviors. The individual item response scale ranges from “1” (Never important to me or my family) to “5” (Always important to me and my family). Table 7 summarizes responses to the 10 self-protective activities.

The overall *SelfPro1* scale exhibited only a marginal change from pretest to posttest for All Schools Combined (see Table 2). For some individual items, however, pre/post changes were larger and in the direction of *less* self protection, particularly for (a) washing fruit/vegetables before eating, (b) reading directions for household products, (c) reading ingredient/warning labels, and (d) testing smoke detectors. It is unclear why students would perceive less importance in these activities from pretest to posttest. Perhaps the knowledge and information they received as part of the curriculum gave them greater confidence in their ability to understand environmental health risks. As a result, their more positive perspective on self-protection may have led to lower assessments of risk from household hazards. A more careful analysis of the relationship between these factors is needed.

The *SelfPro2* scale was comprised of three attitude items relating to self protection. The response scale for these items ranged from “1” (Strongly Disagree) to “4” (Strongly Agree). Table 8 summarizes responses to these three items. The only item of significance was the following:

“For most of the chemicals I am exposed to in daily life, including chemicals in the environment, I feel I know how to protect my health and safety.”

Pre/post change scores in response to this item were in the direction of more positive agreement suggesting that students were more likely to see themselves as knowledgeable about self-protection with respect to chemical risks. The change was significant for both the Single Teacher (2.78 vs. 3.00,  $p < .05$ ) and Integrated Team Program (2.81 vs. 2.98,  $p < .05$ ). The larger sample size of the All School Combined group lead to greater statistical power and a higher level of significance.

Table 7. *SelfPro1* Scale: Summary of individual items by single teacher, integrated team and all schools combined.

	All Schools Combined					Single Teacher <sup>a</sup>					Integrated Team <sup>b</sup>					Between-program significance		
	N	Pre	Post	Diff <sup>c</sup>	<i>t-test</i> <sup>d</sup>	N	Pre	Post	Diff	<i>t-test</i>	N	Pre	Post	Diff	<i>t-test</i>	Pre	Post	Diff
Wash fresh fruit and vegetables before eating.	274	4.21	3.88	(-0.32)	p<.0001	132	4.05	3.85	(-0.20)	p=.10	142	4.35	3.92	(-0.44)	p<.0001	p<.05	ns	ns
Read the directions for using household consumer products.	272	3.70	3.54	(-0.16)	p<.05	132	3.55	3.34	(-0.21)	p=.09	140	3.84	3.73	(-0.11)	ns	p<.05	p<.01	ns
Read and understand my city's drinking water reports.	273	2.64	2.64	0.00	ns	132	2.56	2.42	(-0.14)	ns	141	2.71	2.84	0.13	ns	ns	p<.01	p=.09
Read product ingredient labels and warning labels for household chemical products.	273	3.56	3.37	(-0.19)	p<.05	133	3.43	3.19	(-0.24)	p=.06	140	3.69	3.55	(-0.14)	ns	p=.07	p<.01	ns
Test smoke detectors and replace batteries regularly.	274	3.60	3.44	(-0.16)	p<.05	131	3.44	3.39	(-0.05)	ns	143	3.75	3.48	(-0.27)	p<.05	p<.05	ns	ns
Replace filters on home heating systems, such as furnaces.	276	3.36	3.34	(-0.03)	ns	133	3.33	3.29	(-0.04)	ns	143	3.39	3.38	(-0.01)	ns	ns	ns	ns
Use protective equipment such as safety glasses or gloves when recommended.	275	3.52	3.48	(-0.04)	ns	132	3.49	3.43	(-0.06)	ns	143	3.55	3.52	(-0.03)	ns	ns	ns	ns
Discuss safe use of products with other members of your family.	274	3.03	3.08	0.05	ns	131	2.82	2.87	0.05	ns	143	3.22	3.28	0.06	ns	p<.01	p<.01	ns
Provide adequate ventilation when using chemical products indoors.	274	3.83	3.79	(-0.04)	ns	133	3.70	3.77	0.08	ns	141	3.96	3.80	(-0.16)	ns	p<.05	ns	ns
Have my drinking water tested for contaminants.	275	2.63	2.70	0.07	ns	132	2.61	2.65	0.04	ns	143	2.65	2.74	0.09	ns	ns	ns	ns

<sup>a</sup>Single teacher school = Benson HS

<sup>b</sup>Integrated Team = Reynolds HS, Westview HS (Catapult), Fir Ridge Campus, Young Parent Program, The Community Schoolhouse

<sup>c</sup>Mean Difference Scores are computed across subjects by taking the average difference of the posttest minus the pretest.

