

# Systemic Underfunding and Educational Deficits in Canadian New Approach Methodologies: A Comparative Policy and Curriculum Analysis

This research report evaluates the structural underfunding and educational gaps surrounding New Approach Methodologies (NAMs) in Canada. While global leaders like the United States and the European Union aggressively fund non-animal, human-relevant testing, computational toxicology, and microphysiological models, Canada relies on a fragmented and biased funding system. This investigation audits federal investments, university and K-12 curricula, regulatory mandates under the Canadian Environmental Protection Act (CEPA), and ethical frameworks governing student autonomy. The findings demonstrate a critical workforce skills gap and systemic academic barriers that place Canadian students and scientists at a severe disadvantage internationally.

## Comparative Fiscal Analysis of Federal Funding for New Approach Methodologies

The transition toward New Approach Methodologies (NAMs)—encompassing non-animal, human-relevant testing, *in silico* modeling, computational toxicology, and microphysiological systems—is rapidly reshaping biomedical research, safety testing, and drug development worldwide.<sup>1</sup> This paradigm shift promises superior predictive accuracy for human biology, a reduction in the massive attrition rates of pharmaceutical candidates, and more ethical scientific practices.<sup>4</sup> However, a comparative analysis of public R&D spending reveals that Canada is experiencing a profound fiscal deficit in dedicated funding for NAMs, leaving its scientific infrastructure, academic institutions, and students lagging behind international peers.<sup>7</sup>

In Canada, federal funding for NAM-related research is highly fragmented, distributed across competitive, project-specific grants from the tri-agency councils—the Canadian Institutes of Health Research (CIHR), the Natural Sciences and Engineering Research Council (NSERC), and the Social Sciences and Humanities Research Council (SSHRC)—or ad-hoc strategic initiatives like Genome Canada.<sup>8</sup> While isolated academic teams have successfully secured project-level funding—such as the \$4.7 million CAD Genome Canada Genomics Application Partnership Program (GAPP) grant for the validation of the EcoToxChip test system<sup>10</sup>, or a \$1.25 million CAD NSERC Alliance grant for the indigenization of NAMs in contaminated site assessments<sup>10</sup>—these allocations are temporary, localized, and restricted to specific research questions.<sup>8</sup> Canada lacks a centralized, ring-fenced federal funding pool dedicated to the development,

validation, and regulatory standardization of alternative models.<sup>8</sup>

This project-level fragmentation stands in stark contrast to the institutionalized financial commitments of Canada's global competitors.<sup>1</sup> In the United States, the National Institutes of Health (NIH) Common Fund launched the Complement Animal Research In Experimentation (Complement-ARIE) program, dedicating \$150 million USD over an initial five-year phase starting in 2024 to accelerate the development, standardization, and validation of human-based NAMs.<sup>1</sup> Complement-ARIE funds comprehensive technology development centers, a centralized NAMs Data Hub and Coordinating Center (NDHCC), and a Validation and Qualification Network (VQN) designed to shepherd alternative models through regulatory approval.<sup>1</sup> This is supplemented by other major allocations, such as an \$87 million USD NIH center for organoid development<sup>14</sup> and a \$15.3 million USD NIH-funded NAMs Decision Center at Texas A&M University to advance chemical safety assessments.<sup>15</sup>

Australia is also building its non-animal research system,<sup>2</sup> because they recognize non-animal models are "crucial tools in biomedical and clinical research [and are] being increasingly used as readily accessible model types in medical product development".<sup>52</sup> As such, Phenomics Australia runs a national research service for non-animal modeling.

The European Union has leveraged Horizon Europe and national-level growth funds to drive systemic change. In the Netherlands, the Dutch National Growth Fund invested €124.5 million (approximately \$135 million USD) in the Centre for Animal-Free Biomedical Translation (CPBT).<sup>13</sup> The CPBT functions as a nationwide consortium linking all Dutch academic medical centers, industry stakeholders, regulators, and government agencies to implement and commercialize animal-free biomedical innovations.<sup>13</sup>

The per-capita and proportional investment gaps between Canada and these active jurisdictions are mathematically stark.<sup>1</sup> Let  $F$  represent the dedicated federal funding allocation for national NAM validation, standardization, and educational training infrastructure, and let  $P$  represent the respective national population then the per-capita investment  $I$  is:

$$\text{Per-Capita Investment } (I) = \frac{\text{Dedicated Funding Allocation } (F)}{\text{Population } (P)}$$

For Canada, with a population of approximately 41 million, the lack of any dedicated federal program for national NAM validation and training infrastructure results in:

$$I_{\text{Can}} = \frac{\$0 \text{ CAD}}{41,000,000} = \$0.00 \text{ CAD per capita}$$

For the United States, utilizing only the initial \$150 million USD (\$205 million CAD equivalent) allocation for the Complement-ARIE program for a population of 340 million:

$$I_{\text{US}} = \frac{\$150,000,000 \text{ USD}}{340,000,000} \approx \$0.44 \text{ USD per capita } (\approx \$0.60 \text{ CAD})$$

