

## **Miroirs: A Videogame Exploration of EcoHealth, Wellness, and Aquatic Ecosystems**

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**Abstract.** Grounded in an EcoHealth framework, the Mental'Eau project examines the interconnections between individuals and aquatic ecosystems through the lens of both usage and health. It examines how mental and physical well-being are related to the perceived ecological and landscape quality of these environments.

Within the project, a survey is conducted through the video game *Miroirs* (*Mirrors*) to broaden the audience. To the best of our knowledge, *Miroirs* is unique in that it integrates a survey directly into the gameplay experience.

The decision was made to implement a dual survey system, consisting of both a game-based and a web-based format. The game features interactive narration designed to capture users' perceptions of their well-being in connection with their practices, their evaluation of ecosystem health, and the perceived impacts on the environment. Players explore various aquatic recreational sites and ecosystems, complete quests, and self-report their perceptions and emotional responses in a two-page diary (fill in blanks within a predefined text and assign ratings across five different EcoHealth dimensions). A very similar web-based survey was also developed to complement the in-game survey results.

The game and its database management system are being developed using the Unity game engine. A total of 100 data is collected through gameplay. The surveys were launched in September 2025 via social networks. Participants are first invited to complete the web-based survey, which will unlock access to the *Miroirs* game as a bonus experience.

As a preliminary result and conclusion, *Miroirs* has attracted interest from water-related and mediation stakeholders, thanks to its

36 promising ability to engage players in EcoHealth issues through in-  
 37 teractive storytelling.

38 1 **Keywords:** Aquatic systems, EcoHealth, Well-being, Video  
 39 game, In game survey.

## 40 1 Introduction

41 The EcoHealth approach emphasizes the core link between human health and  
 42 the integrity of ecosystems, positing that healthy environments are essential for  
 43 disease prevention and population well-being, while inviting researchers to  
 44 adopt an integrated health perspective at the human–animal–environment inter-  
 45 face. Building on this framework, the video game *Miroirs* (Mirrors) explores  
 46 the interconnections between individuals and aquatic ecosystems through an  
 47 interactive and immersive experience. Uniquely, *Miroirs* integrates a scientific  
 48 survey directly into the gameplay, transforming data collection into an engag-  
 49 ing activity. This innovative approach not only broadens public participation  
 50 but also deepens awareness of the reciprocal relationships between ecological  
 51 quality, landscape perception, and well-being.

## 52 2 Materials and Methods

### 53 2.1 EcoHealth context

54 Although the 'One Health' approach aspires to consider human, animal, and en-  
 55 vironmental health in an integrated manner [4], its implementation often re-  
 56 mains oriented toward immediate human health concerns, typically manifesting  
 57 through biosafety measures. In contrast, the 'Ecohealth' concept underscores the  
 58 importance of environmental conditions and ecosystem integrity for health out-  
 59 comes. It is founded on the premise that healthy ecosystems are essential for  
 60 disease prevention, the well-being of populations, and the promotion of an in-  
 61 tegrated health perspective at the human–animal–environment interface.

62 From this standpoint, the 'Ecohealth' approach affords greater significance to  
 63 biodiversity, emphasizing the interconnectedness of all living beings. Conse-  
 64 quently, it allows for inclusion of other scientific disciplines, such as ecology,  
 65 geosciences, and humanities [11].

66 The Mental'Eau project [5] explores the links between individuals and  
 67 aquatic ecosystems focusing on both use and health, understood as the mental  
 68 and physical well-being people experience in relation to the ecological and  
 69 landscape quality of these ecosystems. The project brings together an interdis-  
 70 ciplinary team to assess ecosystem health [1] and users' perceptions. Currently,

71 the survey is conducted on site, directly within the 30 aquatic settings under  
72 study.

73 Several video games (e.g. *EcoDive* [7], *FloodSim* [9], *The Fish Game* [14],  
74 *Animal Crossing* [3]) promoting pro-environmental behaviors, particularly con-  
75 cerning aquatic ecosystems, illustrate the potential of video games as tools for  
76 enhancing well-being and/or fostering environmental awareness [8]. However,  
77 although gaming behaviors can be monitored, researchers [10] highlight the  
78 difficulty of obtaining telemetric data from entertainment companies and con-  
79 ducting additional surveys. This has motivated the creation of a video game that  
80 embeds the survey within the gameplay experience, aiming to engage individ-  
81 uals who rarely interact with aquatic environments.