<sup>d</sup>T-test for signed difference scores: \*p<.05; \*\*p<.01; \*\*\*p<.001; \*\*\*\*p<.0001

Table8. *SelfPro2* Scale: Summary of individual items by single teacher, integrated team and all schools combined.

	All Schools Combined					Single Teacher <sup>a</sup>					Integrated Team <sup>b</sup>					Between-program Significance		
	N	Pre	Post	Diff <sup>c</sup>	<i>t-test</i> <sup>d</sup>	N	Pre	Post	Diff	<i>t-test</i>	N	Pre	Post	Diff	<i>t-test</i>	Pre	Post	Diff
For most of the chemicals I am exposed to in daily life, including chemicals in the environment, I feel I know how to protect my health and safety.	235	2.80	2.99	0.19	p<.01	114	2.78	3.00	0.22	p<.05	121	2.81	2.98	0.17	p<.05	ns	ns	ns
For most of the chemicals in the environment, I feel I know how to protect my health and safety.	224	2.72	2.74	0.02	ns	111	2.68	2.79	0.11	ns	113	2.75	2.68	-0.07	ns	ns	ns	ns
I have read and can understand most of the warning labels on chemicals in my home.	246	3.07	3.13	0.06	ns	118	2.96	3.08	0.13	ns	128	3.17	3.16	-0.01	ns	p=.06	ns	ns

<sup>a</sup>Single teacher school = Benson HS

<sup>b</sup>Integrated Team = Reynolds HS, Westview HS (Catapult), Fir Ridge Campus, Young Parent Program, The Community Schoolhouse

<sup>c</sup>Mean Difference Scores are computed across subjects by taking the average difference of the posttest minus the pretest.

<sup>d</sup>*t-test* for signed difference scores: \*p<.05; \*\*p<.01; \*\*\*p<.001; \*\*\*\*p<.0001

### **Value for Science (*ValueSci*).**

Acquiring and using environmental health science knowledge both depends upon and results in more positive view of science in daily life as well as a positive view of science as a social enterprise. The items in the *ValueSci* scale assess student attitudes toward the value of science, both in general and specifically with regard to environmental health science and personal safety/risk decisions. The attitude items comprising the scale are rated from “1” (Strongly Disagree) to “4” (Strongly Agree). A higher rating indicates a more positive attitude toward science. Table 9 summarizes the individual item responses.

Although the pre/post change for the *ValueSci* scale was significant at a fairly low level for the Integrated Team Program, individual item pre/post change was more significant particularly for the item “I feel that I know how to use science to determine when my exposure to chemicals is safe or not” ( $p < .001$ ; Integrated Team Program). Again, the effect of the curriculum may have been to heightened students’ belief in their ability to determine when they are or are not at risk from chemicals. Other items showing significant pre/post change related to (a) easy of learning science topics, and (b) confidence talking with environmental scientists about their work. Students in both the Single Teacher and Integrated Team Programs were inclined to express *less confidence* talking about science with other people like themselves.

Table 9. *ValueSci* Scale: Summary of individual items by single teacher, integrated team and all schools combined.