For the Netherlands, with a dedicated Growth Fund allocation of €124.5 million (\$185 million CAD equivalent) and a population of 18 million:

$$I_{NL} = \frac{\text{€}124,500,000}{18,000,000} \approx \text{€}6.92 \text{ per capita } (\approx \$10.27 \text{ CAD})$$

| Jurisdiction         | Primary Dedicated NAM Program / Initiative           | Total Dedicated Funding Allocation (CAD Equivalent) | Funding Term (Years) | National Population (Millions) | Dedicated Per-Capita Investment (CAD) | Active National Center or Regulatory Hub            |
|----------------------|--|---|----------------------|--------------------------------|---------------------------------------|---|
| <b>United States</b> | NIH Complement-ARIE & Dedicated Organoid Centers     | ~\$325,000,000                                      | 5                    | 340                            | ~\$0.95                               | Yes (VQN, NDHCC, TAMU Decision Center) <sup>1</sup> |
| <b>Netherlands</b>   | Centre for Animal-Free Biomedical Translation (CPBT) | ~\$185,000,000                                      | 10                   | 18                             | ~\$10.27                              | Yes (CPBT Consortium) <sup>13</sup>                 |
| <b>Canada</b>        | None (Ad-hoc academic grants only)                   | \$0 (No dedicated program)                          | N/A                  | 41                             | \$0.00                                | No (CCAAM permanently closed in 2024) <sup>8</sup>  |

The structural consequence of this funding deficit is the closure of the Canadian Centre for Alternatives to Animal Methods (CCAAM) at the University of Windsor on May 31, 2024.<sup>8</sup> Founded in 2017 as the first and only center in Canada dedicated to non-animal testing and the promotion of human-relevant alternatives, CCAAM was designed to develop, validate, and promote lab methods that bypass animal subjects.<sup>8</sup> Despite receiving a one-time \$1 million CAD philanthropic donation in 2018 from the Eric S. Margolis Family Foundation to build a training facility<sup>18</sup>, the center never received sustained federal operational funding.<sup>8</sup> Ultimately, budget cuts at the University of Windsor forced its permanent closure, leaving Canada without a single national hub to coordinate NAM development, train researchers, or interface with international validation bodies.<sup>7</sup>

According to Dr. Charu Chandrasekera who is the founder and executive director of the Canadian Institute for Animal-Free Science (formerly known as CCAAM), she would require a minimum budget of 10 million/year. That is less than 25 cents per Canadian, yet the Feds are not providing the funding!

## Structural Bias and Legacy Benchmarks in Academic

## Granting Councils

The lack of dedicated NAM funding pools in Canada is compounded by a structural bias within the peer-review mechanisms of CIHR and NSERC.<sup>19</sup> Legally and historically, traditional vertebrate animal models have been treated as the unquestioned "gold standard" for biomedical and toxicological research.<sup>22</sup> Consequently, researchers attempting to secure federal grants for projects utilizing microphysiological systems or computational modeling face a self-perpetuating cycle of rejection.<sup>19</sup>

Peer-review panels at Canadian granting councils are typically populated by established scientists who built their careers on animal-testing protocols.<sup>19</sup> Literature on peer-review performance indicates a pervasive conservative bias, where reviewers unconsciously favor methodologies aligning with their own expertise and academic backgrounds.<sup>19</sup> This systemic inertia penalizes innovative, high-risk, or multidisciplinary proposals.<sup>19</sup> In a standard review process, when an applicant proposes a human-relevant *in vitro* or *in silico* model, reviewers frequently demand supplementary *in vivo* animal validation to "benchmark" the results, viewing the non-animal method as an unproven surrogate rather than a superior predictive tool.<sup>6</sup> The reliability of peer-review ratings at CIHR is demonstrably poor, with intra-class correlation coefficients (ICC) ranging from a low of \$0.20\$ to a moderate \$0.61\$ across different study cohorts.<sup>19</sup> The ICC is somewhat higher for basic medical sciences (\$0.41\$) than for applied sciences (\$0.32\$), reflecting a rigid consensus around traditional, animal-centric basic science methodologies and a deep skepticism toward emerging, multidisciplinary methodologies.<sup>19</sup> This peer-review framework penalizes early-career investigators and favors older, established applicants who rely on legacy animal-based research programs.<sup>19</sup>

While major international agencies have introduced structural interventions—such as the US NIH's High-Risk High-Reward Research Program<sup>26</sup> or the Danish Villum Foundation's "Golden Ticket" system, which allows individual reviewers to rescue highly innovative proposals regardless of consensus scoring<sup>26</sup>—Canadian councils maintain conservative rating and ranking systems that systematically undervalue non-animal innovations.<sup>19</sup>

Furthermore, an institutional conflict of interest underpins Canada's animal research oversight system.<sup>21</sup> The Canadian Council on Animal Care (CCAC), which sets guidelines for animal welfare in research, is funded almost entirely by CIHR and NSERC.<sup>21</sup> Participation in the CCAC is voluntary for private institutions but mandatory for academic universities relying on tri-agency grants.<sup>21</sup>

Because the CCAC's operational existence is structurally dependent on the continuation of animal-based research, and because CIHR and NSERC's core scientific portfolios remain heavily anchored in animal models, there is no centralized institutional incentive to mandate or fund a national transition toward alternative methodologies.<sup>21</sup> This lock-in effect ensures that the regulatory and funding structures continue to feed into one another, solidifying the position of animal models as the legacy benchmark.<sup>21</sup>

## Curriculum Audit of Canadian Higher Education and

# Pockets of Isolation

## University and Graduate Level Mapping

An audit of the biology, biomedical, and toxicology curricula at Canada's top research universities reveals a severe systemic absence of structured, dedicated coursework in advanced NAMs.<sup>8</sup> While global industry and regulatory frameworks are rapidly integrating computational toxicology, microphysiological systems, and high-throughput workflows<sup>1</sup>, Canadian higher education continues to train the next generation of life scientists using legacy, animal-centric frameworks.<sup>8</sup>