## 82 **2.2 Goals and constraints**

83 The overarching goal is to create a game that bridges art and science in the  
84 study of EcoHealth, engages broader publics, and delivers actionable insights  
85 for stakeholders.

86 The game is designed to serve as both an interactive experience and a survey-  
87 based contribution to the EcoHealth framework, here focusing on mental and  
88 physical well-being on the one hand, and aquatic ecosystem health on the other.  
89 This primarily involves considering a range of landscapes and water bodies  
90 (e.g., streams, ponds, lakes, marshes), aquatic ecosystems and their associated  
91 biodiversity, as well as recreational and usage practices.

92 Secondly, and equally important, the game incorporates an innovative in-  
93 game EcoHealth survey designed to explore the relationship between player's  
94 well-being and environmental health. This approach enables real-time data col-  
95 lection within the game environment, providing a novel method for integrating  
96 research into gameplay. For instance, players may be asked about their prac-  
97 tices, their knowledge of contamination or biodiversity, and their perceptions  
98 of the environment. Player responses and behaviors are recorded in a database  
99 for export and analysis outside the game environment.

100 Thirdly, it is essential that the game remains enjoyable, immersive, and edu-  
101 cational, even though there are no right or wrong answers. The main storyline  
102 is consistent across players, although alternative paths may be chosen to com-  
103 plete the central quest.

## 104 **2.3 Game design**

105 Within a narrative driven game, the player is guided through a sequence of  
106 aquatic landscapes that exemplify varying degrees of urbanization and natural-  
107 ness. These environments include a channel, an artificial urban lake, a river, a  
108 swamp, and a natural lake, each situated along or adjacent to the course of a  
109 main river. This progression illustrates a gradient from highly modified to rel-  
110 atively unaltered systems, thereby foregrounding—without explicitly stating

it— some of the ecological interactions and hydrological processes that underpin the transition from constructed to natural aquatic environments.

Aquatic landscapes play a central role as they are conceived to be representative of actual environments. Initially, we planned to integrate LIDAR (Light Detection and Ranging) height data to generate supporting 3D base terrains. We decided to create fictional environments that would best fit the narrative and the visual style we aimed to achieve. The playable character, non-player characters (NPCs), and most decorative elements (such as buildings, plants, and animals) are implemented as 2D vertical sprites placed upon a 2D horizontal terrain. *Miroirs* is thus developed as a 2.5D video game. Accordingly, Unity was chosen as the game engine, given its superior handling of 2D content compared to Unreal Engine, another widely used platform.

The gamer plays as a neutral main character accompanied by two friends, Béa and Niko, figuring about the people's well-being and the environment, respectively. After learning through social networks that a fantastical creature may exist not far from their home, the main cast embarks on an immersive adventure to uncover the truth. Along the journey, the player interacts with a variety of characters and assists them in reaching their objectives. More important for the scientific survey, the player engages in a range of recreational activities related to water and the environment, as well as experiences the use of different modes of transportation.

From a game design perspective, the most challenging and innovative aspect of this work lies in the integration of a structured yet immersive EcoHealth survey within the game, implemented through a journey notebook. At the conclusion of each game scene, the notebook prompts participants to document water-related environments with which they are familiar or that they have visited near their homes. For example, the first four prompts are presented in the following format (unique choice or free-text responses shown within braces):

*“Hmm... in my journal, I'm going to write about environments with water that {I know/I visit} near my home. First, when I'm near water, I feel {good/bad/neither good, nor bad}. My favorite water-based hobbies are {free text}. I usually do them {with family/with friends/alone}.”*

For each journal page, user inputs and free-text responses are stored as key–value pairs within a PHP script. The data are then transmitted via an SQL web request to an *Alwaysdata* server providing phpMyAdmin-based database management.

To evaluate the game as a data collection medium, an equivalent set of information is gathered using a classical online survey (Google form) derived from the notebook's texts, predefined options, and free-text fields. In contrast to the game notebook, the Google Form includes multiple-choice questions. Completing the online survey grants access to the *Miroirs* [download page](#).