	All Schools Combined					Single Teacher <sup>a</sup>					Integrated Team <sup>b</sup>					Between-program Significance		
	N	Pre	Post	Diff <sup>c</sup>	<i>t-test</i> <sup>d</sup>	N	Pre	Post	Diff	<i>t-test</i>	N	Pre	Post	Diff	<i>t-test</i>	Pre	Post	Diff
I feel I know how to use environmental science to help make decisions that protect my health and safety.	229	2.82	2.92	0.10	ns	114	2.89	2.90	0.02	ns	115	2.75	2.93	0.18	p<.05	ns	ns	ns
Most topics in science are relatively easy for me to learn.	245	2.53	2.67	0.14	p<.05	115	2.46	2.59	0.13	ns	130	2.58	2.73	0.15	p=.08	ns	ns	ns
I feel confident talking with environmental scientists about their work.	235	2.47	2.60	0.13	p<.05	118	2.43	2.58	0.14	ns	117	2.50	2.62	0.11	ns	ns	ns	ns
I am comfortable talking about science with other people like me.	237	2.94	2.82	(-0.12)	p=.09	113	2.82	2.71	(-0.12)	ns	124	3.05	2.92	(-0.13)	ns	p<.05	p<.05	ns
I am generally interested in new developments in environmental science.	227	2.55	2.58	0.04	ns	116	2.59	2.59	0.00	ns	111	2.50	2.58	0.07	ns	ns	ns	ns
I feel that I know how to use science to determine when my exposure to chemicals is safe or not.	234	2.60	2.83	0.23	p<.001	108	2.68	2.83	0.16	ns	126	2.54	2.83	0.29	p<.001	ns	ns	ns
Whether or not I get a good job in the future has very little to do with how well I do in my science classes.	226	2.54	2.45	(-0.09)	ns	110	2.75	2.54	(-0.21)	ns	116	2.35	2.37	0.02	ns	p<.01	ns	ns

<sup>a</sup>Single teacher school = Benson HS

<sup>b</sup>Integrated Team = Reynolds HS, Westview HS (Catapult), Fir Ridge Campus, Young Parent Program, The Community Schoolhouse

<sup>c</sup>Mean Difference Scores are computed across subjects by taking the average difference of the posttest minus the pretest.

<sup>d</sup>*t-test* for signed difference scores: \*p<.05; \*\*p<.01; \*\*\*p<.001; \*\*\*\*p<.0001

### Perception of Risk (*PercRisk*).

As students develop increased knowledge skills and conceptual awareness of environmental health science, their perception of environmental health science risks may change with respect to other risks and hazards. The *items in the PercRisk* scale assesses change in students' perceptions of a broad range of health and safety risks, including those identified by environmental health science. A set of 10 health and safety risks were evaluated by students on a scale ranging from "1" (No Risk) to "4" (High Risk). Figure 1 shows the percentage of students in the Integrated Team Program who rated each of the items "Moderate" or "High Risk." Figure 2 shows the comparable data for students in the Single Teacher Program.