Crucially, standard curricula across these universities completely omit training in the foundational computational tools and chemical modeling suites that are now mandatory in modern regulatory science.<sup>8</sup> Students are not taught how to utilize commercial software platforms such as Leadscope, Derek Nexus, and Case Ultra, nor are they exposed to open-source alternatives like the OECD QSAR Toolbox, VEGA, and OPERA.<sup>28</sup> These platforms are essential for performing structure-activity modeling, identifying toxicophores, and conducting read-across assessments under international frameworks like the ICH M7 guidelines for mutagenic impurities<sup>28</sup> or the Carcinogenic Potency Category Approach used by Health Canada, the FDA, and the EMA.<sup>28</sup>

At the University of Toronto, a premier research institution, there is a notable bifurcation between engineering and the life sciences. The School of Graduate Studies offers a highly specialized graduate-level course, "CHE1334H: Organ-on-a-Chip Engineering," which focuses on the on-chip engineering of heart, kidney, liver, and cancer models.<sup>30</sup> This is supported by the Centre for Microfluidic Systems (CRAFT), a partnership with the National Research Council (NRC) that designs biomimetic microfluidic platforms like the "E-FLOAT" airway-on-a-chip.<sup>6</sup> However, these engineering-led initiatives operate in isolation.<sup>6</sup> They are not integrated into the standard undergraduate life sciences, pharmacology, or toxicology curricula, meaning that the vast majority of biology and pre-medical students graduate without formal exposure to these technologies.<sup>6</sup>

A similar pattern of isolated excellence versus systemic absence is visible across other top-tier universities:

- **McGill University:** Housing the lab of Niladri Basu, McGill represents an active hub of NAM research.<sup>10</sup> However, an audit of course calendars shows that standard environmental health and toxicology courses (such as NRSC 670 and PARA 515) focus broadly on exposure assessment, epidemiology, and traditional water safety.<sup>32</sup> There are no dedicated, core undergraduate modules or laboratory courses in machine learning-driven toxicity prediction, quantitative structure-activity relationship (QSAR) modeling, or human-biology-based *in vitro* data workflows.<sup>32</sup>
- **University of British Columbia (UBC):** Exposure to advanced NAMs is highly restricted. While UBC offers a summer program course, "Innovations in Biomedical Sciences," which introduces 15-to-18-year-old high school students to 3D bioprinting and

organ-on-a-chip models<sup>33</sup>, these topics are largely absent as dedicated, credit-bearing courses within standard undergraduate biology or pharmacology programs.

- **University of Alberta and McMaster University:** These institutions maintain robust biomedical engineering and clinical research programs, but their core life science curricula remain dominated by traditional animal-testing paradigms, lacking systematic instruction in computational toxicology, read-across methods, or high-throughput bioassays.<sup>3</sup>

The closure of CCAAM at the University of Windsor in 2024 eliminated the only academic center in Canada that actively integrated alternative validation and non-animal biomedical training into standard higher education.<sup>8</sup> Consequently, undergraduate and graduate training in NAMs in Canada is restricted to niche, self-taught graduate research environments, creating a major educational deficit when compared to the structured training programs funded by the US Complement-ARIE initiative.<sup>1</sup>

| University                     | Dedicated Undergrad NAM Coursework | Dedicated Graduate NAM Coursework                    | Active Research Centers / Initiatives         | Curricular Assessment & Deficits   |
|--------------------------------|------------------------------------|--|---|--|
| University of Toronto          | None                               | CHE1334H (Organ-on-a-Chip Engineering) <sup>30</sup> | CRAFT (Partnership with NRC) <sup>6</sup>     | Focus is heavily restricted to graduate-level engineering; complete absence of integration in standard undergraduate life sciences, pharmacology, and toxicology.          |
| McGill University              | None                               | None   | Basu Lab (EcoToxChip, Genomics) <sup>10</sup> | Practical training is limited to isolated graduate research; standard toxicology and environmental health courses lack dedicated computational/QSAR modules. <sup>32</sup> |
| University of British Columbia | None                               | None   | Microphysiological research labs              | Core curricula remain traditional; exposure to organ-on-a-chip is  |

|                              |      |      |  |   |
|------------------------------|------|------|--|---|
|                              |      |      |  | limited to non-credit summer youth programs. <sup>33</sup>  |
| <b>University of Alberta</b> | None | None | Preclinical testing labs <sup>28</sup>                 | Reliance on traditional animal-model paradigms; no systematic training in high-throughput or in silico methodologies. <sup>28</sup>                             |
| <b>McMaster University</b>   | None | None | Clinical trial & bioengineering networks <sup>34</sup> | Training is heavily focused on traditional "gold standard" clinical and animal models; lack of structured non-animal methodology tracks. <sup>34</sup>          |
| <b>University of Windsor</b> | None | None | CCAAM / CaCVAM (Defunct as of 2024) <sup>8</sup>       | The complete closure of Canada's only dedicated alternatives center eliminated all active undergraduate and graduate training pathways in Windsor. <sup>8</sup> |

### **K-12 and Secondary Education Baseline**

The educational deficit begins well before higher education, rooted in provincial K-12 science curricula.<sup>35</sup> Assessment of high school biology frameworks across major provinces (Ontario, British Columbia, Quebec, and Alberta) reveals that secondary science programs continue to privilege legacy physical dissection over modern, non-animal scientific alternatives.<sup>35</sup>