### 152 3 Results

153 The gameplay of *Miroirs* is structured as a quest-based adventure designed to  
 154 engage players in exploratory and reflective interactions within familiar aquatic  
 155 environments.

156 On the one hand, the game integrates principles of role-playing and atmos-  
 157 pheric design (elaborated by the two students) to foster immersion and a sense  
 158 of environmental presence. Emphasizing nature-oriented aesthetics and casual  
 159 pacing, *Miroirs* offers a short (approximately one-hour) single-player experi-  
 160 ence that promotes contemplative engagement with aquatic ecosystems through  
 161 interactive practice and spatial exploration. On the other hand, *Miroirs* is a re-  
 162 search-driven game that embeds a survey into its gameplay, inviting players to  
 163 explore aquatic sites both in game and on site, complete quests, and self-report  
 164 their perceptions and emotions.

165 Key scientific elements—such as aquatic environment diversity, field note-  
 166 books, and survey databases—are introduced in Section 3 and further discussed  
 167 in Section 4, with sufficient detail to offer a scientifically grounded preview,  
 168 while avoiding excessive disclosure that could undermine the game’s plot (sto-  
 169 rytelling, quests, iconography, activities). The French version of the game is  
 170 distributed on the *itch.io* video game platform.

#### 171 3.1 Level design

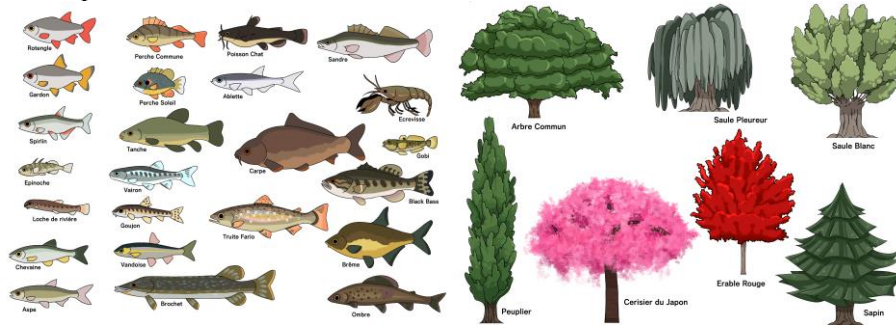
172 The game is made up of 6 different aquatic environments supporting different  
 173 usages and recreational practices. These are water courses (channel, river, cave  
 174 stream), water bodies (urban lake, mountain lake), wetlands (inland marsh).  
 175 Some of them are presented in Fig. 1, illustrating a shift from urbanized areas  
 176 toward more natural landscapes, inside and outside the game. It is worth  
 177 noting that the game (including original sprite assets) was developed from  
 178 scratch over 32 weeks by two undergraduate students and subsequently de-  
 179 bugged over a period of two months. Although the maps could have been made  
 180 more visually distinct, asset reuse was necessary to ensure development effi-  
 181 ciency.



182 **Fig. 1.** Snapshots of four of the aquatic environments—urban lake, river,  
 183 marsh and mountain lake—illustrating a shift from urbanized areas toward  
 184 more natural landscapes.  
 185

186 The surrounding biodiversity is mainly reflected in the tree species and a fish  
 187 collection (Fig. 2). Like *Animal Crossing*, interactions with animals in the game

are primarily playful and recreational, not scientific. Their sprites were hand-drawn based on photographic material and subsequently associated with specific aquatic and environmental habitats.



**Fig. 2.** Collection of fishes and trees (French vernacular names).

Various modes of transportation (Fig. 3) are provided to explore or connect different zones, most of which are recreational within the game and encourage active mobility.