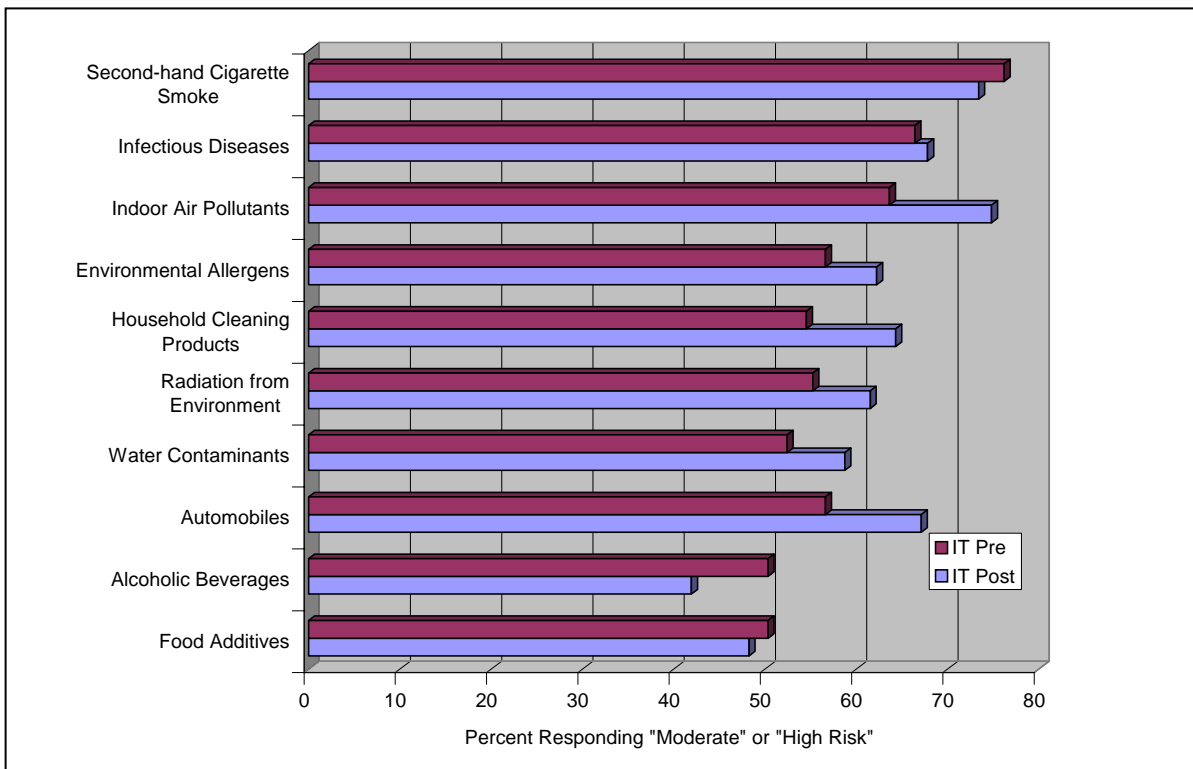


Figure 1. Percentage of students assigning a "moderate" or "high risk" rating to each of 10 risk perception items: Integrated Team Program

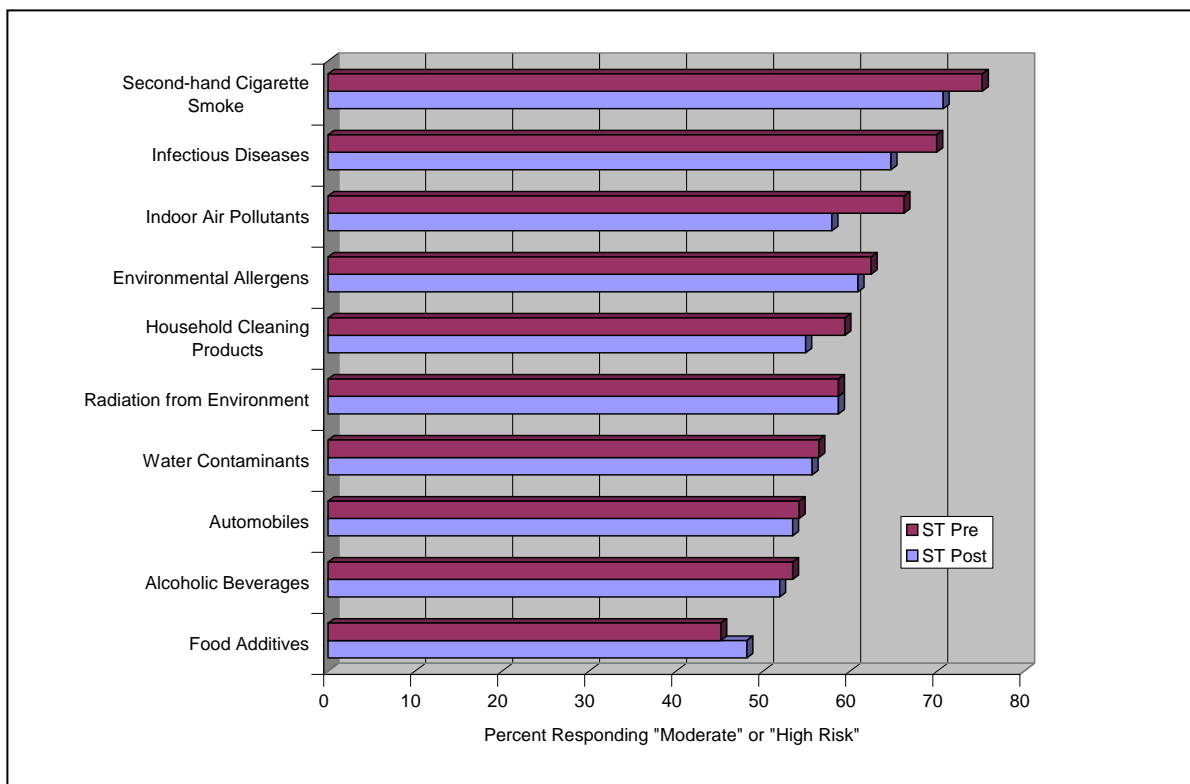


Figure 2. Percentage of students assigning a “moderate” or “high risk” rating to each of 10 risk perception items: Single Teacher Program