In Ontario, the Grade 10 science and Grade 11 biology curricula state that students are to investigate respiratory and digestive systems through physical dissection or computer

simulations.<sup>35</sup> While the curriculum's language implies a choice, studies show that the practical implementation of this policy is highly problematic.<sup>37</sup> The choice is frequently interpreted as a teacher's prerogative rather than a student's right.<sup>37</sup> Surveys of Ontario science teachers indicate that 94.1% continue to conduct physical animal dissections in their classes.<sup>38</sup> Furthermore, 87.5% of these teachers believe that physical dissection is "important" to biology education, and 56.3% assert that "there are no substitutes" for real animal specimens.<sup>38</sup> Consequently, digital or synthetic alternatives (such as virtual simulations or 3D models) are rarely used as replacements, but rather as secondary supplements.<sup>36</sup>

In British Columbia, Quebec, and Alberta, a similar administrative structure exists.<sup>35</sup> While administrative procedures direct school districts to provide alternatives to dissection when students exercise a choice<sup>35</sup>, these policies are rarely promoted proactively.<sup>39</sup> Students are typically required to initiate a confrontation with their instructor to obtain an alternative, navigating a classroom dynamic that implicitly favors physical dissection as the "authentic" way to study anatomy.<sup>36</sup>

Exceptional cases exist—such as the Windsor-Essex Catholic District School Board, which voted in 2019 to completely phase out frog and fetal pig dissections in favor of synthetic models and virtual simulations<sup>35</sup>—but these are highly isolated municipal decisions. Nationally, K-12 frameworks fail to introduce secondary students to the concept of NAMs, reinforcing a cultural norm that biological science is fundamentally dependent on animal exploitation.<sup>36</sup>

| <b>Province</b>              | <b>Primary Curricular Requirement</b>   | <b>Dissection Policy / Student Choice Policy Status</b>  | <b>Primary Implementation Deficit</b>   |
|------------------------------|---|--|---|
| <b>Ontario (ON)</b>          | Grade 10 Science & Grade 11 Biology: observe systems via physical dissection or computer simulation. <sup>35</sup>      | Implied choice in curriculum; formal "opt-out" student choice policies exist in only a few local school boards (e.g., TDSB). <sup>37</sup>         | Over 94% of teachers continue to mandate physical dissection, treating digital alternatives as optional supplements rather than replacements. <sup>38</sup> |
| <b>British Columbia (BC)</b> | Secondary Science: investigate anatomy and systems using dissection, computer models, or prepared slides. <sup>35</sup> | Administrative procedures direct schools to provide alternatives when requested, but students must actively object to initiate this. <sup>35</sup> | Lack of proactive student notification; teachers frequently lack awareness of or training in high-quality digital alternatives. <sup>35</sup>               |
| <b>Quebec (QC)</b>           | Secondary Biology: study physiology and anatomy using prepared specimens,   | Alternatives are permissible but are not formally structured as a proactive student  | Physical dissection remains the default instructional standard; alternative digital   |

|                     |  |  |  |
|---------------------|--|--|--|
|                     | models, or digital tools. <sup>35</sup>  | choice policy; left to individual school discretion. <sup>35</sup>   | platforms are underutilized due to lack of teacher training. <sup>35</sup>   |
| <b>Alberta (AB)</b> | Secondary Biology: investigate relationships and anatomy through dissection or computer simulations. <sup>35</sup> | Schools are directed to provide alternatives within available resources, ensuring no student is forced to participate. <sup>35</sup> | "Practicability" loophole allows schools to bypass providing high-quality synthetic/digital alternatives if budgets are constrained. <sup>35</sup> |

## Regulatory, Legislative, and Labor Market Disconnections

### The CEPA 2023 Implementation Gap

In June 2023, the Parliament of Canada passed Bill S-5, the *Strengthening Environmental Protection for a Healthier Canada Act*, which modernized the *Canadian Environmental Protection Act, 1999* (CEPA).<sup>42</sup> A key amendment to the preamble and regulatory framework of CEPA explicitly recognized the importance of replacing, reducing, or refining the use of vertebrate animal testing in toxicity assessments.<sup>42</sup> In July 2025, Health Canada and Environment and Climate Change Canada (ECCC) formalized this legislative mandate by publishing the *Strategy to Replace, Reduce or Refine Vertebrate Animal Testing under CEPA*.<sup>42</sup> The strategy outlines a progressive objective to completely phase out chemical toxicity testing on vertebrate animals by the year 2035.<sup>42</sup> It establishes a stepwise approach to identify, prioritize, and implement NAMs within CEPA regulatory programs.<sup>42</sup>

Despite the progressive rhetoric of this strategy, a profound implementation gap has emerged.<sup>12</sup> Legal and policy analysts have pointed out that both Bill S-5 and the 2025 Strategy completely lack a dedicated, functional budget or staffing allocation to train and transition the scientific workforce.<sup>42</sup> Instead, Health Canada has stated that the funds required to implement the strategy will be drawn entirely from "existing budgets".<sup>42</sup>

The decision to execute a national scientific transition of this scale without fresh, ring-fenced funding raises serious concerns about regulatory enforcement.<sup>42</sup> The 2025 Strategy relies on the caveat that alternative testing methods will only be required when they are "practicable" and "scientifically justified".<sup>42</sup> Without a dedicated budget to train regulatory scientists in the interpretation, standardization, and validation of NAM data, traditional animal-based data will remain the default "practicable" path, effectively rendering the 2035 phase-out target unachievable.<sup>12</sup>