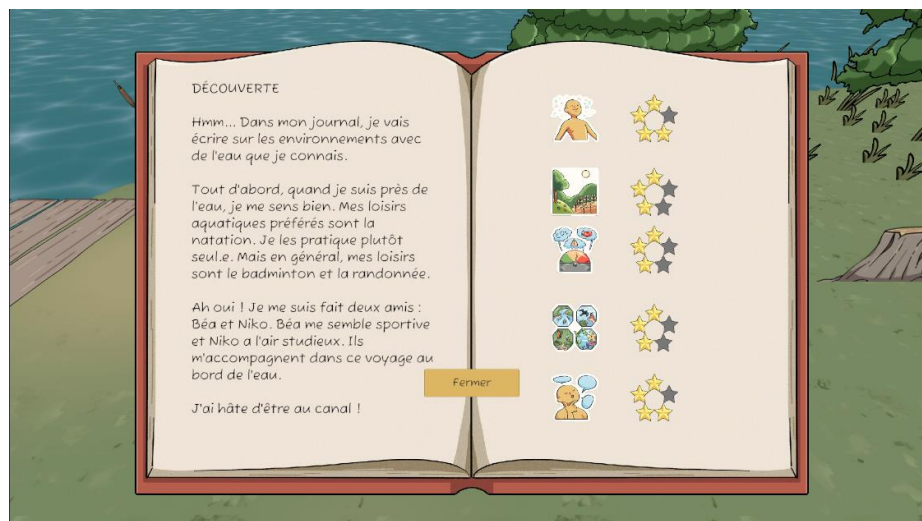


**Fig. 3.** Snapshots of active and sustainable mobilities.

### 3.2 Survey, notebook and databases

Landscape variety serves as the central framework guiding the survey across multiple dimensions to gather player information and assess their knowledge and observations regarding ecosystem services and practices, contamination, and biodiversity.

Each scene concludes with the opening of a journal. In the first stage, the left page presents a text with gaps, while multiple-choice options are displayed on the right page (Fig. 4, Left page). Some translation is provided in subsection 2.3. In the second stage, five Likert-scale ratings are presented to the player to evaluate the on-site environment described on the left page. These ratings assess the player's perceived 'on site' well-being, landscape quality, level of contamination, biodiversity, and overall evaluation of the ecosystem's health (Fig. 4, Right page).



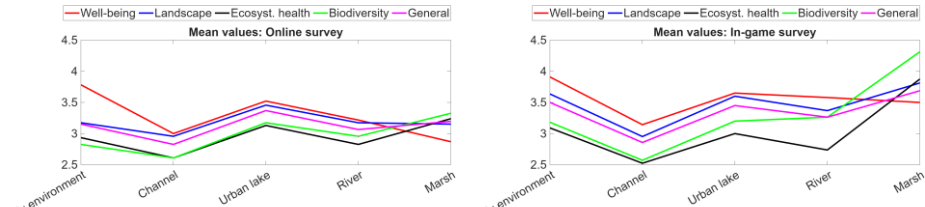
**Fig. 4.** Snapshot of the journal.

Respondents were recruited through multiple channels. Initially, friends and colleagues were invited to participate as beta testers for the game. Additionally, students from various master programs were contacted. Third, to reach a different audience, business cards containing QR codes linking to the online survey will be available in selected cultural venues in the Grand-Est Region of France (Vigie de l'Eau, Vittel; Cité du Paysage, Saxon-Sion; Jardin des Sciences; Le Vaisseau, Strasbourg) and distributed via mailing lists. Additional communication through social media is planned for the first semester of 2026, to be undertaken by two students.

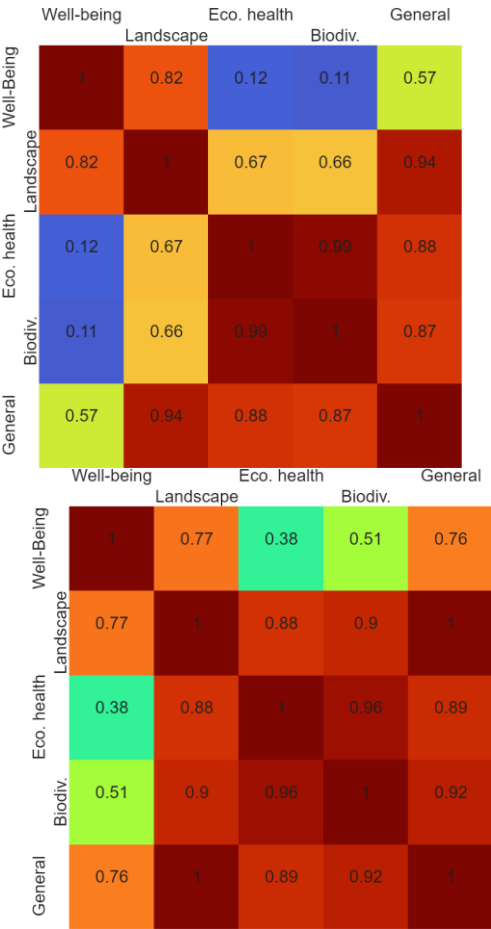
### 3.3 Analysis

At the time of the writing, respondents were mainly beta-testers of the game, often observed by one of the game designers, and/or master students for the online survey. This does not allow us to fairly address the Mental'Eau project objectives, notably because we do not have sufficient data for any actual aquatic place.