With respect to the ranking of the 10 risk items, based on pretest results the rankings were identical for both programs. “Second-hand cigarette smoke”, “infectious diseases”, “indoor air pollutants” and “environmental allergens” were the top four hazards in terms of perceived risk. For the Single Teacher Program (Figure 2) there was very little change from pretest to posttest in risk ratings. None of the changes reached statistical significance. However, for the Integrated Team Program (Figure 1) “indoor air pollutants” increased significantly ( $p < .05$ ) from pretest to posttest, as well as “environmental allergens” though at a lower level of significance ( $p < .10$ ). In general, students in the Integrated Team Program appear to have been more sensitized by the curriculum to the risks associated with a number of potential hazards (and particularly those associated with air quality) than were their counterparts in the Single Teacher Program. This effect can be seen more clearly in Table 10 that shows the results for the *EnviroRisk* scale, a subscale based on three items from the *PercRisk* scale.

Table 10. *EnviroRisk* Scale: Summary of individual items by single teacher, integrated team and all schools combined.

	All Schools Combined					Single Teacher <sup>a</sup>					Integrated Team <sup>b</sup>					Between-school Significance		
	N	Pre	Post	Diff <sup>c</sup>	<i>t-test</i> <sup>d</sup>	N	Pre	Post	Diff	<i>t-test</i>	N	Pre	Post	Diff	<i>t-test</i>	Pre	Post	Diff
Indoor air pollutants	240	2.87	2.98	0.10	ns	115	2.91	2.87	(-0.04)	ns	125	2.83	3.07	0.24	p<.05	ns	p=.07	p<.05
Water contaminants	227	2.69	2.74	0.06	ns	113	2.69	2.72	0.03	ns	114	2.68	2.77	0.09	ns	ns	ns	ns
Environmental allergens	230	2.75	2.93	0.18	p<.05	120	2.73	2.89	0.17	ns	110	2.77	2.97	0.20	p=.07	ns	ns	ns

<sup>a</sup>Single teacher school = Benson HS

<sup>b</sup>Integrated Team = Reynolds HS, Westview HS (Catapult), Fir Ridge Campus, Young Parent Program, The Community Schoolhouse

<sup>c</sup>Mean Difference Scores are computed across subjects by taking the average difference of the posttest minus the pretest.

<sup>d</sup>*t-test* for signed difference scores: \*p<.05; \*\*p<.01; \*\*\*p<.001; \*\*\*\*p<.0001

Students' average ratings on the *EnviroRisk* scale increased significantly from pretest to posttest for the Integrate Team Program ( $p < .01$ ; See Table 2). This change was largely due to increased risk ratings for "indoor air pollutants" and "environmental allergens." Ratings for "water contaminants" went unchanged. The results suggest that the tendency of the curriculum is to focus students' awareness on the particular content of a hazard as opposed to the characteristics of hazards in general. Nonetheless, the results shown in Figure 1 for the Integrated Team Program show substantial (though not statistically significant) increases in risk perception for all risks except "alcoholic beverages" and "food additives." Comparable increases in risk perception did not appear to occur for the Single Teacher Program, suggesting that the modality of program delivery and/or idiosyncratic teaching styles in the classroom can have important effects on student change associated with curriculum implementation.

### **Intuitive Toxicology (*IntuiTox*)**

In previous years, a concept that we assessed was based on the notion that interaction with scientific and technical experts (either personally or through the curriculum) would produce student change in the direction of attitudes and intuitions about exposure to environmental hazards that are more consistent with those of the scientific community. We called this concept "Intuitive Toxicology" to reflect the intuitive models and ideas students have regarding the relationship between hazards, exposure, dose-response, and health-related outcomes. The evaluation of the Pesticide Spill and the Mysterious Illness Outbreak curricula used a multiple-item scale to assess change in the *IntuiTox* concept. Although important changes did occur in the direction hypothesized, the scale itself tended to exhibit weak psychometric properties with a low and marginal internal consistency index (Cronbach's  $\alpha < .50$ ). This low  $\alpha$  argues against combining the individual items into a single scale since they appear to be measuring different concepts. The items can be seen in Table 11 for the IAQ *IntuiTox* scale. All were rated on a scale from "1" (Strongly Disagree) to "4" (Strongly Agree) scale.