### The Workforce Skills Gap and Brain Drain

The lack of funding for NAM education and regulatory transition has created a severe workforce skills gap that threatens Canada's position in the global biotechnology and pharmaceutical sectors.<sup>45</sup> The global market is rapidly shifting toward AI-driven drug discovery, high-throughput in vitro toxicology, and microphysiological testing.<sup>47</sup> These advanced technologies require highly specialized STEM skills, combining cell biology, microfluidic engineering, programming, and machine learning.<sup>47</sup>

According to national labor market reports by BioTalent Canada, the country's life sciences sector is facing an acute talent shortage.<sup>45</sup> By 2029, the sector will require an estimated 65,000 additional workers, including 16,000 specifically for advanced biomanufacturing and research roles.<sup>45</sup> A major component of this shortage is a lack of job-ready, highly specialized technical skills.<sup>45</sup> While Canadian post-secondary institutions excel at teaching fundamental biology, they are failing to provide hands-on, industry-aligned training in the automated, digitalized workflows that define modern NAMs.<sup>45</sup>

CASTL's "Future-Ready" report, developed in partnership with BioTalent Canada and the Future Skills Centre, notes that 80% of biotechnology employers require Good Manufacturing Practices (GMP) and advanced laboratory skills (70%), yet graduates systematically lack this regulated laboratory experience.<sup>45</sup> This skills gap directly slows the adoption of predictive preclinical models by Canadian biotechnology firms.<sup>47</sup>

Because Canada lacks the academic infrastructure and national centers necessary to support high-level training in NAMs, it is facing a significant risk of scientific "brain drain".<sup>7</sup> Top-tier graduates specializing in computational chemistry, microfluidics, and stem-cell bioengineering are forced to leave Canada to pursue advanced training or competitive employment in the United States or the European Union, where multi-million-dollar programs (like Complement-ARIE or the CPBT consortium) provide robust, state-of-the-art career pathways.<sup>1</sup> This talent migration leaves Canadian start-ups and regulatory bodies understaffed, reinforcing Canada's dependency on foreign-developed testing models and undermining its domestic scientific sovereignty.<sup>7</sup>

## **Ethical Frameworks and Student Autonomy in Post-Secondary Institutions**

### **Systemic Ethical Compromise**

Forcing students to participate in invasive vertebrate testing and physical dissections creates acute ethical conflicts that compromise their psychological welfare and academic choices.<sup>36</sup> A significant portion of life science students harbor personal, moral, religious, or environmental objections to the use and killing of animals for educational purposes.<sup>39</sup>

Surveys of secondary and post-secondary students reveal a stark disconnect between public objection rates and vocalized complaints.<sup>39</sup> While school administrators and teachers frequently report that unsolicited student objections to dissection are rare, typically averaging only 3% to 5% of a class<sup>39</sup>, anonymous surveys indicate that the actual level of objection is

dramatically higher.<sup>39</sup> In some evaluations, up to 67% of students expressed ethical objections to dissecting vertebrates like rabbits, cats, or rodents.<sup>39</sup>

The cause of this discrepancy is a systemic lack of student autonomy.<sup>39</sup> Students operating in traditional academic environments face significant risks if they choose to voice an objection.<sup>39</sup>

These risks include:

- The loss of critical grades or course failure if the instructor refuses to accommodate them.<sup>39</sup>
- Ridicule, humiliation, or isolation from peers and instructors.<sup>39</sup>
- The psychological burden of being viewed as rebellious or academically "soft" for prioritizing ethical concerns.<sup>39</sup>

Consequently, the vast majority of ethically opposed students choose to "go along" with invasive procedures against their convictions, experiencing a form of systemic ethical compromise.<sup>37</sup> For many compassionate and highly capable students, this negative classroom environment serves as a barrier that drives them away from pursuing further studies or careers in the life sciences entirely.<sup>36</sup> This is not a new issue; documented cases of students seeking legal recourse to avoid killing and dissecting animals date back decades in Canada—such as the 1993 case of a University of Victoria biology student who chose to study and release a live marine mollusk rather than dissect it, illustrating the long-standing nature of this academic friction.<sup>39</sup>

## **The Legal and Institutional Void in Higher Education**

While K-12 school boards have slowly introduced regional "student choice policies," Canadian higher education exists in an institutional and legal void regarding the right to conscientious objection.<sup>51</sup> Currently, not a single university in Canada has established a formal, university-wide policy that guarantees students the right to conscientiously object to animal use and be provided with equivalent, non-animal learning alternatives without academic penalty.<sup>51</sup> While some individual instructors are willing to accommodate students on an ad-hoc, informal basis, this decentralized approach leaves students entirely dependent on the personal goodwill of their professors.<sup>51</sup>

This lack of institutional protection exposes a significant legal gap.<sup>51</sup> Under the *Canadian Charter of Rights and Freedoms*, Section 2 guarantees "freedom of conscience and religion" as well as "freedom of thought, belief, opinion and expression".<sup>51</sup> Section 15 further prohibits discrimination based on "creed".<sup>51</sup> In theory, these constitutional provisions protect a student's right to refuse to participate in practices they morally condemn.<sup>51</sup>

However, in practice, invoking Charter protections in a university setting is extremely difficult.<sup>51</sup> Under Canadian jurisprudence, universities are treated as government actors only for certain, specific purposes, largely determined by their funding arrangements and administrative relationships with the state.<sup>51</sup> For other purposes, they are viewed as private actors, meaning the Charter does not directly apply to their internal academic policies.<sup>51</sup> This legal ambiguity leaves post-secondary students without clear, enforceable rights, forcing them to choose between their ethical integrity and their academic progression.<sup>39</sup>