We first conduct an analysis to compare the mean evaluations of the different criteria (Fig. 5) with the corresponding daily environment assessments, for both online and in-game samples. The dataset includes 46 online respondents and 22 in-game respondents, 10 of whom participated in both surveys over the past two months. One observes similar trends for the criteria, except for well-being. Note that in-game evaluations are a little bit more optimistic than online ones.



**Fig. 5.** Mean values computed from Likert scales. Left: Online survey, Right: In-game survey.



**Fig. 6.** Correlation coefficients computed from Fig.5 using channel, urban lake, river and marsh data. Left: Online survey, Right: In game survey.

The average values computed for each kind of aquatic sites are then used to assess the correlations between the different criteria (Fig. 6). Red tones indicate

243 strong correlations, whereas green to blue tones indicate that the respondents'  
 244 evaluations of the two criteria are not correlated.

## 245 4 Discussion

246 As far as Sustainable Development Goals are regarded, *Miroirs* primarily ad-  
 247 dresses SDG 3 (Good Health and Well-Being), SDG 14 (Life Below Water),  
 248 and SDG 15 (Life on Land) by engaging with mental health and representing  
 249 aquatic and terrestrial ecosystems and biodiversity. By promoting sustainable  
 250 mobility and tourism within the game, it contributes to SDG 12 (Responsible  
 251 Consumption and Production). Similarly, the fill-in-the-gap texts in the note-  
 252 book (in-game survey) and the online survey raise some awareness of climate  
 253 change impacts (SDG 13, Climate Action).

254 *Miroirs*, through its interdisciplinary study and its art-and-science approach,  
 255 also supports SDG 4 (Quality Education). Some user feedback identifies its po-  
 256 tential as a game-based educational tool. Further investigation is required, par-  
 257 ticularly through a post-gaming survey [2]. Note that the SDG's multidimen-  
 258 sional framing can limit the visibility of the overarching EcoHealth framework,  
 259 as it emphasizes the sustainability of individual goals rather than the holistic  
 260 perspective advocated by [13].

261 To the best of our knowledge, *Miroirs* is unique in integrating a survey di-  
 262 rectly into the gameplay experience. *Miroirs* is well received by respondents  
 263 and has attracted interest from some water-related stakeholders (associations,  
 264 scientists), thanks to its promising ability to engage players in EcoHealth issues  
 265 through interactive storytelling.

266 From a simulation and gaming perspective [6], a comparison between the  
 267 online and in-game survey results shows that respondents tend to evaluate the  
 268 different criteria more positively in the in-game context. A study should be con-  
 269 ducted to quantify the potential bias introduced by the game's aesthetically  
 270 pleasing and immersive atmosphere.

271 Preliminary results (Fig. 6) indicate that well-being is correlated with land-  
 272 scape beauty; however, it is landscape that predominantly shapes the general  
 273 opinion. In contrast, ecosystem health and biodiversity exhibit only weak cor-  
 274 relations with well-being. The in-game survey reveals strong correlations  
 275 among landscape, ecosystem health, biodiversity, and general opinion. As seen  
 276 in Fig. 5, this pattern is largely explained by the marsh site, where biodiversity  
 277 receives the highest scores while well-being is among the lowest. Similar pat-  
 278 terns are present in the online survey results even correlation coefficients are  
 279 smaller.

280 Both surveys indicate that respondents experience discomfort in the marsh  
 281 environment—a space that is, a priori, less anthropized, characterized by high  
 282 levels of biodiversity, and recognized as one of the healthiest ecosystem types.

This discomfort results in reduced interaction with such environments, which consequently fail to deliver the expected benefits typically associated with visits to aquatic natural settings. Conversely, urban ponds emerge as the aquatic environments associated with the highest levels of perceived well-being.