As can be seen from Table 11, the only item for which a significant pre/post change occurred was:

"If a person is exposed to a chemical that can cause cancer in humans, then that person will probably get cancer some day."

Students in the Integrated Team Program tended to express greater disagreement with the statement in the posttest than the pretest ( $p < .01$ ), an attitude generally more in agreement with how toxicological experts would respond. Students in the Single Teacher Program showed no significant pre/post change.

Table 11. *IntuiTox* Scale Items: Summary of individual items by single teacher, integrated team and all schools combined.

	All Schools Combined					Single Teacher <sup>a</sup>					Integrated Team <sup>b</sup>					Between-program Significance		
	N	Pre	Post	Diff <sup>c</sup>	<i>t</i> -test <sup>d</sup>	N	Pre	Post	Diff	<i>t</i> -test	N	Pre	Post	Diff	<i>t</i> -test	Pre	Post	Diff
If a chemical is released into the environment, then everyone in that environment is exposed to the chemical	242	2.96	2.89	-0.07	ns	115	2.84	2.80	-0.04	ns	127	3.06	2.98	-0.09	ns	p<.05	p=.10	ns
If a person is exposed to a chemical that can cause cancer in humans, then that person will probably get cancer someday.	214	2.80	2.64	(-0.16)	p<.01	110	2.70	2.61	(-0.09)	ns	104	2.91	2.67	(-0.24)	p<.01	p<.05	ns	ns
Risks from chemicals usually seem larger to people who don't understand very much about environmental science.	233	2.45	2.53	0.08	ns	116	2.46	2.52	0.06	ns	117	2.44	2.54	0.10	ns	ns	ns	ns
Making good decisions about things that affect my health and safety, such as chemicals in the environment, is basically just a matter of getting a good feel for what might harm me.	228	2.91	2.84	-0.07	ns	108	2.84	2.81	-0.03	ns	120	2.97	2.87	-0.10	ns	ns	ns	ns
In general, if a person is not exposed to a hazard then they are not at risk.	241	2.51	2.63	0.12	p=.10	113	2.63	2.73	0.11	ns	128	2.41	2.54	0.13	ns	p<.05	p=.10	ns
If a person is exposed to a hazard, then they will always experience some degree of harm.	224	2.57	2.63	0.06	ns	108	2.59	2.63	0.04	ns	116	2.55	2.63	0.08	ns	ns	ns	ns
When it comes to managing risks that affect all of us, such as chemicals in the environment, we should leave the decisions to the experts.	238	2.63	2.63	0.00	ns	118	2.59	2.64	0.05	ns	120	2.66	2.62	-0.04	ns	ns	ns	ns

<sup>a</sup>Single teacher school = Benson HS

<sup>b</sup>Integrated Team = Reynolds HS, Westview HS (Catapult), Fir Ridge Campus, Young Parent Program, The Community Schoolhouse

<sup>c</sup>Mean Difference Scores are computed across subjects by taking the average difference of the posttest minus the pretest.

<sup>d</sup>*t*-test for signed difference scores: \*p<.05; \*\*p<.01; \*\*\*p<.001; \*\*\*\*p<.0001

An alternative approach to examining student change is based on an analysis of the intercorrelations between *IntuiTox* items that can be conceptualized in terms of a mental model depicting how toxicological concepts are linked to one another. Figure 3 shows the correlational relationship between three *IntuiTox* items pertaining to hazard, exposure and harm.