# Strategic Policy Conclusions

The current state of New Approach Methodologies in Canada is characterized by a profound disconnect between legislative ambition and educational, fiscal, and institutional reality.<sup>8</sup> While the 2023 amendments to the Canadian Environmental Protection Act and the subsequent 2025 Strategy set a progressive target to phase out animal-based toxicity testing by 2035, the federal government's refusal to allocate dedicated funding or staffing resources has crippled the implementation of this mandate from its inception.<sup>42</sup> This fiscal deficit has directly led to the collapse of Canada's only dedicated alternatives center, CCAAM, leaving the country without a national hub for validation, training, or international coordination.<sup>8</sup>

Consequently, Canadian higher education is failing to prepare its workforce for the global transition toward AI-driven, computational, and microphysiological safety testing.<sup>45</sup> The systemic absence of dedicated NAM coursework in top-tier research universities, combined with an educational framework that privileges legacy animal models as the "gold standard" in peer-review granting, has created an acute skills gap and a severe risk of brain drain.<sup>8</sup>

Furthermore, the lack of formal policies protecting conscientious objection in universities forces students into systemic ethical compromise, discouraging compassionate talent from entering the life sciences.<sup>39</sup>

To bridge this gap and ensure Canada remains globally competitive, the federal government must:

1. Establish a dedicated, permanent federal funding pool (administered through CIHR and NSERC) modeled on the US Complement-ARIE and Dutch CPBT initiatives to support the development and validation of human-relevant alternatives.<sup>1</sup>
2. Provide sustainable funding to re-establish and scale a national center for alternatives to animal testing (such as a re-launched CCAAM in Ottawa) to lead the training of regulatory and academic scientists.<sup>8</sup>
3. Reform tri-agency peer-review mechanisms to eliminate the "gold standard" bias toward animal models and actively promote the acceptance of validated NAM data.<sup>20</sup>
4. Mandate the integration of computational toxicology and microphysiological training pathways within university life science curricula to align the domestic workforce with global industry demands.<sup>45</sup>
5. Enact clear, legally enforceable institutional policies in all post-secondary institutions protecting a student's right to conscientious objection, ensuring that humane, high-quality alternatives are available by default.<sup>40</sup>

## Works cited

1. Complement-ARIE Frequently Asked Questions - NIH Common Fund, accessed May 18, 2026, <https://commonfund.nih.gov/complementarie/faqs>
2. Building Australia's non-animal technologies ecosystem: a national cross-sector mapping and strategic insights from the non-animal technologies network (NAT-Net) - Frontiers, accessed May 18, 2026,

- <https://www.frontiersin.org/journals/toxicology/articles/10.3389/ftox.2026.1790806/full>
3. New approach methodologies in human regulatory toxicology – Not if, but how and when!, accessed May 18, 2026, <https://pmc.ncbi.nlm.nih.gov/articles/PMC10858683/>
  4. USA establishes new framework for animal-free research - Ärzte gegen Tierversuche, accessed May 18, 2026, <https://www.aerzte-gegen-tierversuche.de/en/news/usa-establishes-new-framework-for-animal-free-research>
  5. A Call to Action: Advancing New Approach Methodologies (NAMs) in Regulatory Toxicology through a Unified Framework for Validation and Acceptance - ResearchGate, accessed May 18, 2026, [https://www.researchgate.net/publication/393609539\\_A\\_Call\\_to\\_Action\\_Advancing\\_New\\_Approach\\_Methodologies\\_NAMs\\_in\\_Regulatory\\_Toxicology\\_through\\_a\\_Unified\\_Framework\\_for\\_Validation\\_and\\_Acceptance](https://www.researchgate.net/publication/393609539_A_Call_to_Action_Advancing_New_Approach_Methodologies_NAMs_in_Regulatory_Toxicology_through_a_Unified_Framework_for_Validation_and_Acceptance)
  6. Organ-on-Chip - Centre for Research and Applications in Fluidic Technologies, accessed May 18, 2026, <https://craftmicrofluidics.ca/research/organ-on-chip/>
  7. We contribute to plans to reshape animal testing in Canada - Cruelty ..., accessed May 18, 2026, <https://www.crueltyfreeinternational.org/we-contribute-to-plans-to-reshape-animal-testing-in-canada/>
  8. Windsor: Canadian Centre for Alternatives to Animal Methods (CCAAM) closed - InvitroJobs, accessed May 18, 2026, <https://www.invitrojobs.com/index.php/en/news/news-archive/item/6605-windsor-canadian-centre-for-alternatives-to-animal-methods-ccaam-closed>
  9. Help push Canada toward a future without animal testing - Vancouver Humane Society, accessed May 18, 2026, <https://vancouverhumanesociety.bc.ca/posts/help-push-canada-toward-a-future-without-animal-testing/>
  10. News - Environmental Health Sciences Lab - McGill University, accessed May 18, 2026, <https://basulab.weebly.com/news.html>
  11. Transcranial magnetic stimulation in Non-Human Primates: A systematic review | Request PDF - ResearchGate, accessed May 18, 2026, [https://www.researchgate.net/publication/371515595\\_Transcranial\\_magnetic\\_stimulation\\_in\\_Non-Human\\_Primates\\_A\\_systematic\\_review](https://www.researchgate.net/publication/371515595_Transcranial_magnetic_stimulation_in_Non-Human_Primates_A_systematic_review)
  12. Canada Publishes Final Strategy on Animal Testing – But Gaps Remain, accessed May 18, 2026, <https://www.crueltyfreeinternational.org/canada-publishes-final-strategy-on-animal-testing-but-gaps-remain/>
  13. MIMETAS Participates in €124.5 million Initiative to Transition to Animal-free Innovation, accessed May 18, 2026, <https://www.mimetas.com/en/news/793/mimetas-participates-in-124-5-million-initiative-to-transition-to-animal-free-innovation.html>
  14. FDA, NIH pledge more flexibility and \$150M investment for animal testing alternatives, accessed May 18, 2026,