To more rigorously examine the determinants of this kind of biophobia [12]—whether related to gender differences [2] or to characteristics of individuals’ everyday living environments [13]—it will be necessary to rely on larger respondent samples and to conduct a more granular analysis of the two available datasets.

## 5 Conclusion and outlook

Both datasets support findings in the existing literature suggesting that subjective well-being is not necessarily correlated with ecosystem health. From a simulation and gaming perspective, the telemetry data collected during the *Miroirs* gaming sessions align well with the online survey results, although respondents gave more positive ratings in the game. A larger dataset, with more respondents per site, will be needed to more robustly assess the relationship between well-being and ecological characteristics.

Further developments will be carried out within the ‘Wetlands Project’ of the Réseau des Zones Ateliers, with particular emphasis on marshes, small wetlands, and peatlands as well as on interactions with the environment.

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## References

1. Argillier, C., Chauvin, C., Lepage, M., Logez, M., Souchon, Y., Villeneuve, B.: 20 ans de recherche pour le développement des méthodes hydroécologiques en appui à la directive-cadre européenne sur l’eau. Technical report, INRAE, 12 (2020).
2. Bornioli, A., Gatersleben, B.: Man or bear? How gender affects experiences of natural environments with varying levels of vegetation density and different danger threats. *Journal of Environmental Psychology* 106, 102722 (2025).

- 315 3. Coroller, S., Flinois, C.: Video games as a tool for ecological learning: the  
316 case of animal crossing. *Ecosphere*,14(3), e4463 (2023).
- 317 4. Destoumieux-Garzón, D., Mavingui, P., Boetsch, G., Boissier, J., Darriet,  
318 F., Duboz, P., Fritsch, C., Giraudoux, P., Le Roux, F., Morand, S., Paillard,  
319 C., Pontier, D., Sueur, C., Voituron, Y.: The one health concept : 10 years  
320 old and a long road ahead. *Frontiers in Veterinary Science* 5 (2018).
- 321 5. Dousset S., Fries Paiola C., Chauvin C., Paul A., Denechaud C., Nori L.,  
322 Abildtrup J.: The Mental'eau project: what is the relationship between  
323 aquatic ecosystem health and human well-being? *ARPHA Conference Abs-*  
324 *tracts* 8, e155729 (2025).
- 325 6. Duke, R.D.: Origin and Evolution of Policy Simulation: A Personal Jour-  
326 ney, *Simulation & Gaming* (42), 342-358 (2011).
- 327 7. Feldmann, M., Geier, P., Ruppenthal, J.N., Zielasko, D.: Ecodive : Enhanc-  
328 ing presence and ambient environmental awareness in a virtual reality ex-  
329 perience for underwater marine debris collection. In *Proceedings of the 30th*  
330 *ACM Symposium on Virtual Reality Software and Technology, VRST '24,*  
331 *New York, NY, USA* (2024).
- 332 8. Galván-Pérez, L., Ouariachi, T., Pozo-Llorente, M.T., Gutiérrez-Pérez, J.:  
333 Outstanding videogames on water: A quality assessment review based on  
334 evidence of narrative, gameplay and educational criteria. *Water* 10(10)  
335 (2018).
- 336 9. Games4Sustainability. Floodsim. <https://games4sustainability.org/game->  
337 [pedia/floodsim/](https://games4sustainability.org/game-).
- 338 10. Johannes, N., Vuorre, M., Przybylski, A.K.: Video game play is positively  
339 correlated with well-being. *Royal Society Open Science* (2021).
- 340 11. Lerner, H., Berg, C.: A comparison of three holistic approaches to health:  
341 One health, ecohealth, and planetary health. *Frontiers in Veterinary Science*  
342 4 (2017).
- 343 12. Mammola, S., Nanni, V., Martino, S., Correia, R., Eckert, E.M., Norberg,  
344 M.M., Soga, M.: Beyond mental well-being: A One Health perspective on  
345 biophobias. *BioScience*, biae084 (2025).
- 346 13. Schwartz, A., Tzunz, M., Gafter, L., Colléony, A.: One size does not fit all:  
347 The complex relationship between biodiversity and psychological well-be-  
348 ing. *Urban Forestry & Urban Greening* 86, 128008 (2023).
- 349 14. The Cloud Institute for Sustainability Education. The fish game.  
350 <https://cloudinstitute.org/fish-game>