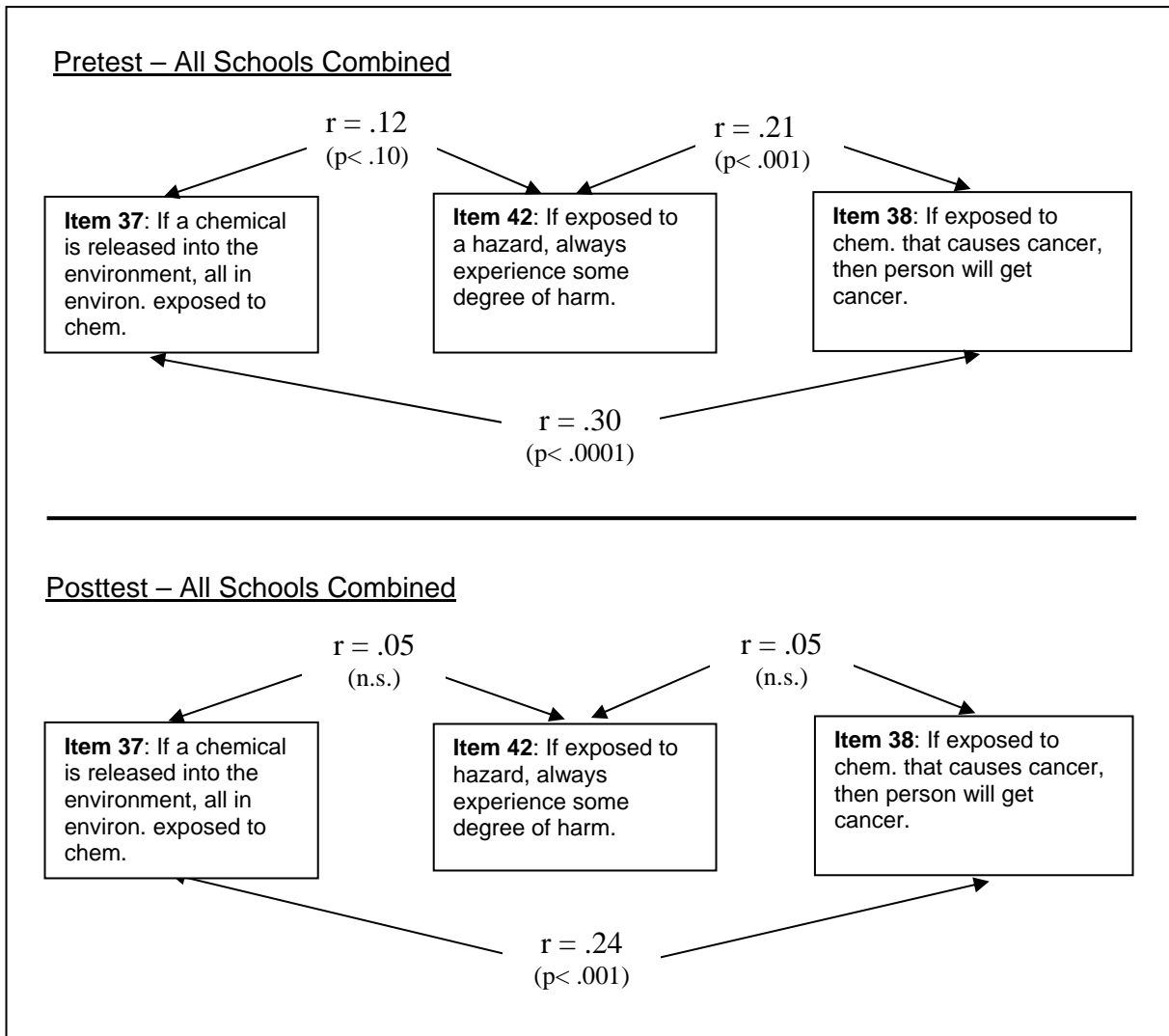


Figure 3. Intercorrelations of *IntuiTox* items pertaining to hazard, exposure and likelihood of harm.

The top frame of Figure 3 shows the pretest results for All Schools Combed for three key attitude statements concerning toxicology. The far left item assesses attitudes regarding the relationship between the release of a hazard and exposure (Item 37), the middle item pertains to the relationship between exposure to a hazard and subsequent harm (Item 42), and the third posits a relationship between exposure to a carcinogen and certainty of harm (Item 38). In the pretest, these three items all bear a statistically significant pattern of intercorrelation: chemical release and subsequent exposure tends to

be perceived as always producing a degree of harm and when a particular hazard (chemical) is brought into the picture the harm tends to be seen as occurring with certainty. However, in the posttest the pattern changes somewhat: although there is still a relationship between chemical exposure and harm, the notion that exposure to hazards in general always results in harm is attenuated. Students in the posttest appeared to make stronger distinctions between exposure to a hazard and the likelihood of subsequent. In this light, their intuitions about toxicology bear a strong resemblance to that of toxicological science.