- <https://www.fiercebiotech.com/biotech/fda-and-nih-pledge-more-flexibility-and-new-150m-investment-animal-testing-alternatives>
15. Texas A&M University Launches \$15.3 Million NIH-Funded Center To Strengthen Chemical Safety Assessments, Reduce Animal Use, accessed May 18, 2026, <https://vetmed.tamu.edu/news/press-releases/texas-am-15-3m-nih-chemical-safety-center/>
  16. Dutch National Growth Fund invests €124.5 million in transition to animal-free innovation, accessed May 18, 2026, <https://www.rivm.nl/en/alternatives-to-animal-testing/dutch-national-growth-fund-invests-eu1245-million-in-transition-to-animal-free-innovation>
  17. Dutch National Growth Fund invests 124,5 million in transition to animal-free innovation, accessed May 18, 2026, <https://www.hdmt.technology/2024/03/18/dutch-national-growth-fund-invests-1245-million-in-transition-to-animal-free-innovation/>
  18. Canadian Centre for Alternatives to Animal Methods - Wikipedia, accessed May 18, 2026, [https://en.wikipedia.org/wiki/Canadian\\_Centre\\_for\\_Alternatives\\_to\\_Animal\\_Methods](https://en.wikipedia.org/wiki/Canadian_Centre_for_Alternatives_to_Animal_Methods)
  19. Ranking versus rating in peer review of research grant applications - PMC, accessed May 18, 2026, <https://pmc.ncbi.nlm.nih.gov/articles/PMC10553257/>
  20. Evaluating Grant Peer Review in the Health Sciences: An Update Study for the Canadian Institutes of Health Research | RAND, accessed May 18, 2026, <https://www.rand.org/randeurope/research/projects/2018/cihr-peer-review-health-sciences.html>
  21. Canada's Research Animals Need National Legislation - Faunalytics, accessed May 18, 2026, <https://faunalytics.org/canadas-research-animals-need-national-legislation/>
  22. (PDF) “We Recognise the Value of Animal Experimentation, but we Recognise the Value of Animals as well”: Qualitative Insights on the Conflicting Experiences of Researchers on the Implementation of the 3Rs in Switzerland - ResearchGate, accessed May 18, 2026, [https://www.researchgate.net/publication/398046611\\_We\\_Recognise\\_the\\_Value\\_of\\_Animal\\_Experimentation\\_but\\_we\\_Recognise\\_the\\_Value\\_of\\_Animals\\_as\\_well\\_Qualitative\\_Insights\\_on\\_the\\_Conflicting\\_Experiences\\_of\\_Researchers\\_on\\_the\\_Implementation\\_of\\_the\\_3Rs\\_in\\_Switzerland](https://www.researchgate.net/publication/398046611_We_Recognise_the_Value_of_Animal_Experimentation_but_we_Recognise_the_Value_of_Animals_as_well_Qualitative_Insights_on_the_Conflicting_Experiences_of_Researchers_on_the_Implementation_of_the_3Rs_in_Switzerland)
  23. West & North Yorkshire Business Summer 2024 - Issuu, accessed May 18, 2026, [https://issuu.com/yorkshirebusiness/docs/yorkshire\\_business\\_magazine\\_summer\\_2024\\_pages](https://issuu.com/yorkshirebusiness/docs/yorkshire_business_magazine_summer_2024_pages)
  24. \jargon\ BUSTER - Canadian Institutes of Health Research, accessed May 18, 2026, [https://cihr-irsc.gc.ca/e/documents/cihr\\_jargon\\_buster-en.pdf](https://cihr-irsc.gc.ca/e/documents/cihr_jargon_buster-en.pdf)
  25. Biases in the Research Ecosystem: Transcript - CIHR, accessed May 18, 2026, <https://cihr-irsc.gc.ca/e/54537.html>
  26. What works for peer review and decision-making in research funding: a realist synthesis, accessed May 18, 2026, <https://pmc.ncbi.nlm.nih.gov/articles/PMC8894828/>

27. Animal Dissection in the College Classroom and the Case for Student Choice - Rivier University, accessed May 18, 2026, [https://www2.rivier.edu/faculty/pcunningham/Research/Student\\_Choice\\_in\\_the\\_Biology\\_Classroom\\_1998.pdf](https://www2.rivier.edu/faculty/pcunningham/Research/Student_Choice_in_the_Biology_Classroom_1998.pdf)
28. Bridging science and curriculum: preparing future leaders in computational toxicology - PMC, accessed May 18, 2026, <https://pmc.ncbi.nlm.nih.gov/articles/PMC12832508/>
29. computational toxicology - National Academic Digital Library of Ethiopia, accessed May 18, 2026, <https://ndl.ethernet.edu.et/bitstream/123456789/49347/1/197.pdf>
30. CHE1334H | School of Graduate Studies (SGS) Calendar - University of Toronto, accessed May 18, 2026, <https://sgs.calendar.utoronto.ca/course/che1334h>
31. Organ-on-a-Chip for Airway Tissue Modelling | Research & Innovation - University of Toronto, accessed May 18, 2026, <https://research.utoronto.ca/technology-opportunities/db/organ-chip-airway-tissue-modelling>
32. Basu, Niladri | Natural Resource Sciences - McGill University, accessed May 18, 2026, <https://www.mcgill.ca/nrs/basu-niladri>
33. Innovations in Biomedical Sciences - UBC Extended Learning, accessed May 18, 2026, <https://extendedlearning.ubc.ca/courses/innovations-biomedical-sciences/0582>
34. Accelerating Clinical Trials (ACT) Pan-Canadian Consortium, accessed May 18, 2026, <https://cihr-irsc.gc.ca/e/53357.html?filter=ACT+Pan-Canadian+Consortium>
35. Canada - High school - InterNICHE, accessed May 18, 2026, <https://www.interniche.org/en/legislation/canada/highschool>
36. 83 Dissection as an Instructional Technique in Secondary Science: Choice and Alternatives Alan D. Bowd 1 LAKEHEAD UNIVERSITY, CA - Animals & Society Institute, accessed May 18, 2026, <https://www.animalsandsociety.org/wp-content/uploads/2015/10/bowd.pdf>
37. Dissection and Choice in the Science Classroom: Student Experiences, Teacher Responses, and a Critical Analysis of the Right to - Semantic Scholar, accessed May 18, 2026, <https://pdfs.semanticscholar.org/b6b9/4542cbae19c655b025b1dedacde2691d8f83.pdf>
38. Perspectives on animal dissection and alternatives - International Journal of Environmental and Science Education, accessed May 18, 2026, [http://www.ijese.net/makale\\_indir/IJESE\\_1515\\_article\\_5831732d561c2.pdf](http://www.ijese.net/makale_indir/IJESE_1515_article_5831732d561c2.pdf)
39. Student/Teacher Conflict Regarding Animal Dissection - WBI Studies Repository, accessed May 18, 2026, [https://www.wellbeingintlstudiesrepository.org/cgi/viewcontent.cgi?article=1043&context=acwp\\_he](https://www.wellbeingintlstudiesrepository.org/cgi/viewcontent.cgi?article=1043&context=acwp_he)
40. Animal dissection is a long-standing, yet long-contested, science classroom practice., accessed May 18, 2026, <https://www.lakeheadu.ca/sites/default/files/uploads/112/publications/Suiter%20Oakley%20Goodman%202016%20Prevalence%20of%20Student%20Choice%20P>

- [olicies.pdf](#)
41. Dissection Alternatives for High School Biology - Kristin Moon Science, accessed May 18, 2026, <https://kristinmoonscience.com/dissection-alternatives-for-high-school-biology/>
  42. The Limits of Legislating towards a Cruelty-Free Future — McGill ..., accessed May 18, 2026, <https://www.mjsdl.com/content/canadas-energy-production-plans-following-us-strikes-in-venezuela-6hncb-55mcr-lfnyd-s9ysy>
  43. Canada Gazette, Part 1, Volume 159, Number 29: GOVERNMENT NOTICES, accessed May 18, 2026, <https://gazette.gc.ca/rp-pr/p1/2025/2025-07-19/html/notice-avis-eng.html>
  44. Strategy to replace, reduce or refine vertebrate animal testing under the Canadian Environmental Protection Act, 1999 (CEPA) - Canada.ca, accessed May 18, 2026, <https://www.canada.ca/en/environment-climate-change/services/canadian-environmental-protection-act-registry/implementing-modernized-cepa/strategy-replace-reduce-refine-vertebrate-animal-testing.html>
  45. Future-Ready: Building Canada's Biomanufacturing Workforce - BIOTECanada, accessed May 18, 2026, <https://www.biotech.ca/news/future-ready-building-canadas-biomanufacturing-workforce/>
  46. 'Massive demand' for B.C. biotech talent putting pressure on sector - Business in Vancouver, accessed May 18, 2026, <https://www.biv.com/news/technology/massive-demand-bc-biotech-talent-putting-pressure-sector-8266652>
  47. 3D Cell Culture Market Growth Analysis - Size and Forecast 2026-2030 | Technavio, accessed May 18, 2026, <https://www.technavio.com/report/3d-cell-culture-market-industry-analysis>
  48. Essential and technical skills will help Canada's bio-economy reach its full potential, accessed May 18, 2026, <https://www.biotalent.ca/articles/essential-and-technical-skills-will-help-canadas-bio-economy-reach-its-full-potential/>
  49. The advancement of artificial intelligence in biomedical research and health innovation: challenges and opportunities in emerging economies - PMC, accessed May 18, 2026, <https://pmc.ncbi.nlm.nih.gov/articles/PMC11107016/>
  50. Dissection Objectors Share Their Science Class Experiences - Animals & Society Institute, accessed May 18, 2026, <https://www.animalsandsociety.org/wp-content/uploads/2016/05/oakley.pdf>
  51. Valid Science in Education – Animal Defence and Anti-Vivisection ..., accessed May 18, 2026, <https://adavsociety.org/alternatives/alternatives-in-education/>
  52. Australia's National Research Infrastructure for Non-Animal Modelling, <https://phenomicsaustralia.org.au/australias-national-research-infrastructure-for-non-animal-modelling/>

*Credits: original research by Gemini, accuracy checks by Mistral and Augure, final modifications and production by PNARS staff.*